# Bering Sea Non-Chinook Salmon PSC Management Measures

# Initial Review Draft Environmental Assessment


THE KAYKO OR DOG SALMON.
Oncorhynchus keta (Walb.), Gill & Jordan. (p. 476.)
Drawing by H. L. Todd, from No. 27617, U. S. National Museum, collected at Fort Alexander, Cook's Inlet, Alaska, July 4, 1880, by J. Cohen.

**North Pacific Fishery Management Council**

**United States Department of Commerce**
National Oceanic and Atmospheric Administration
National Marine Fisheries Service, Alaska Region

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# Executive Summary

This executive summary summarizes the draft Bering Sea Chum Salmon prohibited species catch (PSC) Management Environmental Assessment (EA) and Regulatory Impact Review (RIR). The EA and RIR provide decision-makers and the public with an evaluation of the predicted environmental, social, and economic effects of alternative measures to minimize non-Chinook (primarily chum and referred herein as such) PSC in the Bering Sea pollock fishery. The area of the fishery and major river systems are depicted in Figure ES-1.

The proposed action is to amend the Bering Sea Aleutian Islands groundfish fishery management plan (FMP) and federal regulations to establish new measures to reduce chum salmon bycatch in the Bering Sea pollock fishery to the extent practicable while achieving optimum yield. The proposed action is focused on the Bering Sea pollock fishery because this fishery catches the majority of the chum salmon taken incidentally as bycatch in the Bering Sea and Aleutian Islands (BSAI) groundfish fisheries. Since 2005 the pollock fishery contribution to the total non-Chinook bycatch has ranged from 88% in 2010 to 99.3% in 2005.

Any amendment to the FMP must comply with the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and all other applicable federal laws. With respect to the Magnuson-Stevens Act, the amendment must be consistent with all ten national standards. The most relevant for this action are National Standard 9, which requires that conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch; and National Standard 1, which requires that conservation and management measures prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry. The Magnuson-Stevens Act defines optimum yield as the amount of harvest which will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems. Therefore, this action must minimize chum salmon bycatch in the Bering Sea pollock fishery to the extent practicable while achieving optimum yield. Minimizing chum salmon bycatch while achieving optimum yield is necessary to maintain a healthy marine ecosystem, ensure long-term conservation and abundance of chum salmon, provide maximum benefit to fishermen and communities that depend on chum salmon and pollock resources, and comply with the Magnuson-Stevens Act and other applicable federal law.

Several management measures are currently used to minimize chum salmon PSC in the Bering Sea pollock fishery. Chum salmon taken incidentally in groundfish fisheries are classified as prohibited species and, as such, must be either discarded or donated through the Prohibited Species Donation Program. In the mid 1990s, NMFS implemented regulations recommended by the Council to control the bycatch of chum salmon taken in the Bering Sea pollock fishery. These regulations established the Chum SSA and mandated year-round accounting of chum salmon bycatch in the trawl fisheries. An exemption to this closure for the pollock fishery was enacted in regulation in 2007 (and through an exempted fishing permit in 2006) provided the fleet participated in a rolling Hot spot closure program. The Council is now considering whether additional management measures are needed to minimize the bycatch of chum salmon in the Bering Sea pollock fishery.

Note that throughout this document chum salmon bycatch is referred to as chum salmon prohibited species catch (PSC) wherever possible. PSC is a specific definition under the BSAI groundfish FMP and as such any ‘bycatch’ of salmon species is referred to by it’s FMP-level definition to indicate it’s status under the FMP. By Magnuson Act definition this chum salmon is taken as bycatch in the pollock fishery, however in deference to the specific BSAI FMP designation the specific term used in this analysis of bycatch is ‘PSC’.

This EA examines three alternatives to reduce chum salmon PSC in the Bering Sea pollock fishery. The EA evaluates the environmental consequences of each of these alternatives with respect to four resource categories:

- Pollock
- Chum salmon
- Chinook salmon
- Other Marine Resources including groundfish species, ecosystem component species, marine mammals, seabirds, essential fish habitat and marine ecosystem.

The RIR evaluates the social and economic consequences of the alternatives with respect to three major issues:

- economic impacts and net benefits to the Nation
- Alaska Native, non-native minority, and low income populations
- fisheries management and enforcement

## Bering Sea Pollock Fishery

The pollock fishery in waters off Alaska is the largest U.S. fishery by volume. The economic character of the fishery derives from the products produced from pollock: roe (eggs), surimi, and fillet products. In 2009, the total value of pollock was an estimated $1.03 billion. This increased to $1.06 billion in 2010. Table ES-1 shows the number of participating vessels in the Bering Sea pollock fishery and the pollock total allowable catch (TAC) in metric tons from 2003 to 2011.

Table ES-1. The number of participating vessels in the Bering Sea pollock fishery, the pollock total allowable catch (TAC) in metric tons (t), and the number of non-Chinook (chum) salmon taken as bycatch from 2003 to 2011.

| Year | Number of pollock fishing vessels | Pollock TAC (t) | Non-Chinook (chum) salmon PSC (numbers of fish) |
|---|---|---|---|
| 2003 | 110 | 1,491,760 | 189,185 |
| 2004 | 113 | 1,492,000 | 440,468 |
| 2005 | 109 | 1,478,000 | 704,552 |
| 2006 | 105 | 1,487,756 | 309,630 |
| 2007 | 108 | 1,394,000 | 93,783 |
| 2008 | 108 | 1,000,000 | 15,267 |
| 2009 | 106 | 815,000 | 46,127 |
| 2010 | 104 | 813,000 | 13,222 |
| 2011 | 104 | 1,252,000 | 191,445 |

Until 1998, the Bering Sea pollock fishery was managed as an open access fishery, commonly characterized as a “race for fish.” In October 1998, Congress enacted the American Fisheries Act (AFA) to rationalize the fishery by identifying the vessels and processors eligible to participate in the Bering Sea pollock fishery and allocating specific percentages of the Bering Sea directed pollock fishery TAC among the competing sectors of the fishery. Each year, NMFS apportions the pollock TAC among the inshore catcher vessel (CV) sector, offshore catcher/processor (CP) sector, and mothership sector after allocations are made to the Community Development Quota (CDQ) Program and incidental catch allowances.

The Bering Sea pollock TAC is divided into two seasons –the A season (January 20 to June 10) and the B season (June 10 to November 1). Typically, the fleet targets roe –bearing females in the A season and harvests the A season TAC by early April. The B season fishery focuses on pollock for filet and surimi markets and the fleet harvests most of the B season TAC in September and October.

The AFA also allowed for development of pollock fishing cooperatives. Ten such cooperatives were developed as a result of the AFA: seven inshore CV cooperatives, two offshore CP cooperatives, and one mothership cooperative. Catcher vessels in the inshore CV sector deliver pollock to shorebased processors. Catcher/processors harvest and process pollock on the same vessel. Catcher vessels in the mothership sector deliver pollock to motherships, which are processing vessels.

The CDQ Program was created to improve the social and economic conditions in coastal western Alaska communities by facilitating their economic participation in the BSAI fisheries, which had developed without significant participation from rural western Alaska communities. These fisheries, including the Bering Sea pollock fishery, are capital-intensive and require large investments in vessels, infrastructure, processing capacity, and specialized gear. The CDQ Program was developed to redistribute some of the BSAI fisheries' economic benefits to adjacent communities by allocating a portion of commercially important fisheries to six groups representing those communities as fixed shares of groundfish, halibut, crab, and prohibited species catch. These allocations, in turn, provide an opportunity for residents of these communities to both participate in and benefit from the BSAI fisheries through revenues derived from the fisheries, employment, capital projects, and fisheries infrastructure. Currently, NMFS allocates 10 percent of the pollock TAC annually and the seasonal proportion of the Bering Sea Chinook salmon prohibited species catch limit to the CDQ Program as follows: A season 9.3% of the overall A season proportion and B season 5.5% of the seasonal proportion.

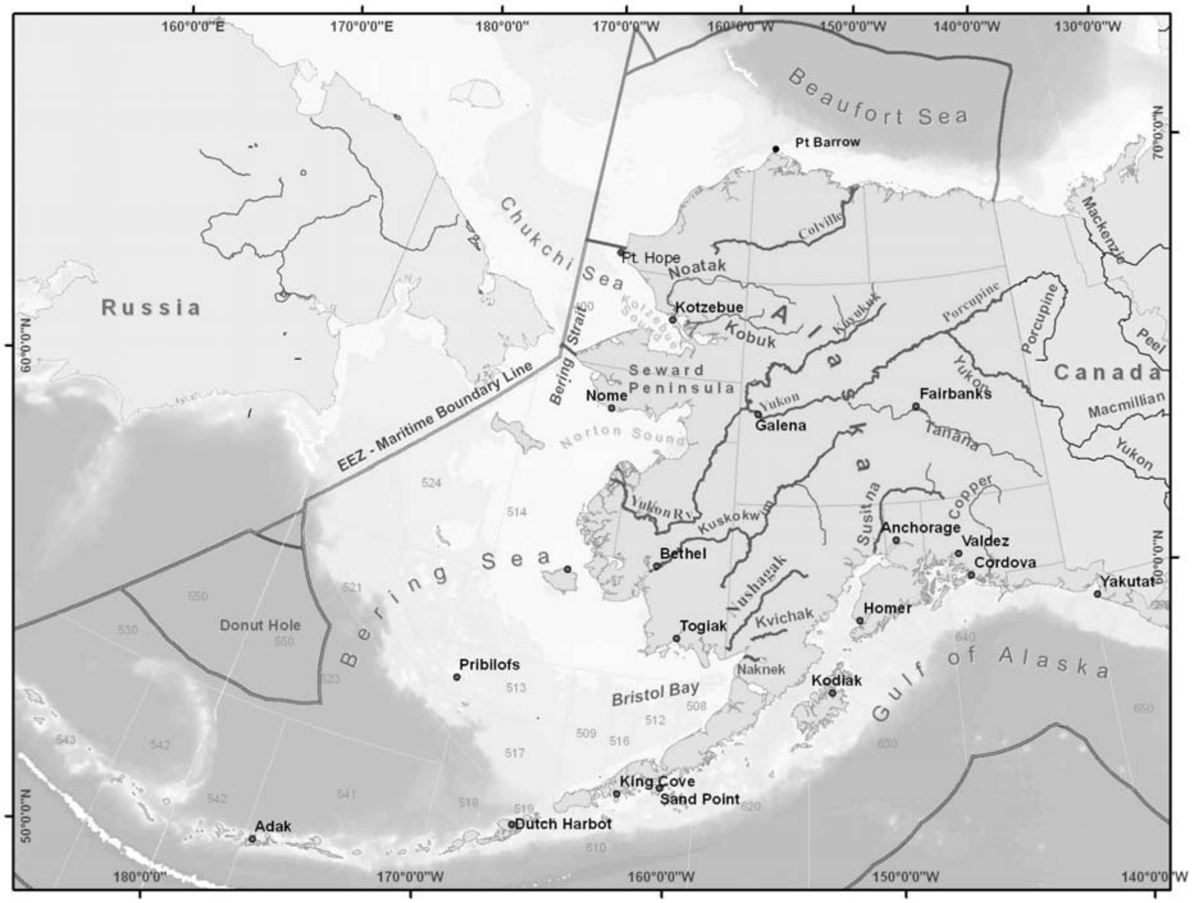



Figure ES-1. Map of the Bering Sea and major connected salmon producing rivers in Alaska and Northwest Canada

## Salmon Bycatch in the Bering Sea Pollock Fishery

Pacific salmon are caught incidentally in the Bering Sea pollock fishery. Pollock is harvested with fishing vessels using trawl gear, which are large nets towed through the water. Salmon in the Bering Sea occur in the same locations and depths as pollock and are, therefore, caught in the nets as fishermen target pollock. Of the five species of Pacific salmon, Chinook salmon (*Oncorhynchus tshawytscha*) and chum salmon (*O. keta*) are caught most often in the pollock fishery. Chinook salmon is caught during both ‘A’ and ‘B’ seasons of the fishery while chum salmon are caught almost exclusively in the ‘B’ season.

Salmon are culturally, nutritionally, and economically significant to Alaska communities (see RIR Chapter 3). Salmon are fully allocated and used in subsistence, commercial, and recreational fisheries in and off Alaska and, in the case of Chinook and chum salmon, in Canada. Therefore, NMFS manages Chinook salmon and all other species of salmon (a category called non-Chinook salmon and here in this analysis summarized as ‘chum’ due to it being comprised of over 99% chum salmon) as prohibited species in the BSAI groundfish fisheries, including the Bering Sea pollock fishery. As a prohibited species, salmon must be avoided as bycatch, and any salmon caught must either be donated to the Prohibited Species Donation Program or be returned to the sea as soon as is practicable, with a minimum of injury, after an observer has determined the number of salmon and collected any scientific data or biological samples.

The Council took action in 2009 on management measures for Chinook salmon under the Amendment 91 Chinook salmon PSC management program. The program imposes a dual cap system which is divided by sector and season. The program includes an annual 'high cap' of 60,000 fish and a lower cap of 47,591 fish. Annual Chinook PSC is intended to remain below the lower cap to avoid penalty. Should any sector exceed its proportion of the lower cap 3 times in a rolling 7-year period, it would then be held to this lower cap only for all future years. In order to fish under the dual cap system (as opposed to solely the lower cap) sectors much participate in incentive program agreements (IPAs) that are approved by NMFS and are designed for further bycatch reduction and individual vessel accountability. This program was implemented in January 2011, thus the fishery has operated under the new program for one year.

Several management measures have been used previously to reduce salmon PSC in the Bering Sea pollock fishery. In the early-1990s, the Chum Salmon Savings Area was established as a large area closure in the Bering Sea in August and further closed when triggered by a cap of 42,000[1] non-Chinook salmon. The savings area was adopted based on areas of high historic observed salmon bycatch rates and designed to avoid areas and times of high salmon bycatch.

While chum salmon PSC in the past few years has been declining, numbers reached an historical high in 2005 with approximately 705,000 fish taken as bycatch in the pollock fishery. Table ES-1 shows the number of chum salmon PSC from 2003 to 2011.

The Council started considering revisions to existing chum salmon PSC management measures in 2004 when information from the fishing fleet indicated that it was experiencing increases in chum salmon PSC following the regulatory closure of the Chum Salmon Savings Area. Contrary to the original intent of the area closure, chum salmon PSC rates appeared to be higher outside of the savings area than inside the area. To address this problem, the Council examined other means to minimize chum salmon PSC that were more flexible and adaptive.

Since 2006, the pollock fleet has been exempt from regulatory closures of the Chum Salmon Savings Areas if they participate in a salmon intercooperative agreement (ICA) with a rolling hotspot system (RHS). The fleet started the RHS for chum salmon in 2001 (and similarly for Chinook salmon in 2002). It was intended to increase the ability of pollock fishery participants to minimize salmon PSC by giving them more flexibility to move fishing operations quickly to avoid areas where they experience high rates of salmon bycatch. The exemption to area closures for vessels that participated in the RHS ICA was implemented in 2006 and 2007 through an exempted fishing permit and subsequently, in 2008, through Amendment 84 to the BSAI FMP. Since 2006, all AFA cooperatives and all six of the CDQ groups have participated in a salmon bycatch reduction ICA and have been exempt from closures of the Chum Salmon Savings Area in the Bering Sea.

The Council has taken recent action to minimize PSC of Bering Sea Chinook salmon by recommending the Chinook salmon PSC management program under Amendment 91. The Council had previously indicated its prioritization of a Chinook salmon PSC management program in light of high Chinook salmon PSC in 2007 (with declining trends in chum salmon simultaneously) but indicated that following action on Chinook salmon, the Council would then examine additional management measures to

[1] The Chum Salmon Savings Area is closed to pollock fishing from August 1 through August 31 of each year. Additionally, if the prohibited species catch limit of 42,000 non-Chinook salmon are caught by vessels using trawl gear in the Catcher Vessel Operational Area during the period August 15 through October 14, the Chum Salmon Savings Area remains closed to directed fishing for pollock for the remainder of the period September 1 through October 14. This limit is divided between with CDQ and combined non-CDQ fisheries.

minimize chum PSC to the extent practicable. This analysis evaluates three alternatives to meet that objective.

## Chum Salmon stock status

The chum salmon taken as bycatch in the pollock fishery originate from Alaska, the Pacific Northwest, Canada, and Asian countries along the Pacific Rim. Combined there about 3 billion chum released each year from hatcheries around the Pacific Rim. The majority of hatchery releases are from Russia and Japan. Currently the North Pacific groundfish observer program treats hatchery and wild origin chum salmon the same even though a less than 20% of hatchery fish are released with thermal signatures that can be identified from otoliths. The percentage of chum salmon in the PSC that are of hatchery origin is unknown but genetic analyses provide estimates of chum that are Asian versus Alaskan origin. Estimates are provided in this analysis of the relative stock composition of the chum salmon PSC from broad regional groupings around the Pacific Rim. The majority of chum PSC appears to be of Asian origin. For PSC impact considerations, analyses focus on the impact to Alaska and in particular to PSC attributed to be from western Alaskan rivers.

Summaries on the status of wild chum salmon stocks in Alaska are presented to provide context of where issues and concerns are highest. These sections include tables of catch, the types of fisheries that the stocks support, whether escapement goals have been met, and whether there are stock concerns which are further summarized here (Table ES-2).

Table ES-2. Overview of Alaskan chum salmon stock performance, 2011.

| Chum salmon stock | Total run size? | Escapement goals met?1 | Subsistence fishery? | Commercial fishery? | Sport fishery? | Stock of concern? |
|---|---|---|---|---|---|---|
| Bristol Bay | Below average | 1 of 1 | Yes | Yes | Yes | No |
| Kuskokwim Bay | Average | 1 of 1 | Yes | Yes | Yes | No |
| Kuskokwim River | Above Average | 2 of 2 | Yes | Yes | Yes | No |
| Yukon River summer run | Above Average | 2 of 2 | Yes | Yes, but limited by low Chinook | Yes | No |
| Yukon River fall run | Above average | 7 of 8 | Yes | Yes | Yes | No |
| Eastern Norton Sound | Above average | 1 of 1 | Yes | Yes | Yes | No |
| Northern Norton Sound | Above average | 7 of 7 | Yes | Yes | Yes, except Nome Subdistrict | Yield concern (since 2007) |
| Kotzebue | Above average | No 2011 surveys | Yes | Yes | Yes | No |
| North Peninsula | Below average | 1 of 2 | Yes | Yes | Yes | No |
| South Peninsula | Average | 4 of 4 | Yes | Yes | Yes | No |
| Aleutian Islands | n/a | n/a | Yes | Yes | Yes | No |
| Kodiak | Average | 2 of 2 | Yes | Yes | Yes | No |
| Chignik | Average | 1 of 1 | Yes | Yes | Yes | No |
| Upper Cook Inlet | Above average | 1 of 1 | Yes | Yes | Yes | No |
| Lower Cook Inlet | Average | 9 of 12 | Yes | Yes | Yes | No |
| Prince William Sound | Below Average | 5 of 5 | Yes | Yes | Yes | No |
| Southeast | Below average | 7 of 8 | Yes | Yes | Yes | No |

1 Some aerial survey-based escapement goals were not assessed due to inclement weather or poor survey conditions.

Chum salmon support subsistence, commercial, personal use, and sport fisheries in their regions of origin. The State of Alaska Department of Fish & Game manages the commercial, subsistence, sport, and personal use salmon fisheries. The Alaska Board of Fisheries (BOF) adopts regulations through a public process to conserve fisheries resources and to allocate fisheries resources to the various users. The first priority for state management is to meet spawning escapement goals to sustain salmon resources for future generations. The highest priority use is for subsistence under both state and federal law. Subsistence fisheries management includes coordination with the Federal Subsistence Board and Office of Subsistence Management, which manages subsistence uses by rural residents on federal lands and applicable waters under Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA). Surplus fish beyond escapement needs and subsistence use are made available for recreational, personal use, and commercial fisheries. Yukon River salmon fisheries management includes obligations under an international treaty with Canada.

Chum salmon serve an integral cultural, spiritual, nutritional, and economic role in the lives of Alaska Native peoples and others who live in rural communities. For Alaska Natives and others throughout western and interior Alaska, harvesting and eating wild subsistence foods are essential to personal, social, and cultural identity, and salmon comprise the majority of subsistence foods harvested and used. In addition, commercial fishing for chum salmon provides a significant source of income for many people who live in remote villages, which often supports the ability to engage in subsistence harvests. For purposes of the RIR and this action, subsistence harvest by rural Alaskan communities is limited to the regions of western Alaska and includes: Norton Sound/Kotzebue (the Arctic Area); the Yukon River; the Kuskokwim Area; Bristol Bay; and the Alaska Peninsula.

Under Alaska's subsistence statute, the BOF must identify fish stocks that support subsistence fisheries and, if there is a harvestable surplus of these stocks, determine the amount of the harvestable surplus that is reasonably necessary for subsistence uses, and adopt regulations that provide reasonable opportunities for these subsistence uses to take place. The BOF evaluates whether reasonable opportunities are provided by existing or proposed regulations by reviewing harvest estimates relative to the "amount reasonably necessary for subsistence use" (ANS) findings as well as subsistence fishing schedules, gear restrictions, and other management actions.

The Alaska Board of Fisheries has made ANS findings for salmon throughout the areas under discussion in the RIR, which provides a perspective on the importance of salmon harvests to subsistence economies of rural Alaska given that these findings are based upon historical harvest patterns within each fisheries management area. The number of summer chum salmon harvested for subsistence from the Yukon River has fallen below the lower limit of the ANS four times between the years 1998 and 2008. Similarly, fall chum salmon harvests have fallen below the lower limit of the ANS eight times between 1998 and 2008. In years of poor salmon abundance, restrictions or closures to the subsistence fishery reduced the harvest success in order to achieve adequate escapements and likely resulted in the lower bound of ANS ranges not being achieved. However, in some years when ANS was not achieved, total summer chum and fall chum runs (and other runs) were adequate to provide for subsistence harvests and no additional restrictions were in place on the subsistence fishery. The importance of salmon for subsistence and other uses is the subject of Chapter 3 of the RIR.

## Description of Alternatives

Chapter 2 describes and compares three alternatives for minimizing chum salmon PSC, including detailed options and suboptions for each alternative.

**Alternative 1: Status Quo (No Action)**

**Alternative 2: Hard cap**

**Alternative 3: Triggered closure with rolling hotspot exemption**

The alternatives analyzed in the EA and RIR generally involve limits or "caps" on the number of non-Chinook (elsewhere in document referred to simply as chum salmon as they comprise over 99% of the composition of the bycatch) that may be caught in the Bering Sea pollock fishery and closures of all or a part of the Bering Sea to pollock fishing once the cap is reached. These closures would occur when a non-Chinook salmon PSC limit was reached even if a portion of the pollock TAC has not yet been harvested. Alternatives 2 and 3 represent a change in management of the pollock fishery because if the non-Chinook salmon PSC limits are reached before the full harvest of the pollock allocation, then directed fishing for pollock must stop either BS-wide or in a specified area. Under Alternative 3, a closure is proposed to which the fleet would be exempt for participating in an RHS program similar to status quo as well as options to provide additional triggered closures to participants. Note that the alternatives are not mutually exclusive and mixing and matching of compenents of each may be done to create a combined management approach which would represent a new alternative.

### Alternative 1: Status Quo (No Action)

Alternative 1 retains the current program of Chum Salmon Savings Area (SSA) closures in the Bering Sea triggered by separate non-Community Development Quota (non-CDQ) and CDQ non-Chinook salmon PSC limits, along with the exemption to these closures by pollock vessels participating in a Rolling Hot Spot intercooperative agreement (RHS ICA) approved by NMFS. The RHS ICA regulations were implemented in 2007 through Amendment 84 to the BSAI FMP. The regulations were revised in 2011 to remove those provisions of the ICA that were for Chinook PSC management given the new program in place under Amendment 91. Closure of the Chum SSA is designed to reduce the total amount of chum incidentally caught by closing areas with historically high levels of salmon PSC. The RHS ICA operates in lieu of regulatory closures of the Chum SSA and requires industry to identify and close areas of high salmon PSC and move to other areas. Only vessels directed fishing for pollock are subject to the Chum SSA closure and ICA regulations. The ICA for 2011 and the list of vessels and CDQ groups participating in it are appended to this document (Appendix 2).

### Chum Salmon Savings Area

Alternative 1 would keep the existing Chum SSA closures in effect (Figure ES-2). The Chum Salmon Savings Area was established in 1994 by emergency rule, and then formalized in the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI FMP) in 1995 under Amendment 35 (ADF&G 1995) This area is closed to all trawling from August 1 through August 31. Additionally, if 42,000 non-Chinook salmon are caught in the Catcher Vessel Operational Area (CVOA) during the period August 15 through October 14, the area remains closed for the remainder of the period September 1 through October 14. As catcher/processors are prohibited from fishing in the CVOA during the B season, unless they are participating in a CDQ fishery, only catcher vessels and CDQ fisheries are affected by the PSC limit. (Figure ES-2).

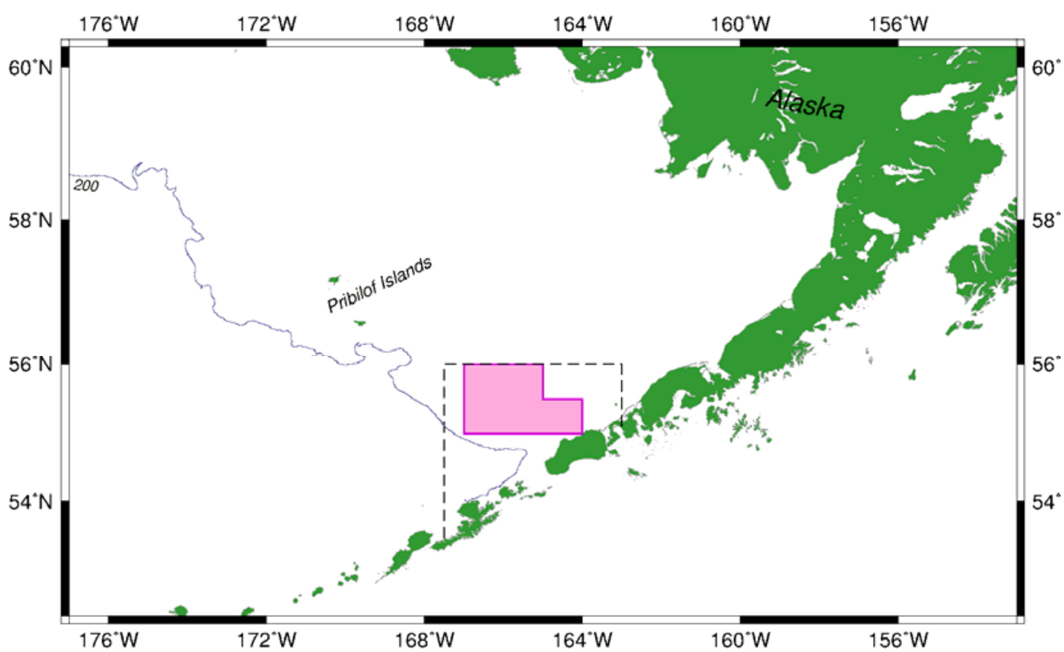



Figure ES-2. Chum Salmon Savings Area (CSSA), shaded, and Catcher Vessel Operational Area (CVOA), dashed line.

### PSC limits for the CDQ Program

Under the status quo, the CDQ Program receives an annual allocation of 10.7 percent of the Bering Sea non-Chinook salmon PSC limits as a prohibited species quota (PSQ) reserve. The non-Chinook PSQ reserve is 4,494 salmon annually and the remaining 37,506 non-Chinook salmon make up the PSC limit for the non-CDQ pollock fisheries. NMFS further allocates the PSQ reserves among the six CDQ groups based on percentage allocations approved by NMFS on August 8, 2005. More information about the CDQ allocations is in a *Federal Register* notice published on August 31, 2006 (71 FR 51804). For non-Chinook salmon, the percentage allocations of the PSQ reserve among the CDQ groups are as follows:

| | |
|---|---|
| Aleutian Pribilof Island Community Development Association (APICDA) | 14% |
| Bristol Bay Economic Development Corporation (BBEDC) | 21% |
| Central Bering Sea Fishermen's Association (CBSFA) | 5% |
| Coastal Villages Region Fund (CVRF) | 24% |
| Norton Sound Economic Development Corporation (NSEDC) | 22% |
| Yukon Delta Fishery Development Corporation (YDFDC) | 14% |

Unless exempted because of participation in the RHS ICA, a CDQ group is prohibited from directed fishing for pollock in the Chum SSA when that group's non-Chinook salmon PSQ is reached. NMFS does not issue fishery closures through rulemaking for the CDQ groups. All CDQ groups are participating in the RHS ICA approved in 2011, so they currently are exempt from closure of the Chum SSA.

### Rolling Hotspot System Intercooperative Agreement

Regulations implemented under Amendment 84 to the BSAI FMP exempt vessels directed fishing for pollock from closures of both the Chum and Chinook Salmon Savings Areas if they participate in an RHS ICA approved by NMFS (NPFMC 2005). The fleet voluntarily started the RHS program in 2001 for chum salmon and in 2002 for Chinook salmon. The exemption to regulatory area closures for vessels that participated in the RHS was implemented in 2006 and 2007 through an exempted fishing permit. The North Pacific Fishery Management Council (Council) developed Amendment 84 to attempt to resolve the bycatch problem through the American Fisheries Act (AFA) pollock cooperatives. These regulations were implemented in late 2007 and the first RHS ICA approved by NMFS under these regulations was in effect starting in January 2008 (Appendix 2). The ICA was amended for the 2011 season to remove regulations related to the Chinook SSA (and all provisions under the ICA related to Chinook bycatch management) following implementation of Amendment 91.

### Chinook Salmon PSC Management Measures under Amendment 91

The Council took final action on Amendment 91, Chinook salmon PSC management measures in the Bering Sea pollock fishery in April 2009. NMFS approved regulations implementing Amendment 91 on August 30, 2010 (72 FR 53026), and the fishery has been operating under the requirements since January 2011. Amendment 91 established two Chinook salmon PSC limits (60,000 Chinook salmon and 47,591 Chinook salmon) for the Bering Sea pollock fishery. For each PSC limit, NMFS issues A season and B season Chinook salmon PSC allocations to the catcher/ processor sector, the mothership sector, the inshore cooperatives, and the CDQ groups. When a PSC allocation is reached, the affected sector, inshore cooperative, or CDQ group is required to stop fishing for pollock for the remainder of the season even if its pollock allocation had not been fully harvested.

NMFS issues transferable allocations of the 60,000 Chinook salmon PSC limit to those sectors that participate in an incentive plan agreement (IPA) and remain in compliance with the performance standard. Sector and cooperative allocations would be reduced if members of the sector or cooperative decided not to participate in an IPA. Vessels and CDQ groups that do not participate in an IPA fish under a restricted opt-out allocation of Chinook salmon. If a whole sector does not participate in an IPA, all members of that sector would fish under the opt-out allocation.

The IPA component is an innovative approach for fishery participants to design industry agreements with incentives for each vessel to avoid Chinook salmon bycatch at all times and thus reduce bycatch below the PSC limits. To ensure participants develop effective IPAs, the final rule required that participants submit annual reports to the Council that evaluate whether the IPA is effective at providing incentives for vessels to avoid Chinook salmon at all times while fishing for pollock. The sector-level performance standard ensures that the IPA is effective and that sectors cannot fully harvest the Chinook salmon PSC allocations under the 60,000 Chinook salmon PSC limit in most years. Each year, each sector is issued an annual threshold amount that represents that sector's portion of 47,591 Chinook salmon. For a sector to continue to receive Chinook salmon PSC allocations under the 60,000 Chinook salmon PSC limit, that sector must not exceed its annual threshold amount three times within 7 consecutive years. If a sector fails this performance standard, it will permanently be allocated a portion of the 47,591 Chinook salmon PSC limit. Under Amendment 91, NMFS would issue transferable allocations of the 47,591 Chinook salmon PSC limit to all sectors, cooperatives, and CDQ groups if no IPA is approved, or to the sectors that exceed the performance standard.

## Alternative 2: Hard cap (PSC limit)

Alternative 2 would establish separate chum salmon PSC limits for the pollock fishery in the B season. When the PSC limit is reached, all directed fishing for pollock must cease for either the remainder of the year (Option 1a) or until August 1 (Option 1b). Only those non-Chinook salmon caught by vessels participating in the directed pollock fishery would accrue towards the cap. When the cap is reached, directed fishing for pollock would be prohibited during the applicable time frame.

Alternative 2 contains components, and options for each component, to determine (1) the total hard cap amount and time frame over which the cap is applied, (2) whether and how to allocate the cap to sectors, (3) whether and how salmon bycatch allocations can be transferred among sectors, and (4) whether and how the cap is allocated to and transferred among catcher vessel (CV) cooperatives.

### Setting the Hard Cap

Component 1 would establish the annual PSC limit based upon a range of numbers as shown below. Component 1 sets the overall cap; this could be either applied at the pollock fishery level to the CDQ and non-CDQ fisheries (not allocated by sector within the non-CDQ sectors), or may be subdivided by sector (Component 2) and the inshore sector allocation further allocated among the inshore cooperatives (Component 4).

### Range of numbers for a hard cap

There are two options considered under the establishment of a non-Chinook PSC limit for vessels fishing in the directed pollock fishery. These options differ by whether the cap is established for the entire B season (Option 1a) or for June and July only (Option 1b).

*Option 1a: Apply a non-Chinook PSC limit to vessels participating in the directed pollock fishery for the entire B season*

Under this option the hard cap (non-Chinook PSC limit) would be established for vessels fishing in the directed pollock fishery according to the range of suboptions as shown below and would be applicable for the entire B season. Once reached, this cap would require all vessels affected by the cap to stop fishing for the remainder of the season.

The range of non-Chinook salmon PSC hard caps considered is shown below. As shown below, the CDQ Program would be allocated 10.7 percent of the fishery level cap with the remainder allocated to the combined non-CDQ fishery.

Range of suboptions for Option 1a cap for non-Chinook with allocations for CDQ Program (10.7%) and remainder for non-CDQ fishery (89.3%)

| | Non-Chinook | CDQ | Non-CDQ |
|---|---|---|---|
| i) | **50,000** | 5,350 | 44,650 |
| ii) | 75,000 | 8,025 | 66,975 |
| iii) | 125,000 | 13,375 | 111,625 |
| iv) | **200,000** | 21,400 | 178,600 |
| v) | 300,000 | 32,100 | 267,900 |
| vi) | **353,000** | 37,771 | 315,229 |

For analytical purposes only, a subset of the cap numbers included in the six suboptions will be used in the impact analysis to assess the impacts of operating under a given hard cap. This subset approximates the upper and lower endpoints of the suboption range, and a midpoint (in **bold** above).

*Option 1b: Apply a non-Chinook PSC limit to vessels participating in the directed pollock fishery during June and July*

Under this option the hard cap (non-Chinook PSC limit) would be established for vessels fishing in the directed pollock fishery during June and July. Once reached, this cap would require all vessels affected by the cap to stop fishing until August 1.

The range of cap suboptions under Option 1b are shown in the table below. They represent the proportion of non-Chinook PSC caught in June and July relative to the B season total during 2003 through 2011. **Bolded** suboptions represent the subset for the analysis.

Range of suboptions for Option 1b cap for non-Chinook with allocations for CDQ Program (10.7%) and remainder for non-CDQ fishery (89.3%)

| | Non-Chinook | CDQ | Non-CDQ |
|---|---|---|---|
| 1) | **15,600** | **1,669** | **13,931** |
| 2) | 23,400 | 2,504 | 20,896 |
| 3) | 39,000 | 4,173 | 34,827 |
| 4) | **62,400** | **6,677** | **55,723** |
| 5) | 93,600 | 10,015 | 83,585 |
| 6) | **110,136** | **11,785** | **98,351** |

## Apportioning the hard cap

The hard caps could be apportioned as:

- fishery level caps for the CDQ fishery and the non-CDQ fishery;
- sector level caps for the three non-CDQ sectors: the inshore CV sector, the mothership sector, and the offshore CP sector; and
- cooperative level caps for the inshore CV sector.

A fishery level cap would be managed by NMFS with inseason actions to close the fishery once the cap was reached. The CDQ fishery caps would be allocated and managed at the CDQ group level, as occurs under status quo. The hard caps could be apportioned to sectors as sector level caps based on the percentages in Table ES-3. Non-CDQ sector level caps would be managed by NMFS with inseason actions to close the fishery once the cap was reached.

The inshore CV sector level cap could be allocated to cooperatives and the inshore CV limited access fishery. The cooperative transferable allocation amounts would be based on the proportion of pollock allocations received by the cooperatives.

For analytical purposes, a subset of the sector level cap options (shown in bold) providing the greatest contrast is used for detailed analysis.

Table ES-3. Sector percentage allocations resulting from options 1-6. The allocation included for analytical purposes are shown in bold.

| Time Period for Average | Option | % historical: pro-rata | CDQ | Inshore CV | Mothership | Offshore CPs |
|---|---|---|---|---|---|---|
| NA (AFA) | 1 | 0:100 | 10.0% | 45.0% | 9.0% | 36.0% |
| 2007-2009 | 2i | 100:0 | 4.4% | 75.6% | 5.6% | 14.4% |
| | 3i | 75:25 | 5.8% | 67.9% | 6.5% | 19.8% |
| | 4i | 50:50 | 7.2% | 60.3% | 7.3% | 25.2% |
| | 5i | 25:75 | 8.6% | 52.6% | 8.2% | 30.6% |
| **2005-2009** | **2ii** | **100:0** | **3.4%** | **81.5%** | **4.0%** | **11.1%** |
| | 3ii | 75:25 | 5.0% | 72.4% | 5.3% | 17.3% |
| | **4ii** | **50:50** | **6.7%** | **63.3%** | **6.5%** | **23.6%** |
| | 5ii | 25:75 | 8.3% | 54.1% | 7.8% | 29.8% |
| 2000-2009 | 2iii | 100:0 | 4.4% | 76.0% | 6.2% | 13.4% |
| | 3iii | 75:25 | 5.8% | 68.3% | 6.9% | 19.1% |
| | 4iii | 50:50 | 7.2% | 60.5% | 7.6% | 24.7% |
| | 5iii | 25:75 | 8.6% | 52.8% | 8.3% | 30.4% |
| 1997-2009 | 2iv | 100:0 | 4.4% | 74.2% | 7.3% | 14.1% |
| | 3iv | 75:25 | 5.8% | 66.9% | 7.8% | 19.5% |
| | 4iv | 50:50 | 7.2% | 59.6% | 8.2% | 25.0% |
| | 5iv | 25:75 | 8.6% | 52.3% | 8.6% | 30.5% |
| **suboption(10.7% to CDQ)** | **6** | **NA** | **10.7%** | **44.77%** | **8.77%** | **35.76%** |

## Transfers and Rollovers

To provide sectors and cooperatives more opportunity to fully harvest their pollock allocations, Alternative 2 could include the ability to transfer sector and cooperative allocations and/or rollover unused salmon bycatch (Table ES-4).

If the Council determines that sector level caps should be issued as transferable allocations, then these entities could request NMFS to move a specific amount of a salmon bycatch allocation from one entity's account to another entity's account during a fishing season. Transferable allocations would not constitute a "use privilege" and, under the suboptions, only a portion of the remaining salmon bycatch could be transferred. If NMFS issues the sector level cap as a transferable allocation to a legal entity representing all participants in that sector, that entity would be prohibited from exceeding its allocation and would be subject to an enforcement action if it exceeded its allocation.

Under the sector rollover option, rollovers would occur when a sector has harvested all of its pollock allocation but has not reached its seasonal sector level Chinook salmon bycatch cap. NMFS would move the unused portion of that sector's cap to the sectors still fishing in that season.

Table ES-4. Transfers and rollovers options for Alternative 2, hard caps.

| | **Option** | **Provision** | | |
|---|---|---|---|---|
| **No transfer of salmon** | | | | |
| **Sector transfers** | Option 1 | Caps are transferable among sectors in a fishing season | | |
| | Suboption | Maximum amount of transfer limited to the following percentage of salmon remaining: | a | 50% |
| | | | b | 70% |
| | | | c | 90% |
| **Sector rollover** | Option 2 | NMFS rolls over unused salmon bycatch to sectors still fishing in a season, based on proportion of pollock remaining to be harvested | | |
| **Cooperative transfers** | Option 1 | Lease pollock among cooperatives in a season or a year | | |
| | Option 2 | Transfer salmon bycatch in a season | | |
| | suboption | Maximum amount of transfer limited to the following percentage of salmon remaining: | a | 50% |
| | | | b | 70% |
| | | | c | 90% |

A summary of the Alternative 2 Components, option and suboptions for analysis is shown in Table ES-5 below.

Table ES-5. Alternative 2 components, options, and suboptions for analysis.

| | | | | | |
|---|---|---|---|---|---|
| **Setting the hard cap (Component 1)** | Option 1a: Cap established for B season. Select cap from a range of numbers* | **Non-Chinook total** | **CDQ** | **Non-CDQ** | |
| | | 50,000 | 5,350 | 44,650 | |
| | | 200,000 | 21,400 | 178,600 | |
| | | 353,000 | 37,771 | 315,229 | |
| | Option 1b: Cap established for June and July. Select cap from a range of numbers* | 15,600 | 1,669 | 13,931 | |
| | | 62,400 | 6,677 | 55,723 | |
| | | 110,136 | 11,785 | 98,351 | |
| **Sector allocation (Component 2)*** | Range of sector allocations* | CDQ | Inshore CV | Mothership | Offshore CP |
| | Option 2ii | 6.7% | 63.3% | 6.5% | 23.6% |
| | Option 4ii | 3% | 70% | 6% | 21% |
| | Option 6 | 10.7% | 44.77% | 8.77% | 35.76% |
| **Sector transfers and rollovers (Component 3)** | No transfers (Component 3 not selected) | | | | |
| | Option 1 | Caps are transferable among sectors and CDQ groups within a fishing season | | | |
| | | Suboption: Maximum amount of transfer limited to: | | a | 50% |
| | | | | b | 70% |
| | | | | c | 90% |
| | Option 2 | NMFS rolls over unused salmon PSC to sectors still fishing in a season, based on proportion of pollock remaining to be harvested. | | | |
| **Cooperative Allocation and transfers (Component 4)** | No allocation | Allocation managed at the inshore CV sector level. (Component 4 not selected) | | | |
| | Allocation | Allocate cap to each cooperative based on that cooperative's proportion of pollock allocation. | | | |
| | Option: Cooperative Transfers | Option 1 | Lease pollock among cooperatives in a season or a year | | |
| | | Option 2 | Transfer salmon PSC (industry initiated) | | |
| | | Suboption Maximum amount of transfer limited to the following percentage of salmon remaining: | | a | 50% |
| | | | | b | 70% |
| | | | | c | 90% |

## Alternative 3-Closure with RHS exemption and Trigger closure options for participants

Alternative 3 would create new boundaries for the Chum Salmon Savings Area. The existing Chum Salmon Savings Area and associated trigger cap would be removed from regulation. The new boundaries would encompass the area of the Bering Sea where historically 80 percent of non-Chinook prohibited species catch occurred from 2003 through 2011 B season (Figure ES-3). The trigger caps that would close this area are described below. The area closure would apply to pollock vessels that are not in an RHS system when total non-Chinook salmon PSC from all vessels (those in an RHS system and those not in an RHS system) reaches the trigger cap level. The trigger cap would be allocated between the CDQ and non-CDQ pollock fisheries, as currently is done under status quo. The non-CDQ allocation of the trigger cap would not be further allocated among the AFA sectors or inshore cooperatives, unless options to do so were selected under Components 2 through 6.

Component 1 of this alternative sets the trigger PSC cap level for this large scale closure. PSC from all vessels will accrue towards the cap level selected. However if the cap level is reached, the triggered closure would not apply to participants in the RHS program. Under Component 2, however, in addition to the large closure for non-RHS participants, a select triggered area closure would apply to RHS participants. Four options of triggered closure areas and time frames are provided under Component 2. Component 3 then sets the trigger PSC cap level for the area selected under Component 2.

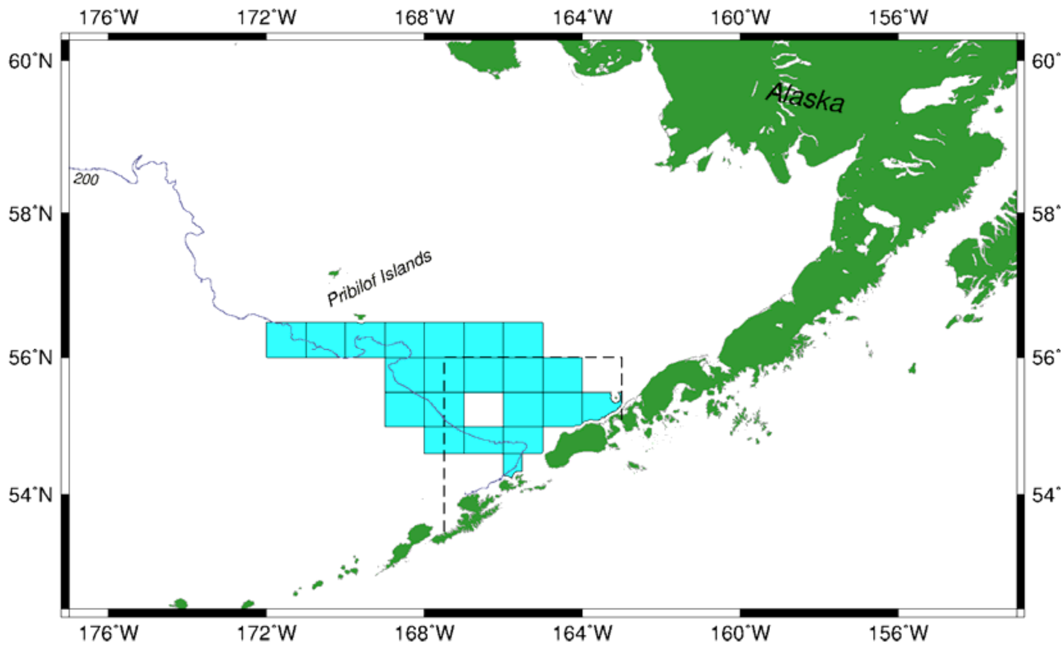



Figure ES-3. Selected area closures covering 80% of B season 2003 through 2011 chum bycatch.

### Component 1: 80% Closure aggregate trigger PSC cap levels

The range of non-Chinook salmon PSC caps considered is shown below. As listed here, the CDQ sector allocation of the fishery level cap would be 10.7 percent, with the remainder apportioned to the combined non-CDQ fishery.

Range of suboptions for trigger PSC cap levels for non-Chinook with allocations for CDQ (10.7%) and remainder for non-CDQ fishery.

| | Non-Chinook | CDQ | Non-CDQ |
|---|---|---|---|
| 1) | **25,000** | **2,675** | **22,325** |
| 2) | 50,000 | 5,350 | 44,650 |
| 3) | **75,000** | **8,025** | **66,975** |
| 4) | 125,000 | 13,375 | 111,625 |
| 5) | **200,000** | **21,400** | **178,600** |

For analytical purposes only, a subset of the cap levels included in the six suboptions were used in this document to assess the impacts of operating under a given hard cap. This subset approximates the upper and lower endpoints of the suboption range, and a midpoint (**bolded**).

NMFS would issue pollock fishery closures once either the non-CDQ fishery or a non-CDQ sector reached its salmon bycatch limit. Vessel operators would be prohibited from directed fishing for pollock in a non-Chinook salmon savings area once NMFS closed the area to a fishery or sector. The CDQ sector would not be subject to pollock fishery closures; instead, CDQ groups would have to stop fishing for pollock in the closed areas once they had reached their non-Chinook bycatch allocation.

Vessels participating in the RHS would operate under a different fishery level cap than any vessels not participating in the RHS. NMFS would continue to manage triggered area closures for vessels not participating in the ICA as described in status quo. Vessels participating in the RHS would be exempt from NMFS's area closures, and would instead be subject to the RHS closures.

The process currently used to monitor salmon PSC and issue salmon savings area closures would continue for these closures. NMFS would have to determine whether a vessel was directed fishing for pollock and then match that vessel with its fishery component (CDQ or non-CDQ) or sector. NMFS currently uses a combination of VMS, industry reported catch information, and observer data to monitor vessel activities in special management areas, such as habitat conservation areas and species-specific savings areas (e.g., salmon savings area). These data sources are used by NMFS on a daily basis to monitor fishery limits. Information from VMS is useful for determining vessel location in relation to closure areas, but it may not conclusively indicate whether a vessel is fishing, transiting through a closed area, or targeting a particular species.

### Component 2: Trigger closure areas and timing for RHS participants:

In addition to the RHS, vessels in the RHS system would be subject to:
*Option 1: a trigger closure encompassing 80% of historical non-Chinook salmon PSC estimates.*

Suboption 1a) Trigger closure would apply for the B season (June-October; Figure ES-5)

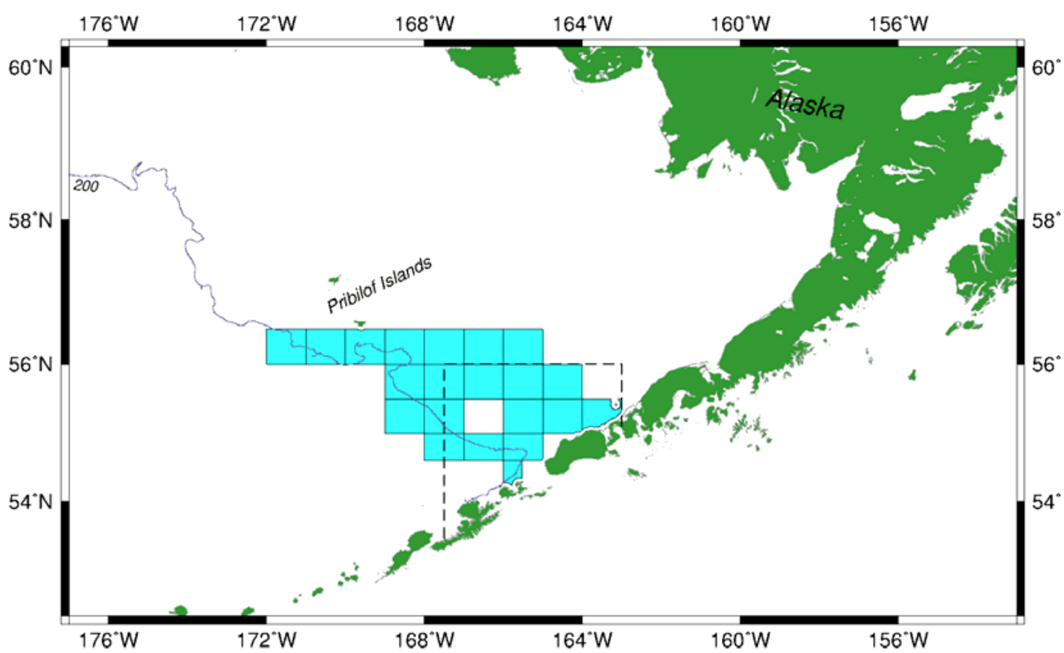



Figure ES-4. Selected area closures covering 80% of B season (Option 1a) 2003-2011 chum bycatch.

Suboption 1b) Trigger closure would only apply in June and July (Figure ES-4).

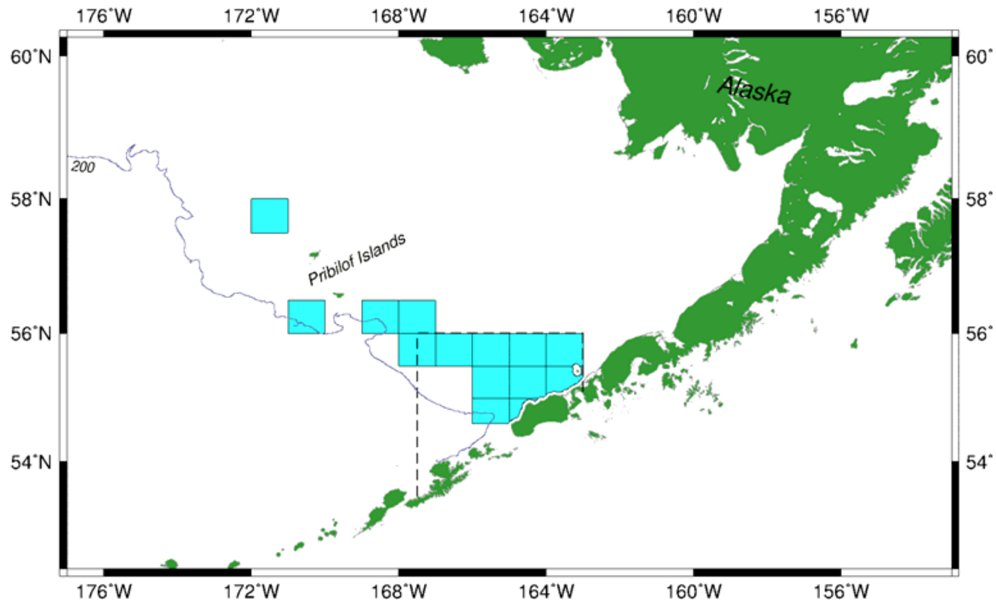



Figure ES-5. Selected area closures covering 80% of June-July (Option 1b) 2003 through 2011 chum bycatch.

*Option 2: a trigger closure encompassing 60% of historical non-Chinook salmon PSC estimates*

Suboption 2a) Trigger closure would apply for the B season (June-October; Figure ES-6).

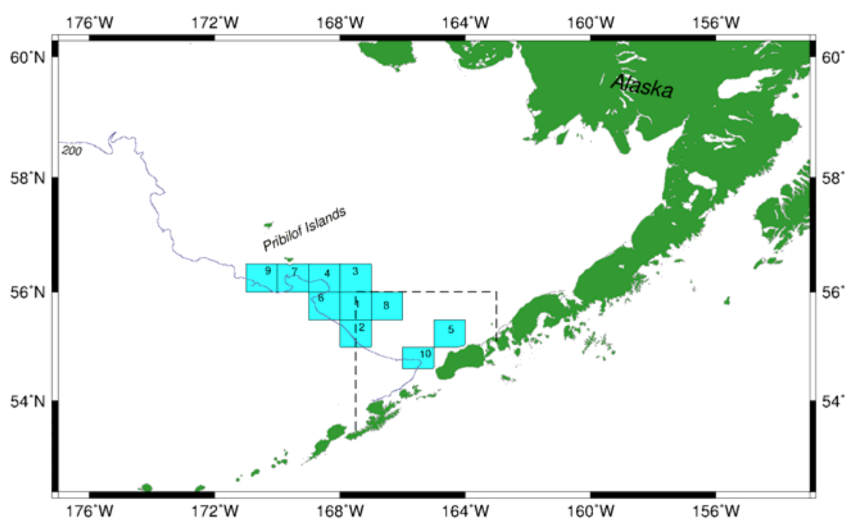



Figure ES-6. Selected area closures covering 60% of B season 2003 through 2011 chum bycatch.

Suboption 2b) Trigger closure would only apply in June and July (Figure ES-7).

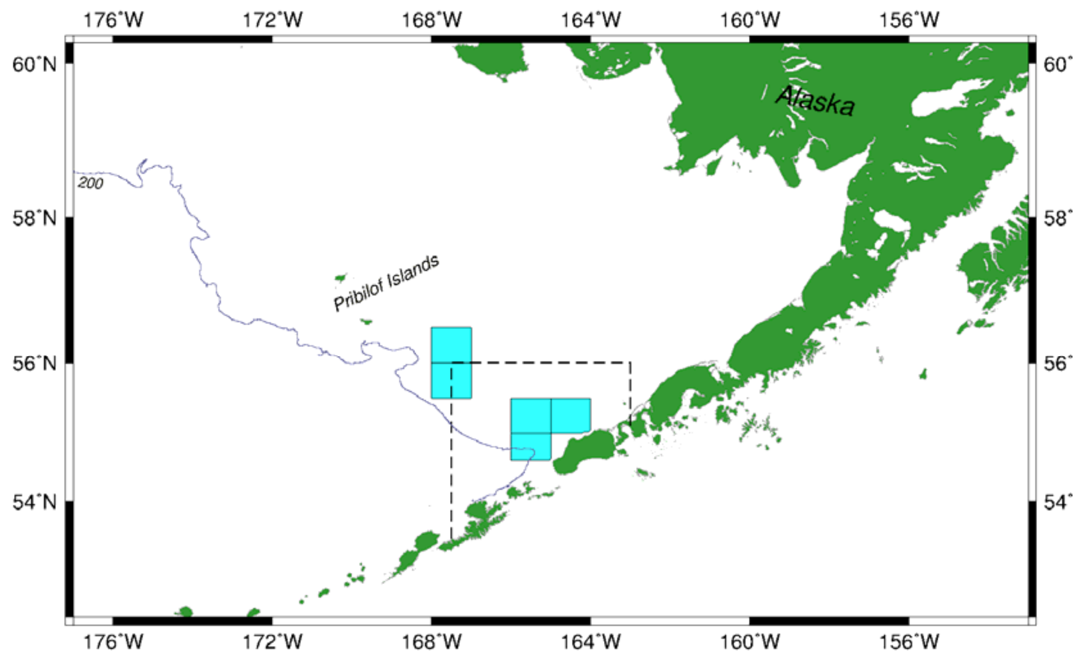



Figure ES-7. Selected area closures covering 60% of June-July 2003 through 2011 chum bycatch.

### Component 3: PSC cap levels for trigger closures for RHS participants

PSC cap level options for a given closure selected under Component 2 are shown below. Note that caps for both Option 1 and Option 2 under Component 2 are shown. If Suboption 1b or 2b is selected, then the June-July cap would reflect the proportion of bycatch in June and July.

Range of suboptions for trigger PSC cap levels for non-Chinook with allocations for CDQ (10.7%) and remainder for non-CDQ fishery for RHS participants.

| | Total Annual cap (Option 1a or 2a) | CDQ | Non-CDQ | June-July cap (Option 1b or 2b) Total June/July | CDQ | Non-CDQ |
|---|---|---|---|---|---|---|
| 1) | 25,000 | 2,675 | 22,325 | 7,800 | 835 | 6,965 |
| 2) | 50,000 | 5,350 | 44,650 | 15,600 | 1,669 | 13,931 |
| 3) | 75,000 | 8,025 | 66,975 | 23,400 | 2,504 | 20,896 |
| 4) | 125,000 | 13,375 | 111,625 | 39,000 | 4,173 | 34,827 |
| 5) | 200,000 | 21,400 | 178,600 | 62,400 | 6,677 | 55,723 |

### Component 4 and 5 : Sector allocation of trigger cap for RHS participants and cooperative provisions

Sector allocation options and cooperative level provisions under aLternative 3 are the same as those listed under Alternative 2.

A summary of the Alternative 3 Components, option and suboptions for analysis is shown in below (Table ES-6).

Table ES-6. Summary of Alternative 3 components, options and suboptions.

| | | | | | |
|---|---|---|---|---|---|
| **Component 1:Fleet PSC management with non-participant triggered closure** | Area | Triggered closure encompassing 80% of historical PSC. Participants in RHS would be exempt from the regulatory closure if triggered. | | | |
| | Option 1: cap | Select a cap from a range of numbers: 25,000 –200,000 | | | |
| **Component 2: Trigger Closure area and timing for RHS participants** | **Option 1:** Area 80% | Triggered closure encompassing 80% of historical PSC for all RHS participants | | | |
| | Suboption a: timing | Applies to remainder of B season if triggered | | | |
| | Suboption b: Timing | Applies in June and July if triggered | | | |
| | **Option 2**: Area 60% | Triggered closure encompassing 60% of historical PSC for all RHS participants | | | |
| | Suboption a: timing | Applies to remainder of B season if triggered | | | |
| | Suboption b: timing | Applies in June and July if triggered | | | |
| **Component 3: PSC Cap levels for closure selected under Component 2 for RHS participants** | Option 1a: PSC cap established for B season closure | Select cap from range of numbers: 25,000 – 200,000 | | | |
| | Option 1b: PSC cap established for June/July proportion | Select cap from range of numbers: 7,800 – 62,400 | | | |
| **Component 4: Allocating the trigger cap to sectors** | Range of sector allocations*: | CDQ | Inshore CV | Mothership | Offshore CP |
| | Option 1 | 10.0% | 45.0% | 9.0% | 36.0% |
| | Option 2ii | 6.7% | 63.3% | 6.5% | 23.6% |
| | Option 4ii | 10.7% | 44.77% | 8.77% | 35.76% |
| | Option 6 | 3.4% | 81.5% | 4.0% | 11.1% |
| **Component 5: Sector transfers and rollovers** | No transfers (Component 5 not selected) | | | | |
| | Option 1 | Caps are transferable among sectors and CDQ groups within a fishing season | | | |
| | | <u>Suboption</u>: Maximum amount of transfer limited to: | a | 50% | |
| | | | b | 70% | |
| | | | c | 90% | |
| | Option 2 | NMFS reallocates unused salmon PSC to sectors still fishing in a season, based on proportion of pollock remaining to be harvested. | | | |
| **Component 6: Inshore Cooperative Allocation and transfers** | No allocation | Allocation managed at the inshore CV sector level. (Component 6 not selected) | | | |
| | Allocation | Allocate cap to each inshore cooperative based on that cooperative's proportion of pollock allocation. | | | |
| | Option: Cooperative Transfers | Option 1 | Lease pollock among cooperatives in a season or a year | | |
| | | Option 2 | Transfer salmon PSC (industry initiated) | | |
| | | <u>Suboption</u> Maximum amount of transfer limited to the following percentage of salmon remaining: | a | 50% | |
| | | | b | 70% | |
| | | | c | 90% | |

## Comparison of Alternatives

The following section provides an overview of the three broad alternatives under consideration and the over-arching management measures that would be imposed under each.

Table ES-7 compares the three alternatives, the relative time frame of the management measures being considered by alternative or multiple options within alternatives where applicable, and the action under consideration. Both Alternatives 2 and 3 have options for a management action enacted in June and July only as compared to a similar action enacted for the entire B season. Note that the alternatives are not mutually exclusive thus measures for one alternative may be combined with those in another to form an additional alternative for consideration. For example, a June-July hard cap under Alternative 2 (Alternative 2, Component 1, Option 1b) could be combined with the B season closure to non-participants in the RHS system under Alternative 3 Component 1 to form a new management system that could be analyzed should the Council decide to mix and match amongst alternative components and options to tailor a specific program and objective for management.

Table ES-7. Comparison of over-arching management measures under the three alternatives considered in this analysis

| Alternative | Timing | Management action | | |
|---|---|---|---|---|
| 1-Status quo | B season | Exemption to regulatory closure of CSSA (Fig. ES-2.) provided participation in current RHS program | | |
| 2-Hard cap | B season (Component 1, Option 1a) | Fishery sectors close for the season when sector-specific cap level is reached | | |
| | June-July (Component 1, Option 1b) | Fishery sectors close until July 31 when sector-specific cap level is reached | | |
| 3-Closure area with RHS exemption | | ***Closure area applies to*** | ***Closure Area*** | ***Basis period*** |
| | B season (Component 1) | **Non-**participants of RHS program when **fishery level** caps[1] reached | 80% of chum (Figure ES-3) | B season |
| | B season (Component 2, Suboption 1a) | Participants of RHS program when **sector-level** caps reached | 80% of chum (Figure ES-5) | B season |
| | June-July (Component 2, Suboption 1b) | Participants of RHS program when **sector-level** caps reached | 80% of chum (Figure ES-7) | June-July |
| | B season (Component 2, Suboption 2a) | Participants of RHS program when **sector-level** caps reached | 60% of chum (Figure ES-7) | B season |
| | June-July (Component 2, Suboption 2b) | Participants of RHS program when **sector-level** caps reached | 60% of chum (Figure ES-6) | June-July |

## Managing and Monitoring the Alternatives

The observer and monitoring requirements currently in place to account for Chinook salmon PSC under Amendment 91 also enable NMFS to monitor non-Chinook salmon PSC under a hard cap. Therefore, NMFS does not anticipate changes to observer requirements or additional monitoring provisions under either Alternative 2 or 3.

If the Council allocates hard caps or trigger caps among sectors and cooperatives, NMFS recommends that any entities receiving allocations be the same as those used for Chinook salmon PSC allocations under Amendment 91. Consistent allocation categories for Chinook and non-Chinook salmon would greatly simplify administrative functions for NMFS and the industry. Existing contracts and application to NMFS establishing these entities could be modified to incorporate the responsibility for receiving and managing non-Chinook salmon PSC allocations.

Area closures could be managed in a number of different ways, depending on the combination of components and options selected. Trigger closures would require a sector to stop pollock fishing in certain closure areas when its allocation of non-Chinook salmon PSC is reached. Depending on the selection of subsequent components in this alternative, salmon may be allocated at the fishery level (CDQ and non-CDQ), to each sector (inshore, mothership, catcher/processor, and CDQ), or among the inshore cooperatives.

Under Alternative 3, participants in the RHS would be exempt from the regulatory closure system. Monitoring and enforcement of this alternative is similar to status quo in which ICA members are managed under the RHS and NMFS closes the trigger area for non-ICA members.

The current census data collection program is highly responsive to management needs and provides timely data, especially considering the logistics of the sectors and variation in operation type. However, even with this highly responsive system, a June and July cap results in a very short time period for NMFS to monitor and insure a timely trigger area closure. NMFS would need to project non-Chinook salmon harvest during the week required to publish a *Federal Register* notice and get census information. These projections may result in a trigger closure being made prior to or after the cap being reached.

If the Council recommends a chum salmon bycatch management program under either Alternative 1 or Alternative 3 that provides exemptions to caps or area closures for participants in an approved ICA, NMFS will continue to require that the federal regulations contain sufficient detail to prevent later substantive revisions to the ICA that would reduce its effectiveness.

In addition, NMFS has determined that federal regulations for the RHS may not include specific requirements for the enforcement provisions or penalties that the ICA would impose on its participants. Therefore, in the future, under either Alternative 1 or Alternative 3, the Council could recommend that federal regulations require the RHS ICA to contain a description of the enforcement provisions and penalties that the ICA participants agree to assess on themselves for violation of the ICA provisions. However, the regulations could not include specific requirements for what these penalties must be.

The fishing industry will continue to incur costs associated with the administration of the RHS ICA. However, NMFS has not identified significant costs to the agency for managing or monitoring these alternatives. NMFS Office of Law Enforcement will provide additional information about the costs of enforcing Amendment 91 and the potential costs of the chum salmon bycatch alternatives prior to Council final action.

## Effects of the Alternatives

Quantitative analysis was completed on the potential impacts of the alternatives on chum salmon, pollock, Chinook salmon, and related economic analyses. Chapter 3 describes the methodology for the quantitative analysis. For the remaining resource categories considered in this analysis - marine mammals, seabirds, other groundfish, essential fish habitat, ecosystem relationships, and environmental justice - impacts of the alternatives were evaluated largely qualitatively based on results and trends from the quantitative analysis.

The estimated impacts of alternative chum salmon PSC management measures were evaluated by examining when cap options would have resulted in fishery closures and then estimating the numbers of salmon that would have been ‘saved’ by virtue of the fishery (or sector) closing earlier. The salmon saved is then compared to the amount of pollock that would have been forgone or diverted to open areas (for Alternative 3). The analyses were based on 2003-2011 NMFS observer data combined with NMFS regional office catch-accounting. Component 1 of Alternative 3 imposes a large-scale triggered closure to which participants in the RHS program are exempt. This component is examined in two ways: 1-as a separate alternative whereby this is the only component selected and thus the RHS program provides the primary management tool while the large-scale area closure provides the incentive to participate in the RHS, and 2-as the first layer in a series of measures including components 2 through 6 as desirable to provide additional protection to minimize chum PSC. Alternative 3 was thus analyzed quantitatively two ways: 1) as a fixed B season closure should all vessels fail to participate in a rolling hotspot program (RHS) to indicate the relative incentive to participate, and 2) with 100% vessel participation in a rolling hotspot program. Additional triggered closures are imposed under Alternative 3 on the participants of the RHS. For these closures the amount of pollock diverted is estimated in conjunction with the amount of chum salmon saved. For all the alternatives the relative catch of Chinook is also estimated.

Results presented in Chapter 5 include both overall changes in chum salmon PSC due to alternative management measures, as well as resulting estimates of the amount of chum salmon that would have returned to natal rivers as adult fish.

The RIR examines the costs and benefits of the alternatives based on the analysis in Chapters 4 and 5 that estimates the likely dates of pollock fishery closures and thereby retrospectively projects likely forgone pollock harvest and the number of chum salmon that may have been saved. Under Alternative 3, the RIR uses estimates of pollock caught outside of proposed closure areas. In this way, estimates of direct costs, in terms of potentially forgone gross revenue due to unharvested pollock, may be compared to the estimated benefits, in terms of the numbers of chum salmon that would not be taken as bycatch. Potentially forgone pollock fishery gross revenue is estimated by tabulating the amount of pollock historically caught after a closure date and applying established sector and seasonal prices. However, it is not a simple matter to estimate changes in gross revenues due to changes in chum salmon PSC predicted under the alternatives. The analysis relies on estimates of chum salmon saved as the measure of economic benefits of the alternatives.

### Chum salmon impacts

Chapter 5 analyzes the impacts of the alternatives on chum salmon. First, estimates on the number of chum salmon saved under each alternative compared to Alternative 1 (status quo) are made based on the details of the alternatives and options. These estimates were then combined with data on the ages of chum salmon taken by the pollock fishery to provide annual estimates on the numbers of chum salmon that would have returned to spawn (referred to as adult equivalents or AEQ). Finally, the data from genetic samples available from 2005-2009 were combined with the AEQ and run size estimates (along with associated uncertainties) to evaluate impacts on specific chum salmon runs or groups of runs to different regions.

Estimates of historical bycatch represent actual numbers of chum salmon taken and include benefits of existing management measures. A separate analysis of the current mechanisms in place under status quo (i.e., the fleet-based rolling hot spot program) estimates what percentages of salmon are likely already being saved. These estimates are provided to understand the effectiveness of the current system relative to one which lacked any salmon PSC avoidance program. The reduction due to this program is estimated to range from 4-28% based on estimation of imposing the system in years prior to its operation. Comparing alternatives against status quo requires understanding that the relative benefits are in addition to the current status quo measures.

Analysis of the efficacy of the existing RHS program showed the following general conclusions:

- From 2003-2010, chum PSC rates in the 1-3 days following RHS closures are approximately 8 percent lower than rates prior to the closure.
- Evaluating the pre-RHS data from 1993-2000, an RHS-like system would likely have reduced chum PSC by 9 percent to 22 percent on average with about 4-10% percent of pollock fishing have been relocated to other areas.
- The pre-RHS analysis suggests that closures in place for chum have likewise been effective for Chinook with the range of Chinook savings as 6 percent to 14 percent per year.
- The average percentage of pollock catch that was moved due to RHS closures from 2003-2011 ranged from 7 percent to 21 percent for CVs and was 6 percent or less for other sectors.

Some additional considerations in analyzing the RHS system include the following:

- Based on 1993-2000 data, large closures reduce salmon PSC more but at the cost of reducing the areas where pollock could be taken. Also, closures based on the most recent information possible lead to larger average reductions and relatively small base rates appear on average to be more effective.
- The "tier system" of the RHS program allows cooperatives with low PSC relative to the base rate to fish inside closed areas. This provides some incentive for cooperatives to have lower chum PSC rates in order to be able to fish in areas closed to others. During closure periods, 4.6 percent of pollock from shore-based catcher vessels and 0.3 percent of pollock from other sectors was taken inside the closure areas.

Compared to alternative spatial management systems, the RHS system has advantages and limitations. Some of the key advantages include the flexibility to adapt to new information rapidly, the ability to explicitly make trade-offs between chum and Chinook as necessary and reporting requirements that allow for transparency in the adherence of vessels to designated closures. Some limitations include provisions on the maximum area that can be closed and a lack of incentives at the vessel level when restrictions are based on a cooperative level bycatch rate. Further information on the methodology and detailed impacts under the RHS system are contained in Chapter 5.

Following the criteria used to evaluate the impact of alternative management measures on chum salmon PSC it is clear that the status quo alternative results in adverse impacts since there are incidental takes of the prohibited species in question. However, given the low relative impact rates in most years of the status quo incidental catch levels on aggregate run sizes, even under the status quo, the relative impact of this incidental take on overall in-river returns is likely low. Nonetheless alternatives are evaluated to estimate potential means to minimize the adverse impacts of this incidental catch levels by reducing PSC catch of chum through different management strategies under Alternatives 2 and 3. Moving forward to evaluation of the other alternatives, comparison is made regarding minimizing adverse impacts by a reduction in incidental catch of chum PSC or increasing adverse impacts on chum PSC if the given alternative would result in an increase of incidental catch of chum PSC as compared with status quo.

### *Adult Equivalent mortality*

AEQ bycatch takes into account the fact that some of the chum salmon taken in the pollock fishery would not have returned to their river of origin in that year. Based on their age and maturity, they might have returned one to two years later. Also, the approach accounts for that fact that some proportion of the bycatch may have suffered mortality in the ocean (e.g., predation). AEQ bycatch estimates provide a way to evaluate the impacts to spawning stocks and future mature returning chum salmon.

Results show that the extent that bycatch is adjusted depending on the ages (to obtain the AEQ estimate) for chum salmon is variable (Figure ES-8). In some years, the actual bycatch may be below the AEQ estimates, due to the lagged impact of higher bycatch in previous years. Overall, the range of uncertainty due to uncertainty in natural mortality, age composition, and maturation rate is relatively small. For projection purposes, the AEQ model results were fit to the annual bycatch and bycatch lagged by one year using linear regression. Given that over 99% of the variability could be explained this was considered a good approximation for converting bycatch numbers into in-river AEQ estimates.

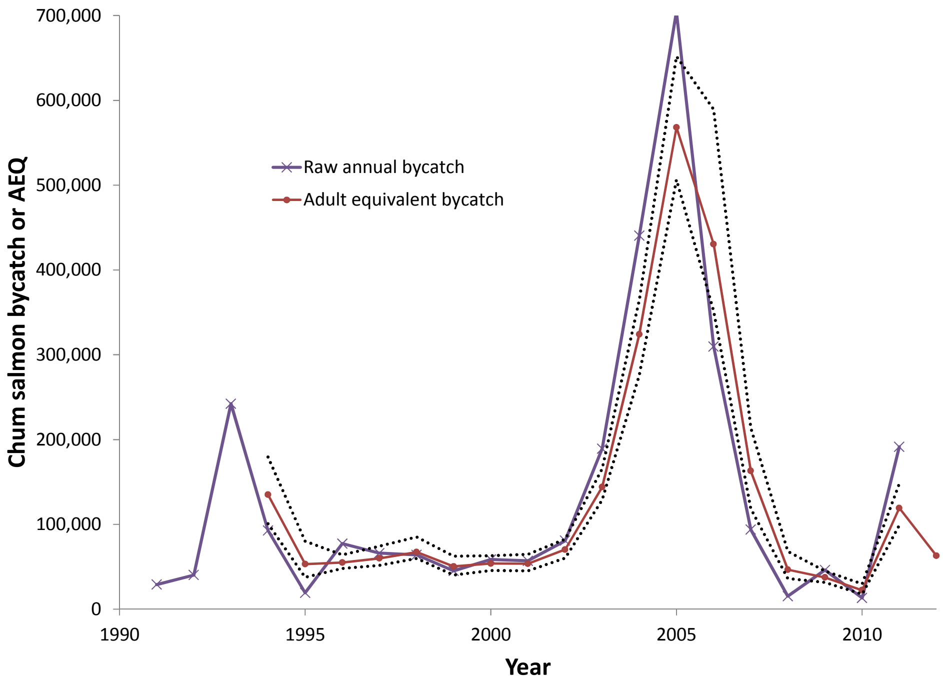



Figure ES-8. Estimated chum bycatch age-equivalent (AEQ) chum bycatch with stochastic (CV=0.4) age-specific oceanic natural mortality scenario 2 and rates compared to the annual tally. Dashed lines represent 5th and 95th percentiles based on 100 simulations. Note that values from 2011 and 2012 are based on predictions from equation 7 (Chapter 3).

### *AEQ chum salmon returns to rivers of origin*

Combining the AEQ results with genetic analysis from 2005-2009 and estimates of run sizes (for coastal west Alaska and the Upper Yukon) provides the means to evaluate the historical impact of chum salmon bycatch. In particular, it provides estimates on how many salmon would have returned to specific river systems and regions had there been no pollock fishing. The stock composition mixtures of the chum salmon bycatch were based on samples collected from the Bering Sea pollock fishery. Results from a number of these analyses have been completed and presented to the Council (i.e., Guyon et al. 2010, Marvin et al. 2010, Gray et al. 2010, and McCraney et al. 2010). This analysis used the same approach and genetic breakouts to 6 individual regions to characterize region of origin for chum bycatch but with a slightly different sample stratification scheme. The regions that could be clearly resolved using genetics were: East Asia (referred in analysis as 'Asia'), north Asia (referred in analysis as 'Russia'), coastal western Alaska (including all WAK systems with the exception of the upper/middle Yukon), upper/middle Yukon, Southwest Alaska (including river systems in Kodiak as well as North and South Peninsula stocks) and Pacific Northwest (which includes river systems from Prince William Sound to WA/OR in the lower 48; Figure ES-9).

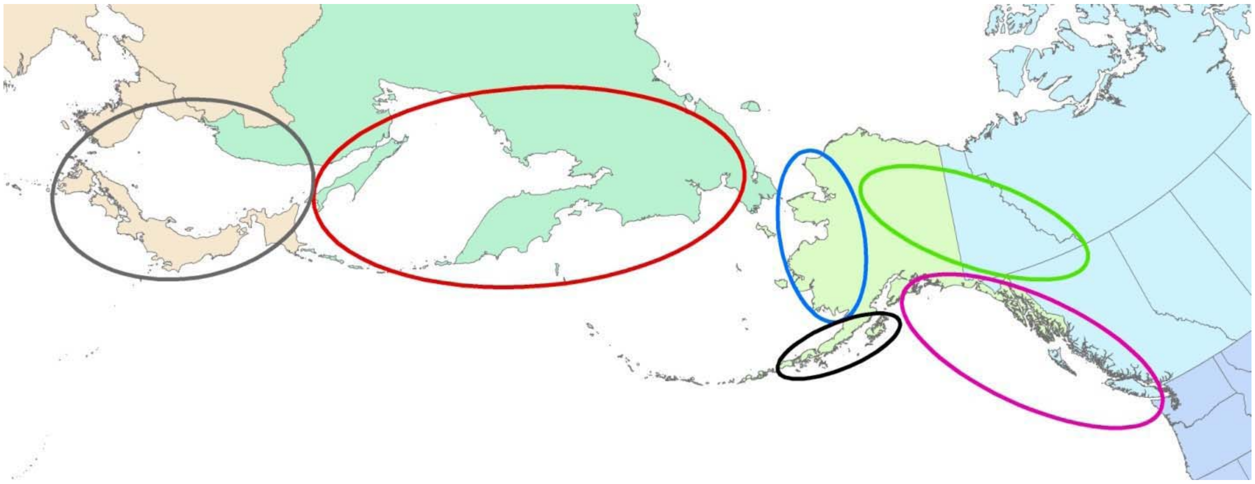


Figure ES-9. Six regional groupings of chum salmon populations used in the analysis including east Asia (grey), north Asia (red), coastal western Alaska (blue), upper/middle Yukon (green), southwest Alaska (black), and the Pacific Northwest (magenta). From Gray et al. 2010.

For this analysis, the genetic analysis was re-done (on the same sets of samples presented in the other studies—e.g., Guyon et al. 2010) but with the samples stratified temporally as from June-July or from August-October. There appears to be a consistent pattern showing that Alaskan stocks are proportionately less common in bycatch later in the season compared to earlier. This re-stratification, along with careful accounting on the relative proportions of bycatch that occurred within years, confirms this pattern with Alaskan stocks being proportionately more common in the June-July period compared to later (Figure ES-10). The proportions of bycatch from the SE Alaska-BC-Washington region also decreased later in the season while proportions from Russia and Japan increased.

Relative impacts to individual river systems depend on where and when the bycatch occurs. This can add to the inter-annual variability in results for the same caps, closures, and allocations between sectors. On average (based on 2005-2009 data) approximately 12% of the AEQ is attributed to the coastal western Alaskan regional grouping while ~7% is attributed to the Upper Yukon (Fall chum). For the Southwest Alaska Peninsula stocks, the average AEQ over this period is ~2%, while for the combined PNW (including regions from Prince William Sound all the way to WA/OR), the average is 22%. Combined estimated Asian contribution is ~58% on average (for Russian stocks and Japanese stocks combined). Yearly estimates are presented in Chapter 3.

These proportions by year are applied to conservative run size estimates, where available, for Alaskan regional groupings to estimate an overall average impact rate of bycatch by region (Figure ES-11). Results indicate that the highest impact rate (chum salmon mortality due to the pollock fishery divided by run-size estimates) was less than 1.7% for the combined western Alaska stocks. For the Upper Yukon stock, the estimate of the impact was higher with a peak rate of 2.73% estimated on the run that returned in 2006 (Figure ES-11). Combined over the period 2004-2011, the estimated mortality for Upper Yukon and coastal western Alaska was low (Figure ES-12). For the SW Alaska region (taken to be from Area M) the estimate of impact rate was the lowest for any of the Alaska sub-regions. The average impact rate (2005-2009) by region (with ranges) was:

| | | |
|---|---|---|
| Coastal west Alaska | 0.49% | (0.07% - 1.23%) |
| Upper Yukon | 1.26% | (0.17% - 2.73%) |
| Combined WAK | 0.63% | (0.08% - 1.31%) |
| Southwest Alaska | 0.40% | (0.07% - 1.03%) |

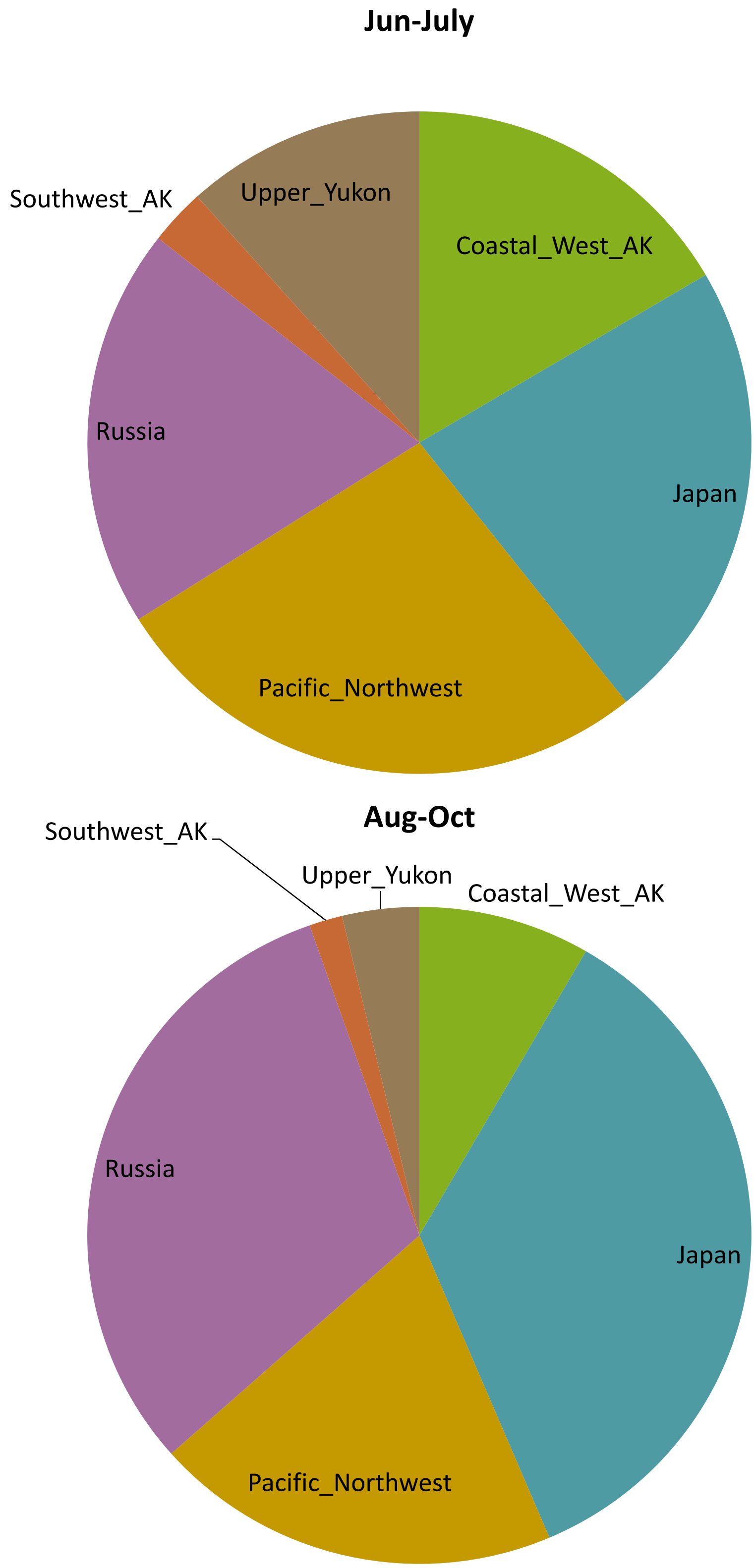



Figure ES-10. Average breakout of bycatch based on genetic analysis by early and late B-season strata, 2005-2009.

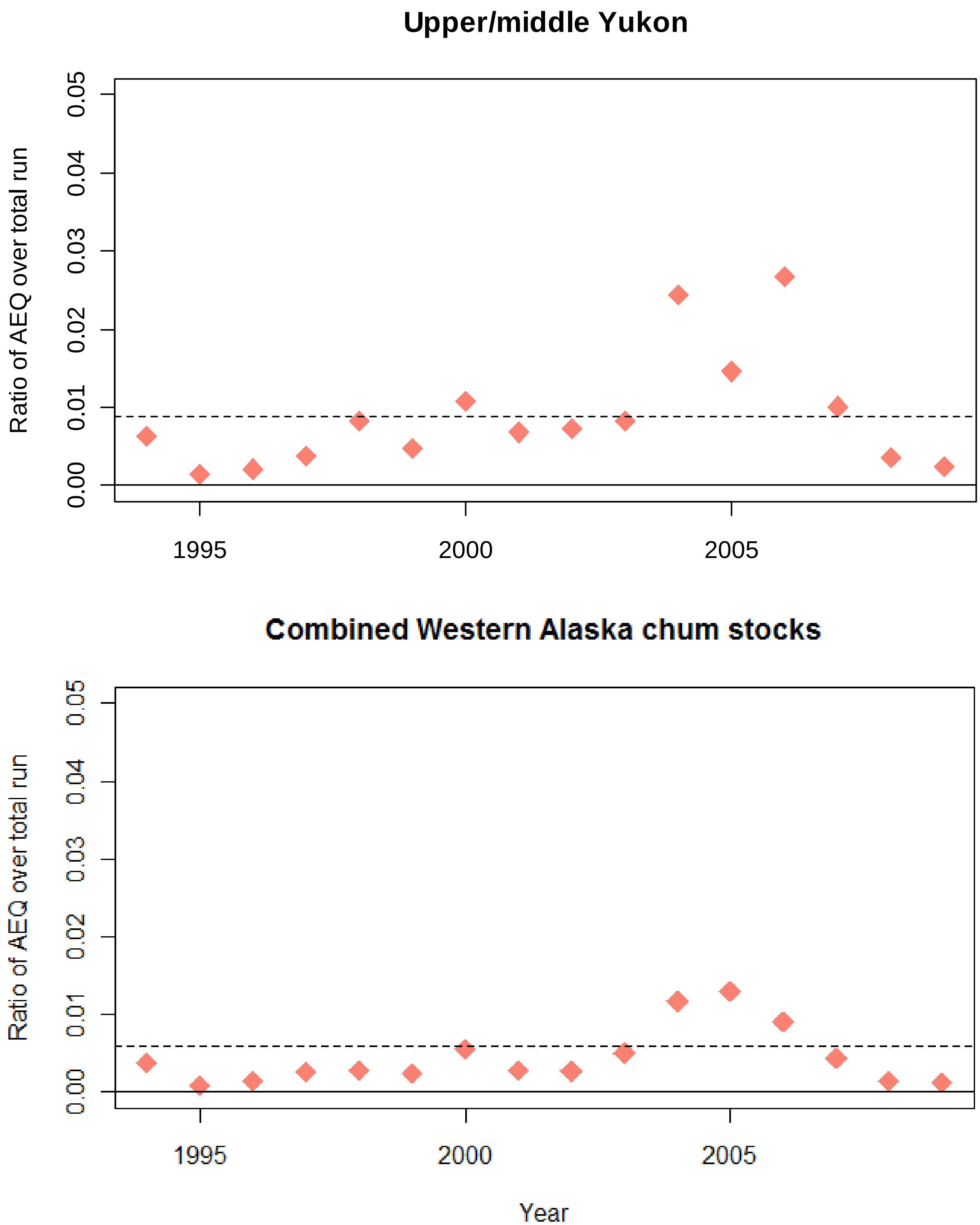
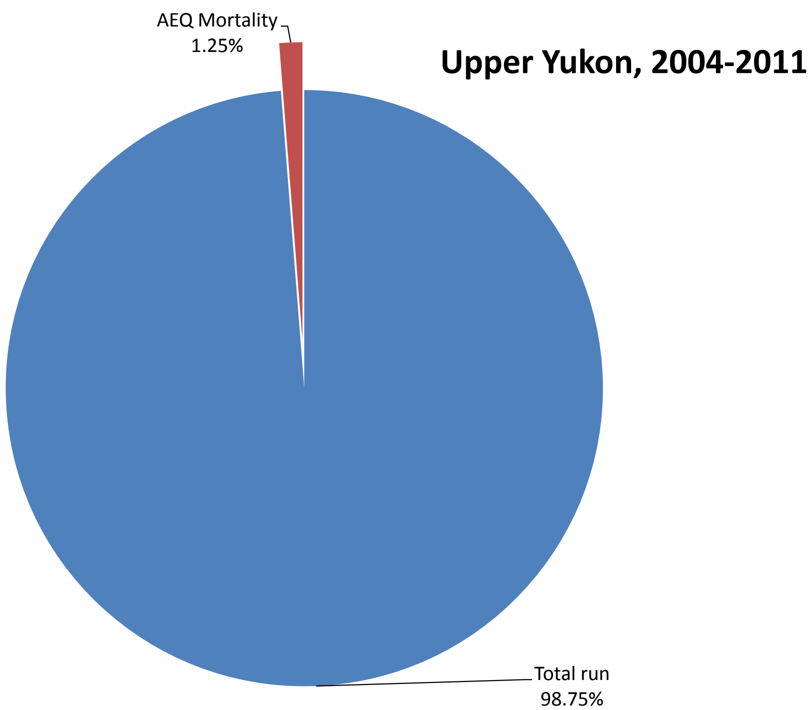



Figure ES-11. Estimated impact rates due to pollock fishery bycatch of chum salmon run sizes for Upper/middle Yukon (top) and for western Alaska stocks (coastal west Alaska stocks plus Upper/middle Yukon combined; bottom). Dashed horizontal line represents the mean value.



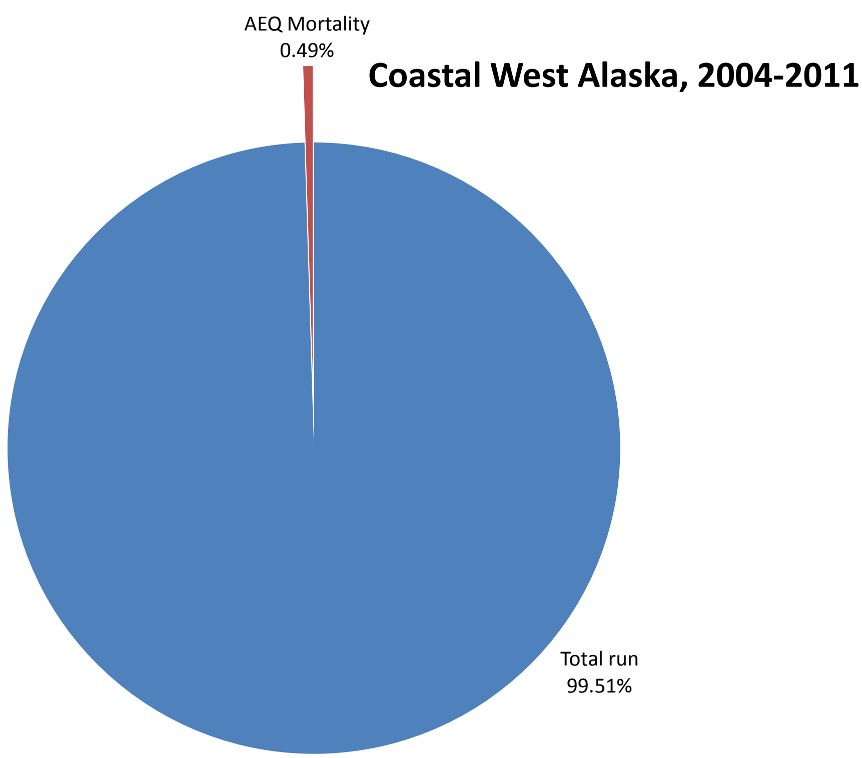




Figure ES-12. Estimated chum 2004-2011 summed AEQ mortality due to pollock fishery bycatch of chum salmon run sizes for Upper/middle Yukon (top) and for coastal western Alaska stocks (bottom).

## Alternative 2, hard cap

Under Alternative 2, the hard cap options, estimates are made by year of the number of salmon saved (in AEQ terms) and compared to the actual amounts estimated under status quo under each cap and sector allocation scenario. The amount of salmon saved under each options varies considerably from year to year as well as by cap and sector allocation. In addition to the caps and sector allocations two options for how the caps would apply were analyzed. For option 1a) they apply over the whole B-season accumulated sector-specific PSC catch of chum salmon. For option 1b) the caps apply only for June-July period. This required accounting for bycatch for these periods to match with genetic stock identification differences. For all evaluations (including for Alternative 3) chum bycatch was converted to AEQ to retain the currency of impact on regional salmon runs.

Under the analyzed options for the hard caps and sector allocations, the numbers of salmon saved is quite high for some years and varies by sector, especially for suboption 1a (Table ES-8). In percentage terms the low cap had the biggest chum salmon savings for most stocks (~80% but lowest savings for the SW Alaska components). This table also shows that different sector allocations had relatively minor impact on savings except for the highest hard cap level which tended to save the most salmon under sector allocation 6 (for option 1a).

For suboption 1b) the numbers of salmon saved was much lower but there was considerable constrast between stocks (Table ES-8). For example, the lowest cap under 1b) reduced the impact on the Upper Yukon on average by 42% but the same option actually increased the estimated AEQ impact on Asian chum salmon. Scrutiny of results summed over years 2004-2011 indicate 1b) is apparently less sensitive to sector allocations than for suboption 1a). For the Upper Yukon different cap levels vary by suboption with 1a at low levels saving more chum whilst at higher cap levels, the savings for 1b is higher (Figure ES-13).

Nearly every option under consideration result in reductions of chum PSC and consequently provide increased returns of adult salmon to their regions of origin. The largest reduction is estimated to occur under a hard cap of 50,000 chum, option 1a for a B-season cap which would have provided an average Coastal western Alaska increased return of 20.3 thousand chum (compared to an average AEQ mortality estimated at 24.2 thousand chum). Given that the average estimated run size for this region for this period is 4.9 million, the ratio of mortality impact is about 0.5% and it seems unlikely that in-river management would have been modified for this amount of returning fish aggregated over all rivers systems in coastal west Alaska given the intricacies of in-season, in-river management as described in Section 5.2.1. In either case, impacts are unlikely to be significantly adverse because they would not diminish protections afforded to chum salmon in the current management of the groundfish fisheries.

Table ES-8. Estimated proportion of Alaska chum salmon saved relative to AEQ mortality year different **hard caps** and sector allocations by year for Alternative 2. Shaded column represents the historical estimated AEQ for years 2004-2011 summed.

| | Sector allocation | Estimated AEQ | 50,000 1a) | 50,000 1b) | 200,000 1a) | 200,000 1b) | 353,000 1a) | 353,000 1b) |
|---|---|---|---|---|---|---|---|---|
| Coastal WAK | 2ii | | 81% | 30% | 45% | 26% | 19% | 24% |
| | 4ii | | 81% | 29% | 50% | 27% | 28% | 24% |
| | 6 | | 84% | 28% | 60% | 29% | 40% | 26% |
| | | 193,649 | | | | | | |
| Upper Yukon | 2ii | | 79% | 42% | 39% | 34% | 13% | 30% |
| | 4ii | | 79% | 42% | 45% | 35% | 23% | 30% |
| | 6 | | 81% | 42% | 57% | 38% | 35% | 32% |
| | | 106,722 | | | | | | |
| SWAK | 2ii | | 42% | 14% | 24% | 12% | 9% | 11% |
| | 4ii | | 42% | 14% | 26% | 12% | 15% | 11% |
| | 6 | | 43% | 14% | 31% | 13% | 22% | 11% |
| | | 68,252 | | | | | | |
| SEAK-BC-WA | 2ii | | 77% | 16% | 45% | 13% | 20% | 12% |
| | 4ii | | 77% | 16% | 48% | 14% | 29% | 12% |
| | 6 | | 78% | 15% | 55% | 16% | 39% | 13% |
| | | 361,690 | | | | | | |
| Asia | 2ii | | 82% | -4% | 53% | 0% | 28% | 1% |
| | 4ii | | 83% | -5% | 54% | 1% | 35% | 2% |
| | 6 | | 84% | -8% | 59% | 1% | 45% | 3% |
| | | 968,497 | | | | | | |

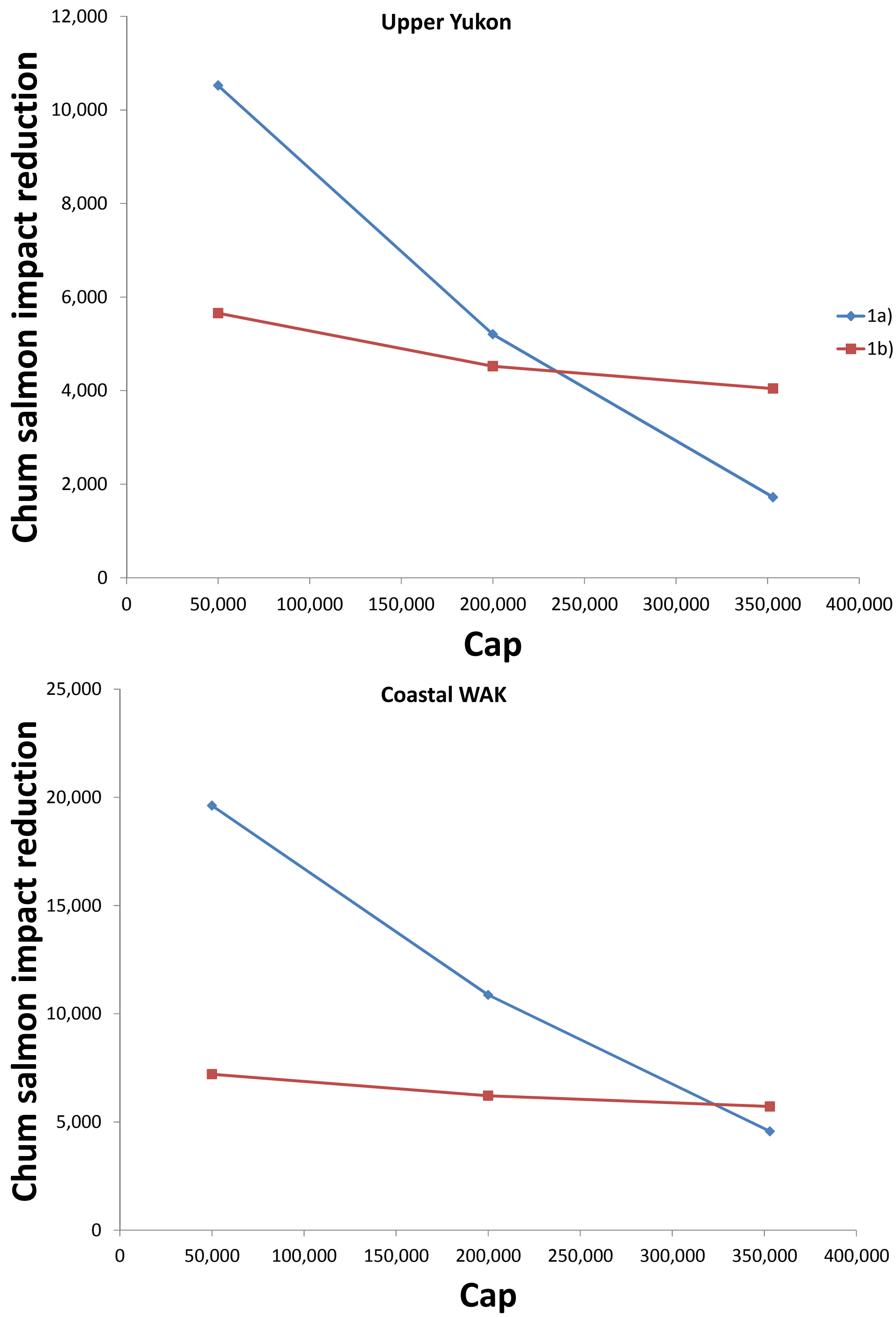



Figure ES-13. Average chum salmon impact reduction (AEQ) by suboption for Alternative 2, sector allocation 2ii, for years 2004-2011 for Upper Yukon (top) and Coastal WAK (bottom). Note that for 1b options the cap considered is that proportion of the B season cap shown in the horizontal axis.

## Alternative 3, Triggered area closures

The following describes the options and the closure area and period used for analysis:

| Option | Closure area | Period/closure size basis |
|---|---|---|
| 1a) | 80% | B season |
| 1b) | 80% | June-July |
| 2a) | 60% | B season |
| 2b) | 60% | June-July |

Due to the difficulty in summarizing the effects of the various caps options and allocations, tables below are intended to highlight the different dimensions of the problem rather than show all results. As noted above, extra accounting is required to evaluate the within-B season impacts of the different components and alternative specifications. For this reason values are presented expanded to the genetics information on chum salmon (available for 2005-2009 and using seasonal average proportions in other years).

Component 1 of Alternative 3 imposes a large-scale triggered closure to which particfiopants in the RHS program are exempt. Given that the current program has 100% participation, it is likely that if this component alone were selected, participation would remain at 100%. Thus the impacts of this component (alone with no other components selected) is best characterized by status quo.

As discussed under Alternative 2, the RHS system has advantages and limitations. Some of the key advantages include the flexibility to adapt to new information rapidly, the ability to explicitly make trade-offs between chum and Chinook as necessary and reporting requirements that allow for transparency in the adherence of vessels to designated closures. In June 2011, the Council requested that additional consideration be given to analyzing the parameters of the current RHS that could be modified to potentially improve performance. Some specific items that were requested for consideration include the following:

- Modification of RHS to operate at a vessel level, instead of at the cooperative level;
- Faster reaction/closure time (shorter delay between announcement and closure);
- Amount of closure area;
- Adjustments that would address timing and location of bycatch of Western Alaska chum stocks;
- Base rates;
- Possibilities by which the tier system may be amended to provide further incentives to reduce chum bycatch.

Discussion in the analysis in Chapter 5 focusses on qualitative discussion of these additional modifications that could be made within the RHS system itself in conjunction with Component 1 (alone with no other components selected) which would potentially improve the savings estimated to be realized under this program. A summary of the issues discussed in conjunction with each parameter is summarized below:

- **Modification to vessel-level**-Modifications of the RHS program to the vessel-level would follow the current shoreside and catcher-processor Chinook RHS programs. An individual-level system would increase the likelihood that vessels face consequences for high PSC. Because there may also be some advantages to having cooperative-level incentives, a RHS system could also include *both* individual and cooperative-level incentives.
- **Faster closure time**-Sea State strives to have recent information available for deciding which areas to close. There is no easy technical fix to reduce the utilization of information. Shortening the approximately 24-hour delay between when closures are announced and implemented would improve the quality of data and could provide some additional incentive to avoid high-PSC areas immediately

before closures are implemented. However, this would occur at additional cost to the fleet and historical simulation results suggest that the reduction in PSC would be relatively small.

- **Amount of closure area**-Historical simulation results indicate that larger closures are likely to further reduce PSC, but at a decreasing rate as they get larger. Larger areas at high-PSC periods would allow more high-PSC areas to be closed.
- **Timing/location of WAK chum**-The RHS could be adjusted to focus on benefits to Western Alaska stocks by being more active early in the B season. However, if extremely large closures are imposed in this period so that fishing is slowed down significantly, it could have the unintended consequence of pushing a larger amount of fishing effort into October, when Chinook PSC is usually highest.
- **Base rates**-When PSC rates change quickly, the current 3-week moving basis for determining the base rate means that all cooperatives or few cooperatives are subject to closures. The base rate could be based on the most recent behavior to ensure that vessels or cooperatives with relatively high PSC rates in the most recent period would be subject to closures.
- **Modifying Tier system incentives**-Modifying the incentives associated with the tier system has the potential to significantly strengthen the effectiveness of the RHS system. Larger and longer closures or any other reward and penalty could be incorporated into the tier system. If a more stringent chum RHS is developed, vessels could be made exempt from some of the closures if they have relatively low *Chinook* PSC, further increasing the incentive to avoid Chinook PSC as well.

Further information on the methodology and detailed impacts under the RHS system are contained in Chapter 5.

All other discussion of Alternative 3 assumes that Components 2 through 6 are considered and thus triggered closure areas are imposed on RHS participants. As expected, higher cap levels result in reduced overall chum salmon savings and imposing closures in June-July has definite consequences for Asian AEQ chum bycatch (much lower savings) compared 1a) or 2a) and varied by sector split (Table ES-9). The dates of closures across options and sector allocations and caps indicate that higher cap levels result in closures that occur later in the season (for options 1a) and 2a) and for the June-July period, generally occur near the end of July.

Over all options and sector splits for Alternative 3, component 2, the sector split configurations had the least contrast (except for the 200,000 cap and option 2a). These results also indicate that the most effective option for saving chum is indicated by option 1b) and the lowest cap level (25,000). Options 1b) and 2b) of Alternative 3 close an area only in the June July period. This presents a challenge for analysis because the potential reaction by the fleet to such closures could vary. For example, vessels restricted by the closure in the June-July period may choose to fish outside the closure during that period or choose divert their pollock to fish after the end of July or some combination of these strategies. Consequently, we analyzed this type of closure three ways, 1) standing down till the end of July, 2) continue fishing and catch the same amount of pollock in the June-July period but outside of closure area, or 3) some combination of 1) and 2). Additional information on the relative salmon savings, AEQ and region of origin impacts under all of the alternatives is contained in Chapter 5.

Based on the analysis of Alternative 3 and the assumptions inherent in evaluating the relative participation in the RHS program and constraints imposed by area closures (and thus the amount of chum salmon ‘saved’ under various closures and PSC cap levels), there are nonetheless incidental takes of chum salmon PSC and therefore there is an adverse impact under this alternative. For some suboptions and combinations, this management alternative will likely decrease the chum salmon PSC for Alaska stocks. These suboptions and combinations would thus minimize the adverse impacts of the status quo management. However, bycatch in some options (e.g., option 1b) results in slightly higher or neglible reductions for Asian chum salmon. The impacts under any of the options and suboptions of Alternative 3 impacts are unlikely to be significantly adverse because they would not diminish protections afforded to chum salmon in the current management of the groundfish fisheries.

Component 1 would impose a revised CSSA on non-participants of the RHS system. Taken on it's own with no other components selected, the impacts of component 1 are best characterized by status quo given the current level (100%) of participation in the RHS program. Some considerations by the Council in conjunction with Component 1 may modify parameters of the current RHS program. While it is difficult to examine the potential impacts of these modifications quantitatively, qualitative discussion of the merits of modifying individual parameters was summarized to provide an overview of the likely impacts. It is likely that modification of some of the RHS parameters has the potential to improve the performance of this system in minimizing the adverse impacts of status quo on chum salmon and possibly Chinook salmon as well.

Components 2-6 would impose additional constraints on the RHS participants in addition to the area closures imposed under the RHS system itself. Based on the analysis of the triggered closures, caps and allocations, some options in some years may be very constraining on the pollock fleet. While this analysis focusses on the amount of chum salmon potentially saved by virtue of the constraints applied by additional area closures, it is important to note that if participation in the RHS program itself becomes increasingly constraining and complicated by layered triggered closures on top of the RHS program, the incentive to participate in the program itself may be undermined. The intent of Component 1 is to provide a strong enough incentive to encourage participation in the RHS program. Under this alternative this is done by imposing a large-scale triggered area closure at a range of cap levels. The magnitude of the incentive to participate in the RHS program will depend upon the level of constraint of the cap level selected in conjunction with this provision, particularly if additional components are selected to layer constraints on the participants. If participation in the program becomes equally or nearly as constraining as the risk of non-participation, then the assumptions inherent in this evaluation (of 100% participation) will be invalid.

Table ES-9. Combined chum salmon saved (AEQ) over years 2004-2011 for **Alternative 3**, by region for different cap levels (apportioned by sector and where appropriate in option 1b) and 2b) by June-July) and allocations. The second column lists the summed run-size estimates whereas the 3rd column are the summed AEQ mortality as estimated from 2004-2011.

| Region | Run Estimate | Estimated AEQ | Cap | Option | Allocation configuration 2ii | 4ii | 6 |
|---|---|---|---|---|---|---|---|
| Coastal WAK | 39,233,000 | 193,649 | 25000 | 1a) | 52% | 51% | 50% |
| | | | | 1b) | 28% | 27% | 26% |
| | | | | 2a) | 39% | 40% | 38% |
| | | | | 2b) | 26% | 25% | 23% |
| | | | 75000 | 1a) | 41% | 44% | 43% |
| | | | | 1b) | 29% | 29% | 28% |
| | | | | 2a) | 28% | 30% | 32% |
| | | | | 2b) | 26% | 26% | 26% |
| | | | 200000 | 1a) | 22% | 26% | 37% |
| | | | | 1b) | 24% | 26% | 28% |
| | | | | 2a) | 10% | 11% | 25% |
| | | | | 2b) | 22% | 24% | 25% |
| Upper Yukon | 8,454,000 | 106,722 | 25000 | 1a) | 51% | 51% | 50% |
| | | | | 1b) | 39% | 38% | 37% |
| | | | | 2a) | 39% | 40% | 38% |
| | | | | 2b) | 33% | 33% | 32% |
| | | | 75000 | 1a) | 40% | 43% | 43% |
| | | | | 1b) | 37% | 37% | 37% |
| | | | | 2a) | 27% | 30% | 32% |
| | | | | 2b) | 32% | 33% | 33% |
| | | | 200000 | 1a) | 19% | 23% | 36% |
| | | | | 1b) | 30% | 32% | 35% |
| | | | | 2a) | 8% | 9% | 25% |
| | | | | 2b) | 26% | 28% | 31% |
| Asia | NA | 968,497 | 25000 | 1a) | 50% | 50% | 50% |
| | | | | 1b) | 0% | -2% | -5% |
| | | | | 2a) | 40% | 40% | 40% |
| | | | | 2b) | 2% | 0% | -2% |
| | | | 75000 | 1a) | 43% | 45% | 45% |
| | | | | 1b) | 4% | 4% | 2% |
| | | | | 2a) | 34% | 35% | 36% |
| | | | | 2b) | 5% | 5% | 4% |
| | | | 200000 | 1a) | 31% | 33% | 38% |
| | | | | 1b) | 4% | 4% | 5% |
| | | | | 2a) | 25% | 26% | 31% |
| | | | | 2b) | 5% | 5% | 7% |

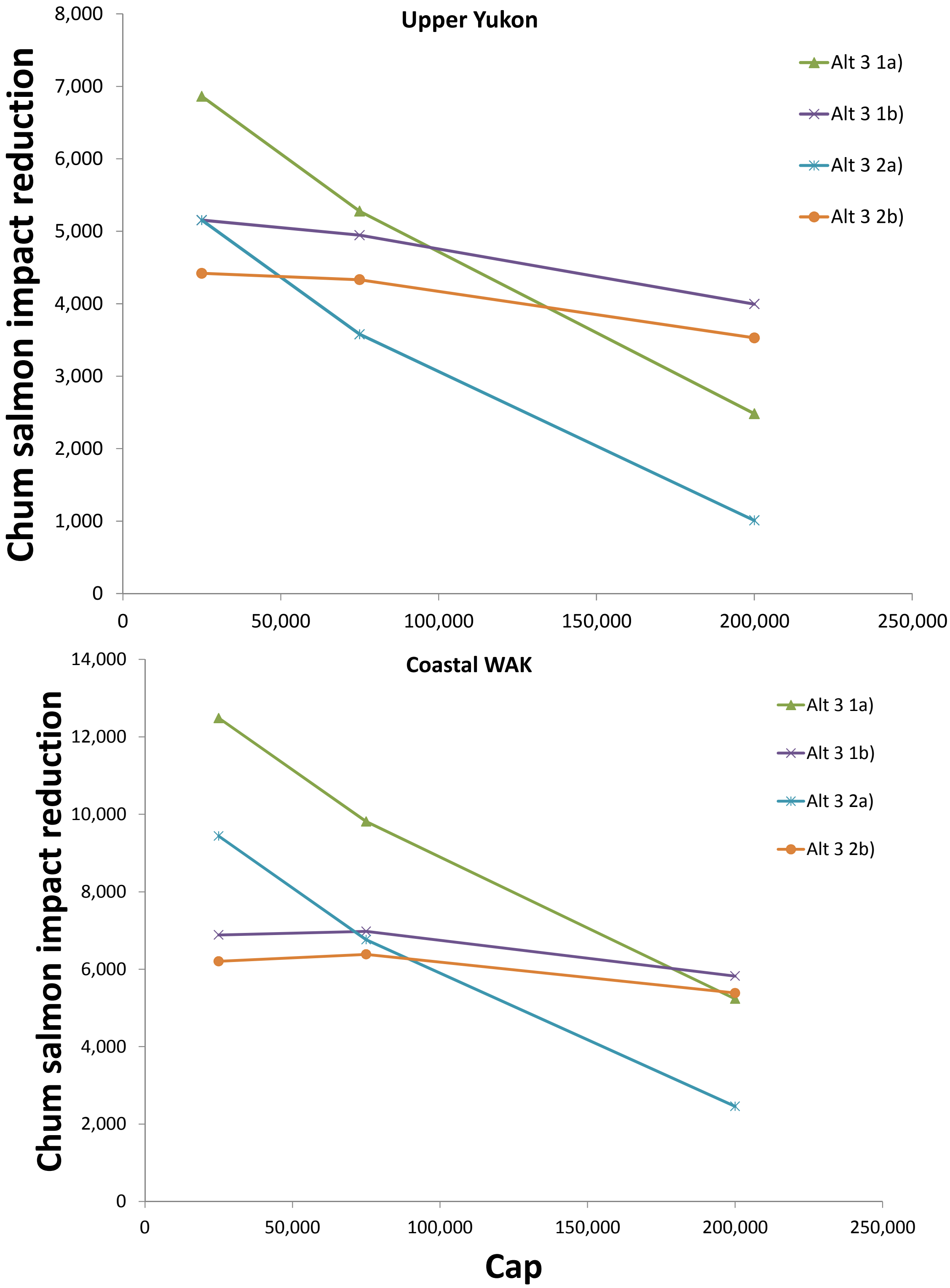



Figure ES-14. Average chum salmon impact reduction (AEQ) by suboption for Alternative 3, sector allocation 2ii, for years 2004-2011 for Upper Yukon (top) and Coastal WAK (bottom). Note that for 1b options the cap considered is that proportion of the B season cap shown in the horizontal axis.

### Chinook salmon impacts

The pollock fishery catches both chum and Chinook salmon PSC in the B-season. The timing of this catch is dissimilar amongst the two species, with Chinook salmon caught in the latter part of the B season and chum salmon caught throughout the B season (Figure ES-15). This pattern is reflected through the chum alternatives 2 and 3 and sub-options showing that chum measures which result in more fishing later in the year will result in more Chinook bycatch (i.e., negative savings; Figure ES-16)

Policy decisions for alternative management measures for chum must also consider the potential impact on the catch of Chinook salmon as a result of imposing additional management measures on the same pollock fishery. 2011 was the first season of management under the new PSC management program implemented by Amendment 91. Incidental catch of Chinook salmon by the pollock fishery participants in the 2011 indicated that pollock fishery participants remained well below their limits and with catch much lower than in the recent five years. Total 2011 A-season PSC was 7,136 fish. This compares to Chinook salmon PSC ranging from 7,624 fish in the A season of 2010 to 69,139 fish in the A season of 2007. In the B-season incidental catch of Chinook salmon by the pollock fishery was also well below the seasonal PSC limits with a total B-season bycatch of 18,363. This is higher than B-season PSC in the previous 3 years but is substantially less than the B-season of 2007 where 25,499 fish were taken. The overall 2011 total Chinook PSC was 25,499. While this amount is higher than the recent years (driven by the increase in the B-season) this was nonetheless well below both the overall PSC limit under Amendment 91 as well as the (lower) performance standard established under that management program.

For Alternative 2, the annual impact of chum salmon options indicate that Chinook salmon bycatch will be decreased in many years under option 1a, especially for the lower cap levels. However, option 1b (which would close the fishery only within the June-July period) resulted in increased bycatch of Chinook salmon because of pollock that would be diverted later in the year. All sectors are estimated to have a similar pattern between options. These alternatives and options would increase the adverse impact on Chinook. These impacts are not believed to be significantly adverse in either case because they would not diminish protections afforded to Chinook salmon under the provisions of Amendment 91 in the current management of the groundfish fisheries.

Similar to the hard cap option, Alternative 3 with options that divert pollock into later in the season result in worse bycatch of Chinook salmon. The variability is somewhat greater which likely reflects changes in the spatio-temporal patterns of Chinook salmon bycatch between years. For Option 1b and suboptions, this management alternative will likely increase the bycatch of Chinook salmon due to increased fishing pressure diverted to later in the B season when Chinook rates tend to be higher. These alternatives and options would increase the adverse impact on Chinook. For options 1a and suboptions, as indicated previously, fishing would be less likely to be diverted early in the B season but any increased effort later in the B season would nonetheless be likely to increase Chinook PSC and thus increase the adverse impact of this alternative on Chinook PSC. As with Alternative 2, these impacts are not believed to be significantly adverse in either case because they would not diminish protections afforded to Chinook salmon under the provisions of Amendment 91 in the current management of the groundfish fisheries.

Additional information on the estimated impacts of proposed chum management measures on Chinook salmon is contained in Chapter 6.

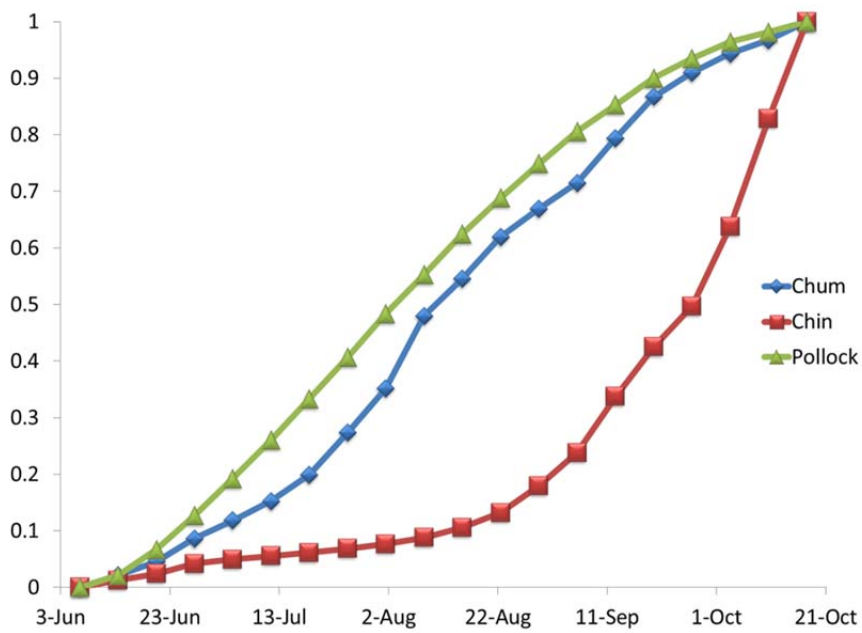



Figure ES-15. Mean relative values of pollock catch (triangles) compared with catch of chum (diamonds) and Chinook (squares) salmon species in the pollock fishery during the B-season.

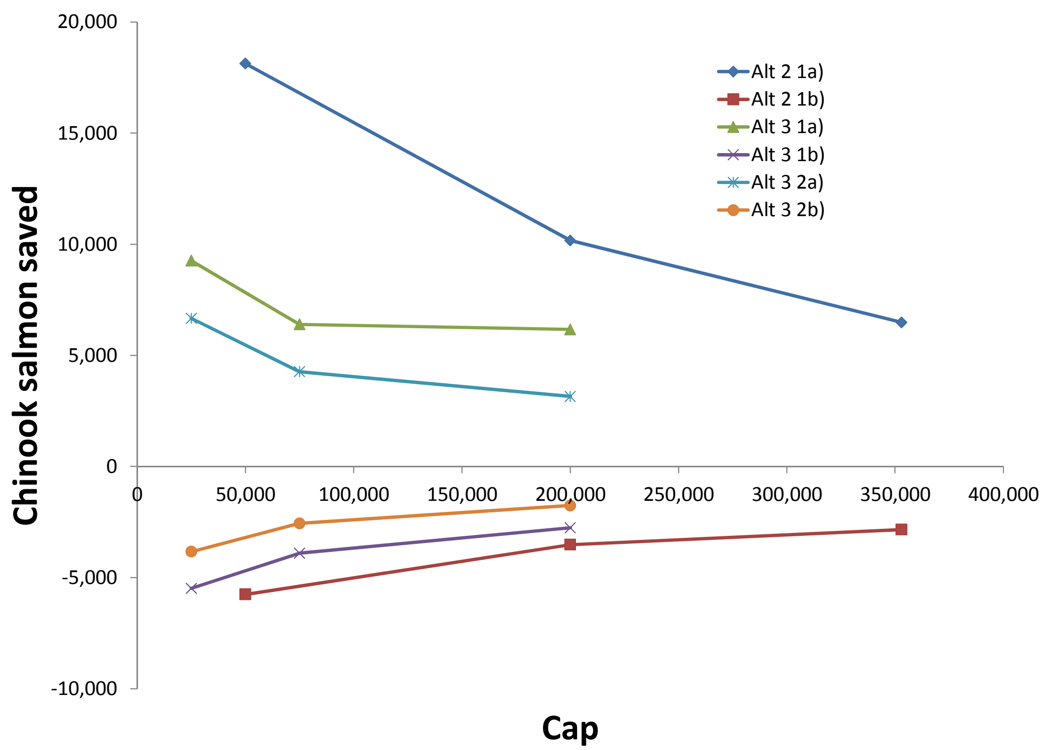



Figure ES-16. Average Chinook salmon saved by suboption for Alternatives 2 and 3 (and their sub-options) given sector allocation 2ii, for years 2004-2011. Note that for 1b options the cap considered is that proportion of the B season cap shown in the horizontal axis.

## Pollock stocks

Chapter 4 analyzes the impacts of the alternatives on pollock stocks. Analysis of Alternatives 2 and 3 indicate that these alternatives would make it more difficult to catch the full TAC for Bering Sea pollock compared to Alternative 1. Catching less pollock than authorized under the TAC would reduce the total catch of pollock and reduce the impact of fishing on the pollock stock. However, these alternatives are likely to result in fishermen shifting where they fish for pollock to avoid chum salmon PSC. Changes in where pollock fishing occurs were shown to likely change the size—and by extension—age to younger smaller pollock which would potentially impact future ABC limits established for the pollock stocks.

Options for maintaining efficiency in the amount that normal pollock grounds must be diverted (while still reducing bycatch) is a challenging problem and can vary considerably from year to year. For example there is a fair amount of variability between sectors for a given allocation scheme, cap, and trigger option

For Alternatives 2 and 3, integrated results over years and sectors to compare the relative impact of the options on the pollock fishery show that the lower cap levels and sector allocation scheme 3 have the largest impact on the pollock fishery. Nonetheless, all hard caps under Alternative 2 show that all sectors would have forgone high levels of pollock catch at most cap levels.  In terms of potential tons of pollock that would be diverted under Alternative 3, Options 1b) and 2b) appear to have the lowest impact on pollock fishing among the other trigger closure options given cap and sector allocation scheme (Figure ES-17).

The impact of Alternative 3 (triggered closures to RHS participants, either June-July or B-season) on pollock fishing was evaluated in a similar way to Alternative 2. The assumption that the pollock TAC may be fully harvested depends on the availability of pollock outside of triggered closures. The data show that in some years, the catch rate is consistently higher outside of the trigger area whereas in other years it is consistently lower for at-sea processors and inshore CVs and for the fleet as whole. The impact of a triggered area closure depends on when the closure occurs and the spatial characteristics of the pollock stock, which, based on this examination, appears to be highly variable between years. As with the evaluation of hard caps, under Alternatives 2 the same impacts under triggered closures (Alternative 3) would apply; it seems likely that the fleet would fish earlier in the summer season and would tend to fish in places farther away from the core fishing grounds north of Unimak Island (estimated average increased distance from port due to closures was about 8%). Both of these effects would result in catches of pollock that were considerably smaller and younger, less valuable age groups. This impact would, based on future assessments, likely result in smaller TACs since individual pollock sizes would smaller since they would miss the benefits from the summer-season growth.

Because this fishery is extensively monitored, the consequences of possibly catching smaller fish due to this alternative would be accounted for in the procedures for setting ABC and OFL. Namely, that as the “selectivity” of the fishery shifts, then the impact on allowable catch levels would be adjusted appropriately so as to avoid overfishing.

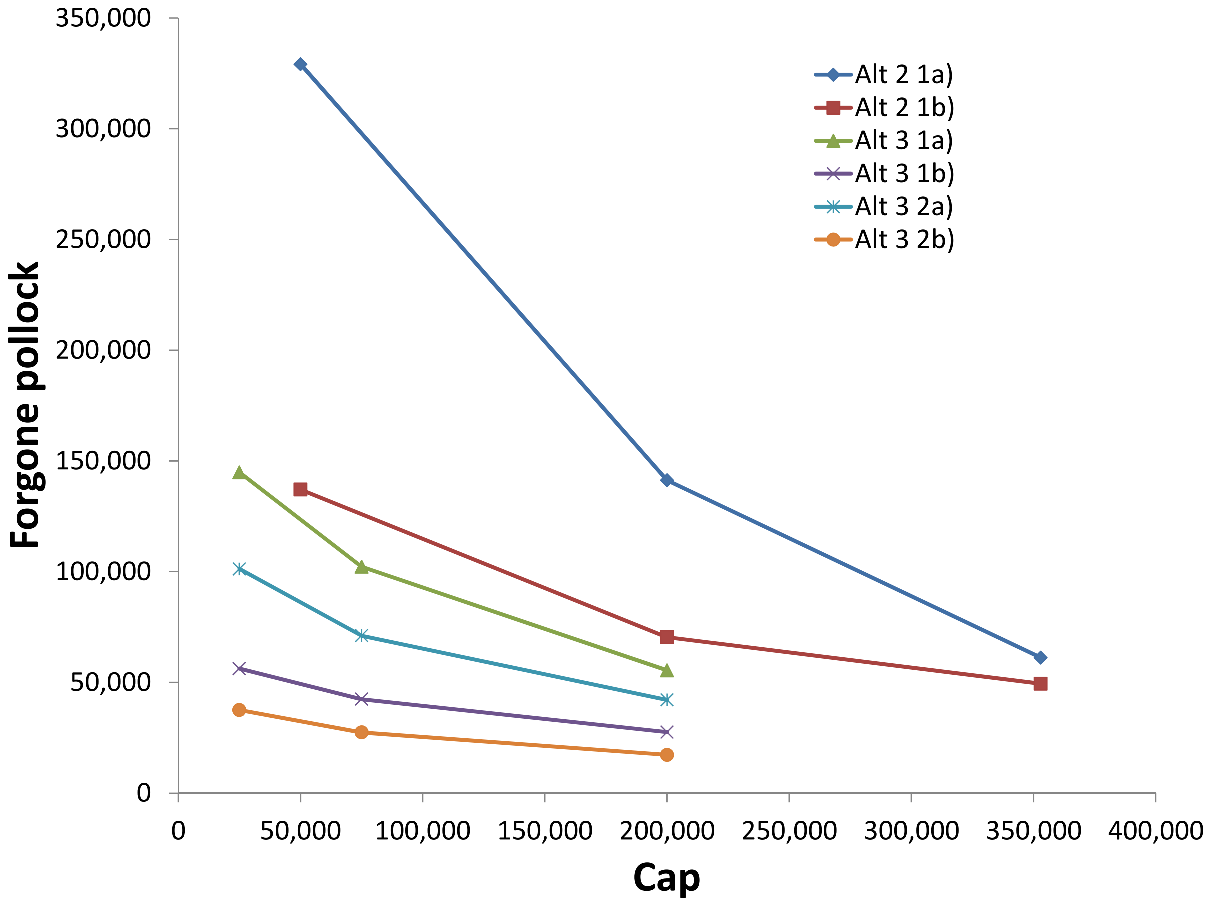



Figure ES-17. Average pollock forgone (t) by suboption for Alternatives 2 and 3 (and their sub-options) given sector allocation 2ii, for years 2004-2011. Note that for 1b and 2b options the cap considered is that proportion of the B season cap shown in the horizontal axis.

### Economic Impacts of the Alternatives

The RIR presents considerable background information which establishes conditions under status quo chum salmon management. A description of the pollock fishery, upon which a regulatory action would apply, is provided along with descriptions of current chum salmon management action being undertaken by participants in the pollock fishery. The RIR also recognizes the critical importance of, and cultural reliance on, chum salmon resources in both subsistence and commercial harvest activities throughout Western Alaska and provides a detailed (approximately 150 page) discussion of the utilization of chum salmon resources. This detailed information was provided by the Subsistence Division of the Alaska Department of Fish and game (ADF&G), with commercial data provided by the Commercial Fisheries division of ADF&G, and a substantial effort was made by staff of the ADF&G Inter-jurisdictional Fisheries Division to compile the subsistence portion of this discussion as well as in assisting the analysts with preparation of the commercial fisheries discussion. In addition, a discussion of regions and communities that are principally dependent on salmon fisheries is provided using analysis conducted by, and reprinted with the permission of, the Alaska Department of Labor Workforce Development Division. These discussions inform the analysis of the status quo conditions for comparison with potential impacts of the proposed action alternatives.

The RIR provides an overview of the alternative set and then proceeds with analysis of the economic impacts of the alternatives in terms of the potential benefits of **salmon saved.** It is a fundamental assumption of this analysis that salmon savings will result in benefits to salmon dependent subsistence, recreational, and commercial fisheries as well as the communities and people who utilize the chum salmon resource!

The RIR utilizes the analysis of changes in chum salmon savings under the alternatives that is contained in Chapter 5 of this Environmental Assessment. The Adult Equivalency (AEQ) estimates represent the potential benefit in numbers of adult chum salmon that would have returned to aggregate regions as applicable in the years 2004 to 2011. These benefits would accrue within natal river systems of stock origin as returning adult fish that may return to spawn or be caught in subsistence, commercial, or sport fisheries. However, given that the average estimated run size for Coastal Western Alaska for this period is 4.9 million chum salmon, the ratio of mortality impact, calculated in the analysis of Chapter 5, is about 0.5%. Thus, it seems unlikely that in-river management would have been modified for this amount of returning fish aggregated over all rivers systems in coastal west Alaska given the intricacies of in-season, in-river management as described in Section 5.2.1 of the EA. Thus, it is simply not possible to quantify exactly how those fish would be used. Consequently, it is simply not possible to quantify comparative levels of benefit that would accrue to users of the chum salmon resource under the action alternatives.

The analytical difficulty regarding potential benefits accruing from salmon savings should not; however, be construed as the "final word" on the potential effects of the alternatives on benefits to chum salmon users. The importance of this resource to those who are greatly dependent on it is fully documented, as discussed above, in the RIR. In addition, the impacts analysis in the RIR contains a qualitative discussion of the potential benefits that salmon savings may provide. This is simply a case where the available quantitative methods and the underlying data, such as genetic data, do not allow as fine a resolution and quantification of effects as one would like. In such instances, it is the agency guidance that a well-informed qualitative analysis is often superior to a data poor quantitative analysis and it is with that concept in mind that the RIR largely relies upon quantitative discussion of the relative merits of reductions in chum salmon bycatch in the pollock fishery, by alternative.

The RIR also provides analysis of the estimated impacts, in terms of potentially forgone gross revenue and gross revenue put at risk, of the alternatives on the directed pollock fishery. It is important to note; however, that proposed action is not designed to close the pollock fishery; it is intended to create incentives for pollock fishermen to avoid non-Chinook salmon. Thus, the impacts on the pollock industry are reported as potentially forgone gross revenue or revenue at risk, depending on alternative, and are not reported as industry losses of revenue. The RIR does not identify these estimates as lost revenue specifically because mitigation of the impacts via harvesting behavior changes are expected, as that is the point of incentivizing avoidance of PSC. The Council's intent is to incentivize non-Chinook salmon PSC avoidance in order to reduce it in all years of abundance, and the caps used in the potentially forgone gross revenue analysis is one part of the incentive. The implication is that the pollock industry will change behavior so that they do not face all of the potential forgone gross revenue, and/or revenue at risk estimated in the analysis, as direct losses in revenue due to direct reduction in pollock harvest.

Some hard caps (Alternative 2) have the potential effect of fishery closure for the remainder of the season resulting in potentially forgone pollock fishery gross revenues. In contrast, the triggered closure (Alternative 3, Alternative 2, June-July closure option) do not directly create forgone earnings, but rather, they place revenue at risk of being forgone. When the closure is triggered, vessels must be relocated outside the closure areas and operators must attempt to catch their remaining allocation of pollock TAC outside the closure area or stand down during the closure. Thus, the revenue associated with any remaining allocation is placed at risk of not being earned, if the fishing outside the closure area is not sufficiently productive to offset any operational costs associated with relative harvesting inefficiencies outside the closure area.

The greatest adverse economic impact on the pollock fishery would have occurred in the highest PSC years (2005 and 2011) and under the most restrictive PSC cap of 50,000 non-Chinook salmon where Alternative 2 Option 1a is estimated to result in approximately $482 million and $519 million in potentially forgone gross revenue in 2005 and 2011, respectively. The 2005 potentially forgone gross value is composed of $209 million from the CV sector, $202 million from the CP sector, $53 million from the Mothership sector, and $18 million from CDQ pollock fisheries. The 2011 potentially forgone gross value is composed of $222 million from the CV sector, $253 million from the CP sector, $78 million from the Mothership sector, and $25 million from CDQ pollock fisheries.

As is expected, as the hard cap amount increases, the adverse economic impacts on the pollock fisheries decrease, all else being equal. As the hard cap level is increased to 200,000 fish the potentially forgone revenue estimates are, as expected, lower and the hard cap is a binding constraint in fewer years. What is also apparent is that as the cap in increased the potentially forgone revenue accrues mostly, and in some cases only, in the CV sector. As the hard cap level is increased to 353,000 fish, and the allocation scenarios go from 2ii to 4ii and to 6, the potentially forgone revenue estimates continue to decline relative to the two lower caps and the impacts accrue exclusively in the CV sector (353,000 cap, allocation 3), and As is the case of the 200,000 fish cap, this is simply a function of the CV sector having the highest proportion of non-Chinook PSC of all sectors.

The effect of Alternative 2, option 1b (June and July closure option), in the highest bycatch years (2005 and 2011) and under the most restrictive PSC cap of 50,000 non-Chinook salmon is estimated to be approximately $191 million and $330 milion in gross revenue at risk in 2005 and 2011, respectively. That gross value is composed of $83 million from the CV sector, $81 million from the CP sector, and $27 million from the Mothership sector. The 2011 revenue at risk is composed of $163 million from the CV sector, $106 million from the CP sector, $37 million from the Mothership sector, and $24 million from the CDQ pollock fisheries. The changes in impacts as the cap increases and the allocation is changed are similar to those identified for option 1a; however, option 1b results in considerably reduced potential impacts on the pollock fishery when compared to option 1a.

The potential effects of Alternative 3 triggered closures, when compared option to option (i.e. A2 1a to A3 1a etc.), on pollock fishery gross revenue are considerably smaller than those identified under Alternative 2. The potential impact of Alternative 3, option 1a in the years with greatest revenue impacts under this alternative (2004, 2011) and under the most restrictive PSC cap of 50,000 non-Chinook salmon area estimated to be approximately $191 million and $275 million in 2004 and 2011, respectively. The 2004 gross value is composed of $122 million from the CV sector, $47 million from the CP sector, $10 million from the Mothership sector, and $13 million from CDQ pollock fisheries. The 2011 gross value is composed of $196 million from the CV sector, $31 million from the CP sector, $37 million from the Mothership sector, and $11 million from CDQ pollock fisheries.

The potential impact of Alternative 3, option 1b in the years with greatest revenue impacts under this alternative (2004, 2011) and under the most restrictive PSC cap of 50,000 non-Chinook salmon area estimated to be approximately $97 million and $136 million in 2004 and 2011, respectively. The 2004 gross value is composed of $86 million from the CV sector, $4 million from the CP sector, and $8 million from the Mothership sector. The 2011 gross value is composed of $101 million from the CV sector, $10 million from the CP sector, $20 million from the Mothership sector, and $4 million from CDQ pollock fisheries.

The potential impact of Alternative 3, option 2a in the years with greatest revenue impacts under this alternative (2005, 2011) and under the most restrictive PSC cap of 50,000 non-Chinook salmon area estimated to be approximately $131 million and $184 million in 2005 and 2011, respectively. The 2005 gross value is composed of $122 million from the CV sector, $4 million from the CP sector, and $5 million from the Mothership sector. The 2011 gross value is composed of $122 million from the CV sector, $26 million from the CP sector, $26 million from the Mothership sector, and $10 million from CDQ pollock fisheries.

The potential impact of Alternative 3, option 2b in the years with greatest revenue impacts under this alternative (2005, 2011) and under the most restrictive PSC cap of 50,000 non-Chinook salmon area estimated to be approximately $72 million and $65 million in 2005 and 2011, respectively. The 2005 gross value is composed of $63 million from the CV sector, $2 million from the CP sector, and $7 million from the Mothership sector. The 2011 gross value is composed of $54 million from the CV sector, $1 million from the CP sector, $9 million from the Mothership sector, and less than $1 million from CDQ pollock fisheries.

As described under Alternative 2, impacts are reduced as the cap is increased Further, shifting from allocation option 2ii to 4ii and 6 while increasing the cap level concentrates most of the potential impacts on to the CV fleet, with relatively smaller amounts of CP and Mothership impacts also estimated to potentially occur. Complete tabular output of impacts and further discussion are presented in detail in the RIR.

Under the alternatives to the status quo, fishermen would be expected to attempt to minimize losses associated with potentially forgone gross revenue and/or revenue placed at risk by altering their current operations. These reactions could include the following: (1) mitigating a triggered area closure by re-deploying fishing effort, using the same fishing gear and methods, to known adjacent fishing grounds that may be equally or only somewhat less productive (similar CPUE) than the fishing grounds lost to the salmon PSC minimization measure; (2) avoiding non-Chinook salmon PSC by re-deploying fishing effort to an area of unknown productivity and operational potential, using the identical fishing gear, in an exploratory mode; (3) mitigating the risk of a hard cap induced closure by speeding up harvesting and processing activities (race for fish). Each of these strategies may have operational cost implications.

Any regulatory action that requires an operator to alter his or her fishing pattern, whether in time or space, is likely to impose additional costs on that operator. While this analysis assumes that the pollock industry will take step to avoid chum salmon bycatch and prevent attainment of a hard cap or attainment of a trigger, it is fully acknowledged that the alternative non-Chinook salmon PSC management actions may affect the operating costs of the pollock fleet, compared to the status quo condition, with the degree of those effects necessarily dictated by the extent to which hard cap and/or triggered closures constrain harvests. However, lacking actual cost of production data for the pollock fleet is it not possible to quantify potential impacts on pollock operational costs under the alternatives.

### Other marine resources

The impacts of the alternative management measures on marine mammals, seabirds, habitat and the ecosystem are evaluated qualitatively based upon results of the quantitative analysis for chum, Chinook, pollock and economic considerations. Alternative 2, hard caps in either June-July or B-season total, is not likely to increase fishery interactions with any of these resources categories, and may result in fewer interactions compared to status quo since the pollock fishery is likely to be closed earlier in the B-season. Under the triggered area closures proposed under Alternative 3, any closure of an area where marine mammals and seabirds are likely to interact with pollock fishing vessels would likely reduce the potential for incidental takes. The potential reduction would depend on the location and marine mammal species. Closures under Alternative 3 would also minimize fishery interactions with the seafloor and benthic habitat. Increased fishing pressure outside of triggered closure may increase the potential adverse impact on non-target fish species and interactions with seabirds and marine mamals in these areas but this interaction is unlikely to be significantly different from status quo. This could increase the adverse impact under this alternative but this is not likely to be significantly adverse given the low levels of incidental catch in this fishery and catch of non-targets is unlikely to substantially increase.

### Cumulative effects

The discussion of cumulative effects includes future actions that may affect the Bering Sea pollock fishery, the salmon caught as bycatch in that fishery, and the impacts of salmon bycatch on the resource components analyzed in this analysis. The future actions considered have been grouped in the following four categories: ecosystem-sensitive management, traditional management tools, actions by other Federal, State, and international agencies and private actions. Details on the actions contained in these categories and the activities considered are contained in Chapter 8. Per Council request, specific information on the South Alaska Peninsula (Area M) chum harvests including proportion of harvests from the June fishery compared to the annual total as well as the information on the known stock of origin of chum salmon harvested in this fishery is contained in Chapter 8.

This cumulative effects section considers the direct and indirect impacts of the proposed action when added to the impacts of past and present actions previously analyzed in other documents (incorporated by reference) and the impacts of the reasonably foreseeable future actions listed. Considering the direct and indirect impacts of the proposed action when added to the impacts of past and present actions previously analyzed in other documents that are incorporated by reference and the impacts of the reasonably foreseeable future actions indicated in Chapter 8, the cumulative impacts of the proposed action are determined to be not significant.

### Policy considerations

In considering a preferred management approach, the Council will evaluate the range of alternatives and the estimated impacts biologically and economically (including impacts to subsistence, commercial, and recreational salmon fishing and commercial pollock fishing) of each alternative. Some comparative information is provided below to compare alternatives in terms of relative chum salmon saved, forgone pollock harvest, pollock revenue at risk (i.e., potentially unrealized economic gain due to closure areas), trade-offs in bycatch reductions for chum salmon compared with Chinook salmon, and relative benefits accrued from reductions in both species. Some estimation of changes in fleet behavior under Amendment 91 is summarized in the analysis but this program has only just completed its first year of operation, thus how the Chinook salmon bycatch management measures will be affected by any new management measures imposed for chum salmon bycatch is difficult to predict and is instead listed below simply in terms of Chinook salmon PSC estimated historically under the management constraints analyzed.

### Comparison of chum salmon saved, forgone pollock harvest and Chinook salmon saved

Selection of a preferred alternative involves explicit consideration of trade-offs between the potential salmon saved (both chum and Chinook) and the forgone pollock catch, and of ways to maximize the amount of salmon saved and minimize the amount of forgone pollock. More details can be found on comparing these options in Chapter 9 titled “Policy considerations of alternatives relative to chum and Chinook salmon and pollock”.

As analyzed Chapters 4, 5 and 6, the impacts of the alternatives on total bycatch numbers of chum salmon and Chinook salmon and forgone pollock would vary by year. This is due to the annual variability in the rate of chum and Chinook salmon caught per ton of pollock and annual changes in chum salmon abundance and distribution in the Bering Sea. The RIR examines the relative cost of forgone pollock fishing under Alternative 2 and the revenue at risk under Alternative 3 as well as the potential benefits to subsistence, commercial, and recreational salmon fisheries.

In terms of cap and sector allocation options under Alternative 2, option 1a, the lowest forgone pollock catches result in expected reductions of chum salmon bycatch by about 8% to 48%, depending on the sector allocation options and stock considered (Figure ES-18). For hard cap scenarios that have the highest impact on forgone pollock catch levels, the sector allocation are estimated to have negligible additional improvements on chum salmon saved (Figure ES-18). For Alternative 2, option 1b, the Asian stocks have the least amount of chum salmon AEQ saved and generally the savings were relatively insensitive to cap levels and sector splits for the Alaskan stocks and savings were limited to about 40% in the best case whereas pollock diverted was below 20%.

Under Alternative 3, options that require a greater proportion of pollock to be diverted elsewhere have diminishing benefits in terms of increased salmon savings but in general require less pollock diversion than Alternative 2 (Figure ES-19). There are some cap options that provide savings of about 38% for chum salmon AEQ while only impacting the pollock fishery by diverting about 8% of the B-season pollock (e.g., option 1b for Upper Yukon).

The implications of imposing Alternatives 2 or 3 and the associated options indicate that reducing bycatch levels and impacts to Alaskan chum salmon runs can be achieved, but improvements would be relative to the current estimated impacts which are already low (typically less than 1%). It is clear that options which reduce chum salmon bycatch the most do so at the expense of forgone pollock and increased Chinook salmon bycatch (or reduced capabilities to avoid Chinook salmon PSC; Table ES-10). Options that perform better by lowering the forgone pollock while still reducing western Alaska chum salmon AEQ mortality, may do poorer at savings of chum salmon originating from Asian regions (Figure ES-20). The extent that these measures, if enacted without a system like the current RHS program (analyzed under Alternative 1), would reduce chum PSC are less well understood. It is clear that bycatch totals generally increase as run sizes increase. It is also clear that the effectiveness of triggered closure areas will vary from year to year due to the inherent variability and complexity of pollock and chum salmon seasonal and spatial distribution.

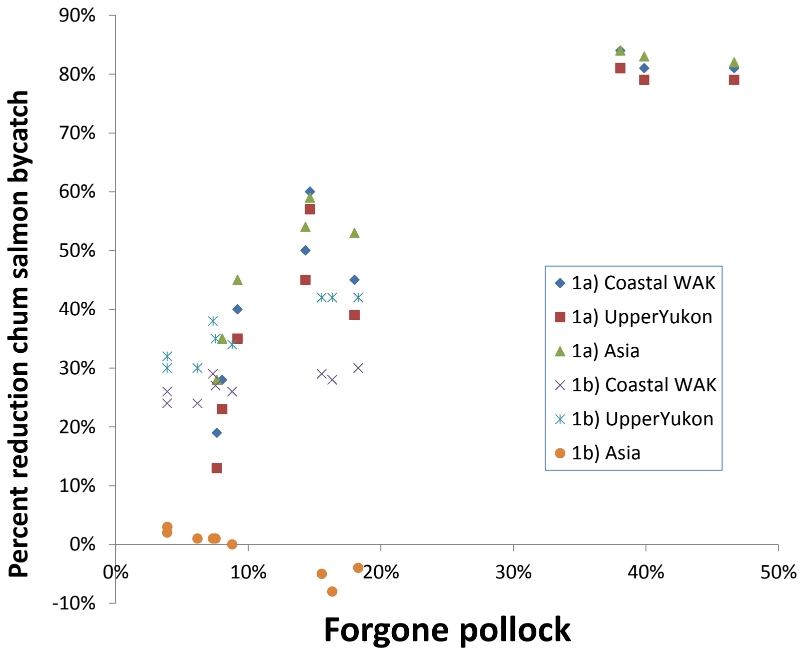



Figure ES-18. Relative reduction of chum salmon AEQ mortality (vertical axis) compared to relative amounts of pollock forgone (or diverted for 1b) by suboption for **Alternative 2**. Each point represents a different combination of sector allocation and cap level summed over 2003-2011. Note that for 1b options the cap considered is that proportion of the B season cap shown in the horizontal axis.

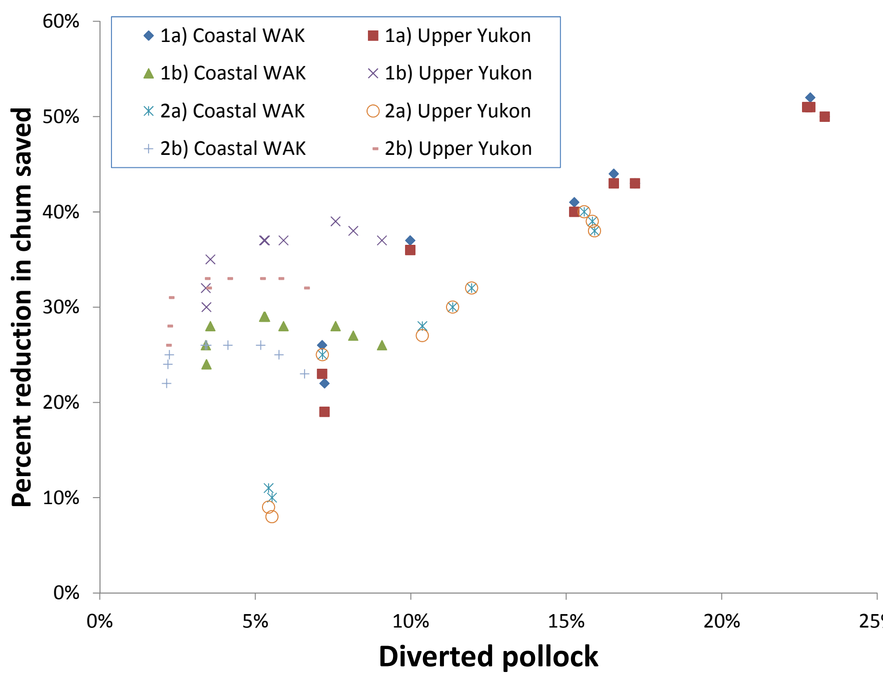



Figure ES-19. Relative reduction of chum salmon AEQ mortality (vertical axis) compared to relative amounts of pollock diverted by suboption for **Alternative 3**. Each point represents a different combination of sector allocation and cap level summed over 2003-2011. Note that for 1b and 2b options the cap considered is that proportion of the B season cap shown in the horizontal axis.

Table ES-10. Summary over alternatives using sector split of 2ii, $\lambda$=0 for different cap levels alternatives and their options. Chum AEQ are estimates of the adult equivalent annual **average** (2004-2011) improvements by alternative and option. Western Alaska is Upper Yukon combined with Coastal west Alaska, Asia include chum from Russia and Japan, the total adds these two groups and the remaining stocks. Chinook salmon are saved are absolute reductions (or increases if negative) in bycatch and pollock are in tons with italicized values signifying diverted catch due to closed areas and bold signifies foregone catch as **averaged** over 2003-2011. Note that for 1b and 2b options the cap considered is that proportion of the B season cap shown in the horizontal axis.

| | | | **Chum salmon** | | | | |
|---|---|---|---|---|---|---|---|
| | | | Western Alaska | Asian | Total chum | Pollock | Chinook |
| Alt 2 | 1a) | 50,000 | 30,142 | 99,352 | 167,897 | 332,264 | 17,430 |
| | | 200,000 | 16,072 | 64,724 | 103,328 | 128,305 | 9,212 |
| | | 353,000 | 6,288 | 34,109 | 50,304 | 54,350 | 5,762 |
| | 1b) | 50,000 | 12,862 | -4,966 | 16,523 | 130,318 | -5,323 |
| | | 200,000 | 10,735 | -336 | 17,500 | 62,579 | -3,127 |
| | | 353,000 | 9,761 | 653 | 16,821 | 43,883 | -2,522 |
| Alt 3 | 1a) | 25,000 | 19,347 | 60,518 | 104,096 | 162,719 | 6,701 |
| | | 75,000 | 15,091 | 52,048 | 86,885 | 108,705 | 5,091 |
| | | 200,000 | 7,717 | 37,696 | 57,769 | 51,486 | 5,517 |
| | 1b) | 25,000 | 12,038 | 530 | 21,529 | 53,998 | -3,714 |
| | | 75,000 | 11,922 | 4,838 | 25,866 | 37,860 | -2,636 |
| | | 200,000 | 9,817 | 4,643 | 21,646 | 24,449 | -1,807 |
| | 2a) | 25,000 | 14,592 | 48,198 | 81,832 | 112,802 | 6,064 |
| | | 75,000 | 10,338 | 41,723 | 67,051 | 73,881 | 4,142 |
| | | 200,000 | 3,466 | 30,095 | 42,141 | 39,453 | 2,848 |
| | 2b) | 25,000 | 10,623 | 2,567 | 21,177 | 36,856 | -2,576 |
| | | 75,000 | 10,713 | 6,620 | 25,739 | 24,516 | -1,718 |
| | | 200,000 | 8,913 | 6,085 | 21,711 | 15,322 | -1,131 |

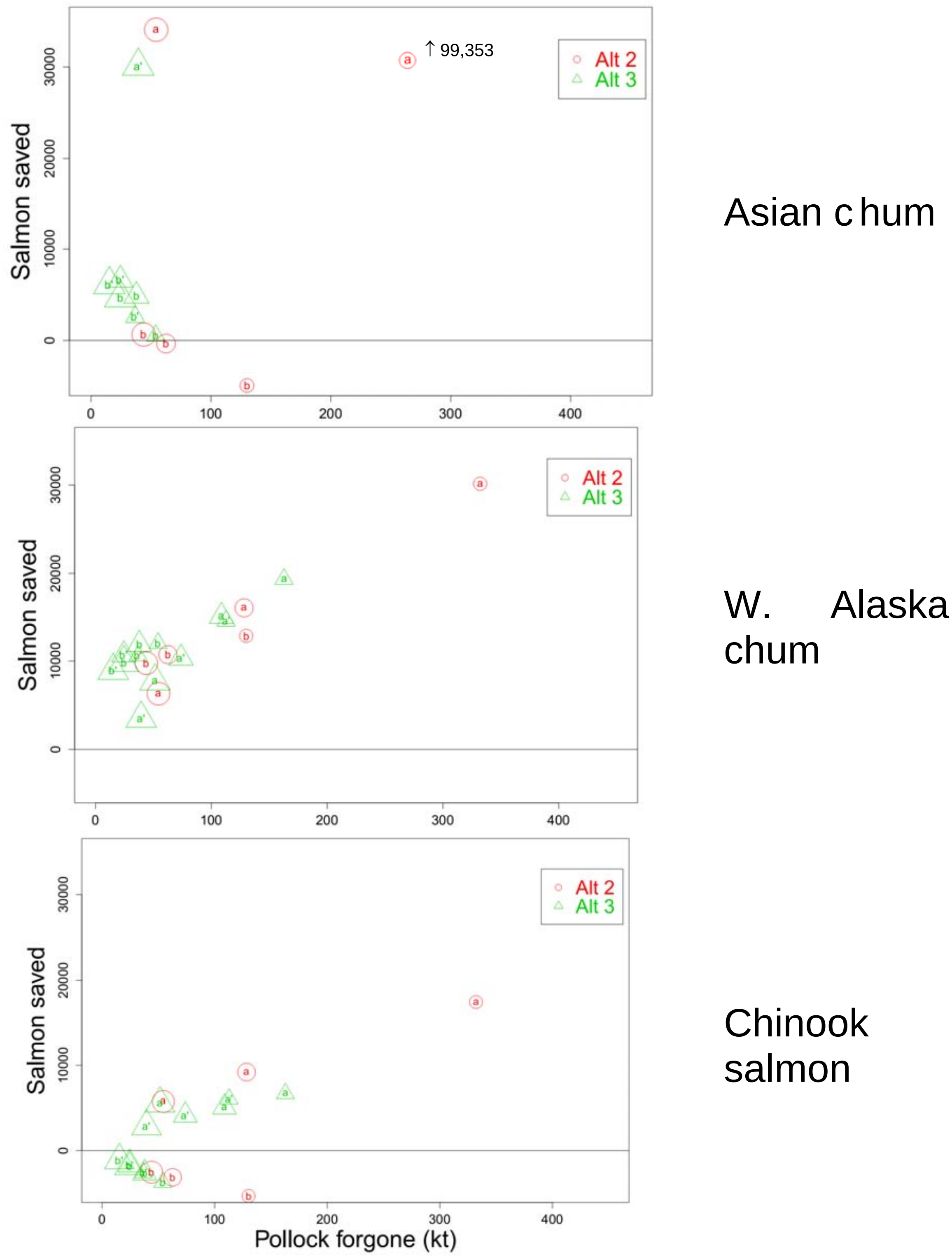



Figure ES-20. Mean expected reduction of salmon mortality (vertical axis) compared to relative amounts of pollock forgone or diverted (thousands of t) for different alternatives, caps and options. Western Alaska stocks include coastal W Alaska and Upper Yukon combined, size of symbols indicates the size of the cap, and letter designations indicate option (and a' and b' are for the 60% area closures for alternative 3 2a) and 2b) options).

## Rural community outreach

One of the Council's policy priorities is to improve outreach and communication with Alaska Native entities, communities, and rural stakeholders in the development of fishery management actions.[2] The Council's Rural Community Outreach Committee met in August 2009 and recommended that the non-Chinook salmon bycatch issue be a priority for rural outreach, as did the Council's Salmon Bycatch Workgroup, and the Council agreed to undertake an outreach effort with affected community and Native stakeholders prior to and during the development of the draft analysis, well prior to final Council action.

The outreach plan for non-Chinook salmon bycatch management measures was developed by Council staff with input from NMFS, the Council, the Rural Community Outreach Committee, and affected stakeholders. It is intended to improve the Council's decision-making processes on the proposed action, as well as enable ongoing, two-way communication with Alaska Native and rural communities. The outreach plan for the proposed action is maintained and updated on the Council website.[3] The general components of the outreach plan include: several direct mailings to stakeholders prior to important steps in the process and/or Council meetings; rural community outreach meetings; additional outreach (statewide teleconferences, radio/newspaper, press releases); and documentation of rural outreach meeting results. In addition, the draft analyses, associated documents, outreach materials, and powerpoint presentations, have been posted on the Council website as the process occurs.

While the outreach plan consists of several components, one of the most significant mechanisms for direct feedback from rural stakeholders has been outreach meetings or presentations to people that depend on salmon in rural communities in western and interior Alaska. The approach to the community outreach meetings was to work with established community representatives, Alaska Native entities, and Tribes within the affected regions, to attend annual or recurring regional meetings, in order to reach a broad group of stakeholders in the affected areas prior to the selection of a preferred alternative by the Council.

Council staff consulted with the coordinators of five of the Federal Subsistence Regional Advisory Councils (RACs), the Association of Village Council Presidents (AVCP), the Tanana Chiefs Conference (TCC), the Yukon River Drainage Fisheries Association (YRDFA), Kawerak, Inc., and the Yukon River Panel, in order to evaluate the potential for time on the agendas of their annual regional meetings.[4] In sum, two Council members and one to two staff analysts attended and presented the preliminary analysis of the alternatives for the proposed action at seven regional meetings, in addition to two meetings with the Yukon River Panel in Anchorage. The meetings were as follows:

| | |
|---|---|
| Yukon River Panel: | December 2010 and April 2011; Anchorage |
| Yukon River Drainage Fisheries Association annual meeting: | February 14 – 17, 2011; Mountain Village |
| Bering Strait Regional Conference: | Feb 22 – 24, 2011; Nome[5] |
| Yukon-Kuskokwim Delta Regional Advisory Council: | February 23 – 24, 2011; St. Mary's |
| Eastern Interior Regional Advisory Council: | March 1 – 2, 2011; Fairbanks |
| Western Interior Regional Advisory Council: | March 1 – 2, 2011; Galena |
| Bristol Bay Regional Advisory Council: | March 9 – 10, 2011; Naknek |
| Tanana Chiefs Conference annual meeting: | March 15 – 19, 2011; Fairbanks |

Council staff and members were available to answer questions, and staff documented the results of each meeting. In addition to input that could be incorporated into the impact analysis, the results of the

[2] This policy priority is identified in the Council's workplan resulting from the Programmatic SEIS.
[3] http://www.fakr.noaa.gov/npfmc/current_issues/bycatch/ChumOutreach1210.pdf.
[4] Schedule conflicts with Council meetings prevented Council members and staff from attending the October 2010 AVCP annual meeting and the February 2011 Seward Peninsula RAC meeting.
[5] NMFS staff presented the prepared information at this meeting, as Council staff could not get into Nome due to weather.

outreach meetings are provided in the form of an outreach report, included as an appendix to this EA/RIR/IRFA (Appendix 4) and posted separately on the Council's website at: http://www.fakr.noaa.gov/npfmc/PDFdocuments/bycatch/ChumOutreach511.pdf.

Please reference the outreach report for details of the meetings, a summary of the input provided, and any formal resolutions resulting from the meetings attended.

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# 1 Introduction

This Environmental Assessment (EA) provides decision-makers and the public with an evaluation of the predicted environmental effects of alternative measures to minimize chum salmon (also known as "non-Chinook salmon" prohibited species catch (PSC) in the Bering Sea pollock fishery. Although salmon PSC can occur in any of the groundfish fisheries, the majority of chum salmon PSC occurs in the Bering Sea pollock fishery. The Regulatory Impact Review (RIR) provides decision-makers and the public with an evaluation of the social and economic effects of these alternatives to addresses the requirements of Executive Order 12866, Executive Order 12898, and other applicable federal law. The EA/RIR serves as the central decision-making document for the North Pacific Fishery Management Council (Council) to recommend to the Secretary of Commerce changes in management of chum salmon PSC through an amendment to the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI FMP). If the Council submits a proposed FMP amendment, the National Marine Fisheries Service (NMFS) will review the Council's rationale and the EA/RIR on behalf of the Secretary of Commerce and will approve, disapprove, or partially approve the proposed amendment. If the FMP amendment is approved or partially approved, NMFS will implement the amendment through revisions to federal regulations at 50 CFR part 679. This EA complies with the National Environmental Policy Act (NEPA). The RIR addresses the requirements of Executive Order 12866 and Executive Order 12898.

The Council developed the following problem statement for this analysis:

> *Magnuson-Stevens Act National Standards direct management Councils to balance achieving optimum yield with bycatch reduction as well as to minimize adverse impacts on fishery dependent communities. Non-Chinook salmon (primarily made up of chum salmon) prohibited species bycatch (PSC) in the Bering Sea pollock trawl fishery is of concern because chum salmon are an important stock for subsistence and commercial fisheries in Alaska. There is currently no limitation on the amount of non-Chinook PSC that can be taken in directed pollock trawl fisheries in the Bering Sea. The potential for high levels of chum salmon bycatch as well as long-term impacts of more moderate bycatch levels on conservation and abundance, may have adverse impacts on fishery dependent communities.*
>
> *Non-Chinook salmon PSC is managed under chum salmon savings areas and the voluntary Rolling Hotspot System (RHS). Hard caps, area closures, and possibly an enhanced RHS may be needed to ensure that non-Chinook PSC is limited and remains at a level that will minimize adverse impacts on fishery dependent communities. The Council should structure non-Chinook PSC management measures to provide incentive for the pollock trawl fleet to improve performance in avoiding non-Chinook salmon while achieving optimum yield from the directed fishery and objectives of the Amendment 91 Chinook salmon PSC management program. Non-Chinook salmon PSC reduction measures should focus, to the extent possible, on reducing impacts to Alaska chum salmon as a top priority.*

## 1.1 What is this Action?

The proposed action is to implement new management measures to minimize chum salmon bycatch in the Bering Sea pollock fishery. This EA analyzes alternative ways to manage chum salmon bycatch, including replacing current management measures with revised or new measures. Current management measures include a PSC limit or "cap" that triggers closure of the Chum Salmon Savings Area (SSA) and exemption to this closure for participants in the rolling hotspot system intercooperative agreement (RHS ICA). The alternatives represent a range of PSC management measures that include new or revised caps, closure areas, and RHS ICA components for analysis that assist the decision-makers and the public in determining the best alternative to meet the purpose and need for the action. The alternatives meet the purpose and need by presenting different ways to minimize chum salmon bycatch in the Bering Sea pollock fishery to the extent practicable while achieving optimum yield.

## 1.2 Purpose and Need for this Action

The purpose of chum salmon PSC management in the Bering Sea pollock fishery is to reduce chum salmon bycatch to the extent practicable, while achieving optimum yield. Minimizing chum salmon bycatch while achieving optimum yield is necessary to maintain a healthy marine ecosystem, ensure long-term conservation and abundance of chum salmon, provide maximum benefit to fishermen and communities that depend on chum salmon and pollock resources, and comply with the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and other applicable federal law. National Standard 9 of the Magnuson-Stevens Act requires that conservation and management measures shall, to the extent practicable, minimize bycatch.

National Standard 1 of the Magnuson-Stevens Act requires that conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry. Section 3(33) of the Magnuson-Stevens Act defines optimum yield to mean "the amount of fish which …(A) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems; [and] (B) is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor…" NMFS has established in regulations at 50 CFR 679.20(a)(1)(i) that the optimum yield for the Bering Sea and Aleutian Island Management area is a range from 1.4 to 2.0 million metric tons (t).[6]

The BSAI FMP defines total allowable catch (TAC) as the annual harvest limit for a stock or stock complex, derived from the acceptable biological catch by considering social and economic factors. NMFS's regulations at 50 CFR 679.20(a)(2) provide that the sum of the TACs so specified must be within the optimum yield range. The BSAI FMP provides further elaboration of the differences among optimum yield (OY), acceptable biological catch (ABC) and TAC:

> In addition to definitional differences, OY differs from ABC and TAC in two practical respects. First, ABC and TAC are specified for each stock or stock complex within the "target species" and "other species" categories, whereas OY is specified for the groundfish fishery (comprising target species and other species categories) as a whole. Second, ABCs and TACs are specified annually whereas the OY range is constant. The sum of the stock-specific ABCs may fall within or outside of the OY range. If the sum of annual TACs falls outside the OY range, TACs must be adjusted or the FMP amended (BSAI FMP at 13).

Recognizing that salmon bycatch management measures precluding the pollock fishery from harvesting its entire TAC for any given year are not determinative of whether the BSAI groundfish fishery achieves OY, providing the opportunity for the fleet to harvest the TAC in any given year is one aspect of achieving optimum yield in the long term.

Several management measures are currently used to minimize chum salmon bycatch in the Bering Sea pollock fishery. Chum salmon taken incidentally in groundfish fisheries are classified as prohibited species and, as such, must be either discarded or donated through the Prohibited Species Donation Program. In the mid 1990s, NMFS implemented regulations recommended by the Council to control the

[6] In addition, through the Consolidated Appropriations Act of 2004 (Pub. L. 108-199), Congress required that the optimum yield for groundfish in the BSAI shall not exceed 2 million metric tons.

bycatch of chum salmon taken in the Bering Sea pollock fishery. These regulations established the Chum SSA and mandated year-round accounting of chum salmon bycatch in the trawl fisheries.

The Chum SSA is a time-area closure designed to reduce overall non-Chinook salmon bycatch in the federal groundfish trawl fisheries. This time-area closure was adopted based on historically observed salmon bycatch rates and was designed to avoid areas and times of high non-Chinook salmon bycatch. The Chum SSA is closed to pollock fishing from August 1 through August 31 of each year. Additionally, if the PSC limit of 42,000 non-Chinook salmon are caught by vessels using trawl gear in the Catcher Vessel Operational Area during the period August 15 through October 14, the Chum SSA remains closed to directed fishing for pollock for the remainder of the period September 1 through October 14.

The Council started considering revisions to salmon bycatch management in 2004, when information from the fishing fleet indicated that it was experiencing increases in Chinook and chum salmon bycatch following the regulatory closure of the Chinook Salmon Savings Areas. This indicated that, contrary to the original intent of the savings area closures, Chinook and chum salmon bycatch rates appeared to be higher outside of the savings area than inside the area. While, upon closure, the non-Community Development Quota (non-CDQ) fleet could no longer fish inside the Chinook and Chum Salmon Savings Area, vessels fishing on behalf of the CDQ groups were still able to fish inside the area because the CDQ groups had not yet reached their portion of the Chinook salmon PSC limit. Much higher salmon bycatch rates were reportedly encountered outside of the closure areas by the non-CDQ fleet than experienced by the CDQ vessels fishing inside. Further, the closure areas increased costs to the pollock fleet and processors.

To address this problem, the Council examined other means that were more flexible and adaptive to minimize salmon bycatch. The fleet voluntarily started the RHS program in 2001 for chum salmon and in 2002 for Chinook salmon. The exemption to area closures for the RHS ICA was first implemented through an exempted fishing permit in 2006 and 2007 subsequently, in 2008, through Amendment 84 to the BSAI FMP. Under Amendment 84, the requirements for an RHS ICA were implemented in federal regulations and vessels, and CDQ groups participating in an RHS ICA approved by NMFS were exempted from closures of the Chinook and Chum Salmon Savings Areas. The RHS ICA was intended to increase the ability of pollock fishery participants to minimize salmon bycatch by giving them more flexibility to move fishing operations to avoid areas where they experience high rates of salmon bycatch. Additional information about Amendment 84 is in Section 2.1.

The Council took additional action to minimize Chinook salmon bycatch in the Bering Sea pollock fishery under Amendment 91 to the BSAI FMP. Amendment 91 was approved by the Council in 2009 and implemented by NMFS in January 2011. This management program implements sector and seasonal Chinook salmon PSC limits (“hard caps”), provisions for higher caps for participants in an approved incentive plan agreement, and a Chinook salmon bycatch “performance standard.” Additional information about Amendment 91 and management and monitoring modifications as a result of this program are contained in Chapter 2.

The Council is now considering whether additional management measures are needed to minimize the bycatch of chum salmon in the Bering Sea pollock fishery.

## 1.3 The Action Area

The action area effectively covers the Bering Sea management area in the exclusive economic zone (EEZ), an area extending from 3 nm from the State of Alaska’s coastline seaward to 200 nm (4.8 km to 320 km). The Bering Sea EEZ has a southern boundary at 55° N. latitude from 170° W. longitude to the U.S.-Russian Convention line of 1867, a western boundary of the U.S.-Russian Convention Line of 1867, and a northern boundary at the Bering Strait, defined as a straight line from Cape Prince of Wales to Cape Dezhneva, Russia.

Impacts of the action may also occur outside the action area in the freshwater origins of the chum salmon caught as bycatch and in the chum salmon migration routes between their streams of origin and the Bering Sea (Figure 1-1). Chum salmon caught as bycatch in the Bering Sea pollock fishery may originate from Asia, Alaska, Canada, or the western United States.

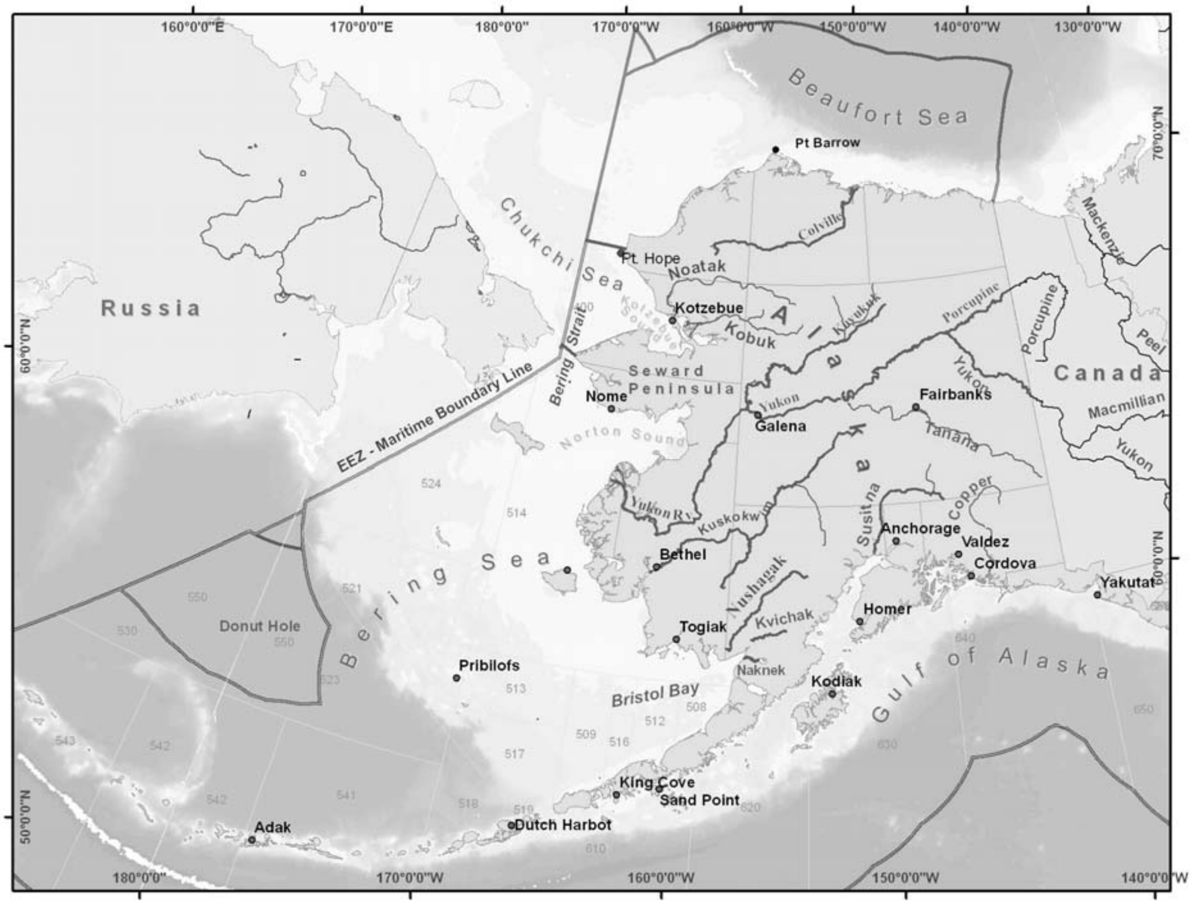



Figure 1-1 Map of the Bering Sea and major connected salmon producing rivers in Alaska and Northwest Canada

A comprehensive description of the action area is contained in previous environmental impact statements (EISs) prepared for North Pacific fishery management actions. The description of the affected environment is incorporated by reference from Chapter 3 of the Programmatic Supplemental Environmental Impact Statement for the Alaska Groundfish Fisheries (NMFS 2004) and Chapter 3 of the Final Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska (NMFS 2005a). These documents contain extensive information on the fishery management areas, marine resources, habitat, ecosystem, social, and economic parameters of the pollock fishery. Both of these public documents are available on the NMFS Alaska Region website.[7]

[7] http://alaskafisheries.noaa.gov/

A large body of information exists on the life histories and general distribution of salmon in Alaska. The locations of many freshwater habitats used by salmon are described in documents organized and maintained by the Alaska Department of Fish & Game (ADF&G). Alaska Statute 16.05.871 requires ADF&G to specify the various streams that are important for spawning, rearing, or migration of anadromous fishes. This is accomplished through the *Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes* (ADF&G 1998a) which lists water bodies documented to be used by anadromous fish, and the *Atlas to the Catalog of Waters Important for Spawning, Returning or Migration of Anadromous Fishes* (ADF&G 1998b), which shows locations of these waters and the species and life stages that use them. Additional information on salmon streams is available from the ADF&G website.[8]

## 1.4 The Bering Sea pollock fishery

Pollock is a commercially targeted species distributed in the North Pacific from Central California to the southern Sea of Japan. Currently, this species comprises a major portion of the BSAI finfish biomass and supports the largest single species fishery in the U.S. EEZ. The economic character of the fishery centers on the products produced from pollock: roe (eggs), surimi, and fillet products. In 2008, the total value of pollock increased to an estimated $1.415 billion but dropped by 2009 to $1.03 billion and for 2010 the estimate is $1.06 billion.

Within the BSAI management area, pollock is managed as three separate stocks: the Eastern Bering Sea, the Aleutian Islands region stock, and the Aleutian Basin or Bogoslof stock. The largest of these stocks, the Eastern Bering Sea stock, is the primary target of the pollock fishery. Since 1977, average annual catch of pollock in the Bering Sea has been 1.2 million tons while reaching a peak of catch of nearly 1.5 million tons in 2006.

Until 1998, the Bering Sea pollock fishery was managed as an open access fishery, commonly characterized as a “race for fish.” In 1998, however, Congress enacted the American Fisheries Act (AFA) to rationalize the fishery by limiting participation and allocating specific percentages of the Bering Sea directed pollock fishery TAC among the competing sectors of the fishery.

Sections 206(a) and (b) of the AFA establish the allocation of the Bering Sea pollock TAC among four AFA sectors. First, 10 percent of the Bering Sea pollock TAC is allocated to the CDQ Program. Then, NMFS reduces the remainder of the TAC by an amount of pollock that will be harvested as incidental catch in the non-pollock fisheries. In 2012, the incidental catch allowance for Bering Sea pollock is 32,400 mt. The remaining amount, after subtraction of the CDQ allocation and the incidental catch allowance, is called the directed fishing allowance. As required under the AFA, NMFS then allocates the directed fishing allowance among the three remaining AFA sectors (the “non-CDQ sectors”): 50 percent to the inshore catcher vessel (CV), 40 percent to the offshore catcher/processor (CP), and 10 percent to the mothership sector. Because the percentage of the TAC allocated to each of the four AFA sectors is specified in the AFA, transfer of pollock among the sectors is not allowed.

Pollock allocations to the AFA sectors are further divided into two seasons — 40 percent to the A season (January 20 to June 10) and the 60 percent to the B season (June 10 to November 1). NMFS may add any under harvest of a sector’s A season pollock allowance to the subsequent B season allowance. Typically, the fleet targets roe-bearing females in the A season and harvests the A season TAC by early April. The B season fishery focuses on pollock for filet and surimi markets, and the fleet harvests most of the B season TAC in September and October.

[8] http://www.state.ak.us/adfg/habitat

In addition to the required sector level allocations of pollock, the AFA allowed for the development of pollock industry cooperatives. Ten such cooperatives have formed as a result of the AFA: seven inshore cooperatives, two offshore cooperatives, and one mothership cooperative. These cooperatives are described below in more detail. All cooperatives are required to submit final annual written reports on fishing activity including PSC on an area-by-area and vessel-by-vessel basis. NMFS and the Council are required by the AFA to release this information to the public.

### 1.4.1 Community Development Quota Program

The CDQ Program was established by the Council in 1992 to improve the social and economic conditions in western Alaska communities by facilitating their economic participation in the BSAI fisheries. The CDQ Program was developed to redistribute some of the BSAI fisheries' economic benefits to communities adjacent to the Bering Sea and on the Aleutian Islands by allocating a portion of commercially important BSAI species including pollock to such communities. Their initial 7.5 percent allocation of pollock was expanded to 10 percent with the enactment of the AFA. These allocations are further allocated among the six CDQ groups: the Aleutian Pribilof Island Community Development Association (APICDA), the Bristol Bay Economic Development Corporation (BBEDC), the Central Bering Sea Fishermen's Association (CBSFA), the Coastal Villages Region Fund (CVRF), the Norton Sound Economic Development Corporation (NSEDC), and the Yukon Delta Fisheries Development Association (YDFDA). The percentage allocations of pollock among the six CDQ groups were approved by NMFS in 2005 based on recommendations from the State of Alaska. These percentage allocations are now the required allocations of pollock among the CDQ groups under section 305(i)(1)(B) of the Magnuson-Stevens Act. CDQ groups typically sell or lease their Bering Sea pollock allocations to various harvesting partners. The vessels harvesting CDQ pollock are the same vessels conducting AFA non-CDQ pollock harvesting. More detailed information on the CDQ Program is contained in the RIR.

### 1.4.2 Inshore catcher vessel sector

Each year, catcher vessels eligible to deliver pollock to the seven eligible AFA inshore processors may form cooperatives associated with a particular inshore processor. These catcher vessels are not required to join a cooperative and those that do not join a cooperative are managed by NMFS under the "inshore open access fishery." Usually, all inshore catcher vessels have joined one of seven inshore cooperatives. Annually, NMFS allocates the inshore sector's allocation of pollock among the inshore cooperatives and, if necessary, the inshore open access fishery. NMFS permits the inshore cooperatives, allocates pollock to them, and manages these allocations through a regulatory prohibition against an inshore cooperative exceeding its pollock allocation.

The inshore CV cooperatives are required to submit copies of their contracts to NMFS annually in their AFA inshore cooperative permit applications. These contracts must contain the information required in NMFS regulations, including information about the cooperative structure, vessels that are parties in the contract, and the primary inshore processor that will receive at least 90 percent of the pollock deliveries from these catcher vessels. Each catcher vessel in a cooperative must have an AFA permit with an inshore endorsement, a license limitation program permit authorizing the vessel to engage in trawl fishing for pollock in the Bering Sea, and no sanctions on the AFA or license limitation program permits. Although the contract requirements are governed by NMFS regulations, compliance with the provisions of the contract (primarily the 90 percent processor delivery requirements) are not enforced by NMFS, but are enforced through the private contractual arrangement of the cooperative.

Once an inshore cooperative's permit application is approved by NMFS, the cooperative receives an annual pollock allocation based on the catch history of vessels listed in a cooperative contract. The annual pollock allocation for the inshore CV sector is divided up by applying a formula in the regulations that allocates catch to a cooperative or the inshore open access fishery according to the specific sum of the catch history for the vessels in the cooperative or the "inshore open access" fishery. Under § 679.62(a)(1), the individual catch history of each vessel is equal to the sum of inshore pollock landings from the vessel's best 2 of the 3 years 1995 through 1997, and includes landings to catcher/processors for vessels that made landings of 500 mt or more to catcher/processors from 1995 through 1997. The percent of the inshore sector's allocation of pollock that is attributed to each CV based on this catch history is shown in Column D of Table 47c to 50 CFR part 679. Each year, fishing permits are issued to the inshore cooperative, with the permit application listing the CVs that are a member of each permitted cooperative.

An inshore CV open access fishery could exist if vessels choose not to join a cooperative in a given year. In this case, the inshore CV pollock allocation would be partitioned to allow for an allocation to the inshore open access fishery. The TAC for the inshore open access fishery is based on the portion of total sector pollock catch associated with the vessels not participating in one of the inshore CV cooperatives.

### 1.4.3 Offshore catcher/processor cooperatives and mothership cooperative

Separate allocations of the Bering Sea pollock TAC are made annually to the offshore CP sector and the mothership sector. These sector allocations of pollock are not further subdivided by NMFS among the vessels or companies participating in these sectors. However, through formation of cooperatives and under private contractual arrangement, participants in the offshore CP sector and the mothership sector further subdivide their respective pollock allocations among the participants in their sector. The purpose of these cooperatives is to manage the allocations made under the cooperative agreements to ensure that individual vessels and companies do not harvest more than their agreed upon share. The cooperatives also facilitate transfers of pollock among the cooperative members, enforcement of contract provisions, and participation in the RHS ICA.

Two fishery cooperatives are authorized by the AFA to form in the offshore CP sector and the offshore catcher vessel sector. A single cooperative may form that includes both CPs and named offshore catcher vessels delivering to CPs, or the CP and CV may form separate cooperatives and enter into an inter-cooperative agreement to govern fishing for pollock in the offshore CP sector. The offshore CP sector elected to form two cooperatives. The Pollock Conservation Cooperative (PCC) was formed in 1999 and is made up of 19 CPs that divide the sector's overall pollock allocation. The AFA listed 20 eligible CPs by name and also allowed eligibility for any other CP that had harvested more than 2,000 mt of pollock in 1997 and was eligible for the license limitation program. One CP, the *Ocean Peace*, met the requirements for an "unlisted catcher/processor" under the AFA and is part of the offshore CP sector. The *Ocean Peace* fished for pollock from 1999 through 2001 and again in 2008. Under the requirements of the AFA, unlisted CPs may harvest up to 0.5 percent of the offshore CP sector's allocation of pollock. The *Ocean Peace* is not part of the PCC.

The High Seas Catcher Cooperative (HSCC) consists of seven catcher vessels that formerly delivered pollock to CPs. These catcher vessels must either deliver to the PCC or lease their allocation to the PCC. The HSCC has elected to lease its pollock allocation to the PCC.

Catcher vessels delivering to motherships have formed a cooperative called the Mothership Fleet Cooperative (MFC). Under the AFA, fishery cooperatives are authorized to form in the mothership sector if at least 80 percent of the catcher vessels delivering to motherships enter into a fishery cooperative. The three motherships in the mothership sector also are eligible to join the cooperative and retain a limited anti-trust exemption under the Fisherman's Collective Marketing Act. The three motherships in this sector have not formed a separate cooperative and are not members of the MFC.

### 1.4.4 Non-Chinook salmon bycatch in the Bering Sea pollock fishery

NMFS manages salmon PSC in two categories: Chinook salmon and "non-Chinook salmon," which includes four species of salmon (sockeye, coho, pink, and chum) and any salmon that are not identified to species. Table 1-1 shows that on average chum salmon comprised over 99.6 percent of the non-Chinook salmon from 2001 to 2011.

Table 1-1 Composition of non-Chinook salmon prohibited species catch by species from 2001 through 2010. **Source:** NMFS catch accounting, extrapolated from sampled hauls only.

| Year | sockeye | coho | pink | chum | Total | % chum |
|---|---|---|---|---|---|---|
| 2001 | 12 | 173 | 9 | 51,001 | 51,195 | 99.6% |
| 2002 | 2 | 80 | 43 | 66,244 | 66,369 | 99.8% |
| 2003 | 29 | 24 | 72 | 138,772 | 138,897 | 99.9% |
| 2004 | 13 | 139 | 107 | 352,780 | 353,039 | 99.9% |
| 2005 | 11 | 28 | 134 | 505,801 | 505,974 | 100.0% |
| 2006 | 11 | 34 | 235 | 221,965 | 222,245 | 99.9% |
| 2007 | 3 | 139 | 39 | 75,249 | 75,430 | 99.8% |
| 2008 | 17 | 9 | 100 | 11,646 | 11,772 | 98.9% |
| 2009 | 37 | 17 | 238 | 29,432 | 29,724 | 99.0% |
| 2010 | 13 | 7 | 122 | 10,620 | 10,762 | 98.7% |
| 2011 | 28 | 445 | 667 | 154,771 | 155,911 | 99.3% |

The majority of non-Chinook PSC in the Bering Sea occurs in the pollock fishery. As shown in Table 1-2, historically, the percent of the non-Chinook bycatch in the Bering Sea that has occurred in the Bering Sea pollock fishery has ranged from a low of 88 percent of all bycatch to a high of greater than 98.7 percent in 1993. Since 2002 bycatch of non-Chinook salmon in the Bering Sea pollock fishery has comprised over 95 percent of the total non-Chinook bycatch. Total catch of non-Chinook salmon in the pollock fishery reached an historic high in 2005 at 704,586 fish. Bycatch of non-Chinook salmon in this fishery occurs almost exclusively in the B season. Previously the historic high was 242,000 in 1993 (prompting previous Council action to enact the Chum SSA. In recent years bycatch levels for chum salmon have been much lower than levels seen between 2003 and 2006, and in 2010 bycatch was approximately 13,000 fish.

Table 1-2 Non-Chinook (chum) salmon mortality in BS pollock directed fisheries 1991 through 2010. **Source:** NMFS catch accounting, updated 1/20/12

| Year | Annual with CDQ | Annual without CDQ | Annual CDQ only | A season with CDQ | B season with CDQ | A season without CDQ | B season without CDQ | A season CDQ only | B season CDQ only |
|---|---|---|---|---|---|---|---|---|---|
| 1991 | Na | 28,951 | na | na | na | 2,850 | 26,101 | na | na |
| 1992 | Na | 40,274 | na | na | na | 1,951 | 38,324 | na | na |
| 1993 | Na | 242,191 | na | na | na | 1,594 | 240,597 | na | na |
| 1994 | 92,672 | 81,508 | 11,165 | 3,991 | 88,681 | 3,682 | 77,825 | 309 | 10,856 |
| 1995 | 19,264 | 18,678 | 585 | 1,708 | 17,556 | 1,578 | 17,100 | 130 | 456 |
| 1996 | 77,236 | 74,977 | 2,259 | 222 | 77,014 | 177 | 74,800 | 45 | 2,214 |
| 1997 | 65,988 | 61,759 | 4,229 | 2,083 | 63,904 | 1,991 | 59,767 | 92 | 4,137 |
| 1998 | 64,042 | 63,127 | 915 | 4,002 | 60,040 | 3,914 | 59,213 | 88 | 827 |
| 1999 | 45,172 | 44,610 | 562 | 362 | 44,810 | 349 | 44,261 | 13 | 549 |
| 2000 | 58,571 | 56,867 | 1,704 | 213 | 58,358 | 148 | 56,719 | 65 | 1,639 |
| 2001 | 57,007 | 53,904 | 3,103 | 2,386 | 54,621 | 2,213 | 51,691 | 173 | 2,930 |
| 2002 | 80,782 | 77,178 | 3,604 | 1,377 | 79,404 | 1,356 | 75,821 | 21 | 3,583 |
| 2003 | 189,185 | 180,783 | 8,402 | 3,834 | 185,351 | 3,597 | 177,186 | 237 | 8,165 |
| 2004 | 440,468 | 430,271 | 10,197 | 424 | 440,044 | 395 | 431,925 | 29 | 8,119 |
| 2005 | 704,552 | 696,859 | 7,693 | 578 | 703,974 | 546 | 693,806 | 32 | 10,168 |
| 2006 | 309,630 | 308,428 | 1,202 | 1,323 | 308,307 | 1,258 | 300,646 | 65 | 7,661 |
| 2007 | 93,783 | 87,303 | 6,480 | 8,510 | 85,273 | 7,354 | 84,136 | 1,156 | 1,137 |
| 2008 | 15,267 | 14,834 | 434 | 319 | 14,948 | 246 | 9,624 | 73 | 5,324 |
| 2009 | 46,127 | 45,178 | 950 | 48 | 46,080 | 48 | 45,719 | 0 | 361 |
| 2010 | 13,222 | 12,696 | 526 | 39 | 13,183 | 39 | 12,233 | 0 | 950 |
| 2011 | 191,445 | 187,676 | 3,769 | 122 | 191,323 | 111 | 190,797 | 11 | 526 |

Non-CDQ data for 1991–2002 from bsahalx.dbf.
Non-CDQ data for 2003–2009 from akfish_v_gg_pscnq_estimate.
CDQ data for 1992–1997 from bsahalx.dbf.
CDQ data for 1998 from boatrate.dbf
CDQ data for 1999–2007 from akfish_v_cdq_catch_report_total_catch
CDQ data for 2008–2010 from akfish_v_gg_pscnq_estimate_cdq
A season - January 1 to June 10
B season - June 11 to December 31

### 1.4.5 2009 through 2011 pollock catch and non-Chinook (chum) salmon bycatch by vessel category

Vessel-specific salmon bycatch information currently exists for catcher/processors, motherships, and observed catcher vessels in the inshore sector. However, vessels in the 30 percent observer coverage category are a significant component of the inshore sector; in 2011, per observer coverage changes implemented under Amendment 91, this sector is now covered at 100 percent. However through 2010, when these vessels were not observed, salmon bycatch rates from other observed vessels are used to estimate the salmon bycatch associated with the pollock catch by the unobserved vessels (as discussed in Section 3.1.5).

Table 1-3 shows the estimated pollock catch and salmon bycatch in the AFA pollock fisheries in the Bering Sea in 2009, by fishery sector and vessel length class. In 2009, 53of the vessels participating in the inshore sector were in the 30 percent observer coverage category. These vessels caught approximately 20 percent of the pollock catch and an estimated 49 percent of the non-Chinook (chum) salmon bycatch.

Table 1-3. Number of vessels that participated in the 2009 AFA pollock fisheries, pollock catch, and estimated non-Chinook salmon bycatch, by vessel category

| Vessel category | Number of Vessels | Pollock (mt) | Percent of Pollock Catch | Number of non-Chinook salmon | Percent of non-Chinook Salmon |
|---|---|---|---|---|---|
| CDQ | 13 | 81,478 | 10% | 950 | 2% |
| Catcher/processor | 15 | 281,603 | 36% | 3,901 | 8% |
| Motherships | 3 | 70,308 | 9% | 1,733 | 4% |
| CV 60 ft.-125 ft. | 53 | 152,649 | 20% | 22,501 | 49% |
| CV ≥ 125 ft. | 26 | 197,718 | 25% | 17,043 | 37% |
| Total | 97 | 783,756 | 100% | 46,127 | 100% |

Source: NMFS Alaska Catch Accounting System, 2/27/12

Table 1-4 shows the estimated pollock catch and salmon bycatch in the AFA pollock fisheries in the Bering Sea in 2010, by fishery sector and vessel length class. In 2010, 55of the vessels participating in the inshore sector were in the 30 percent observer coverage category. These vessels caught approximately 20 percent of the pollock catch and an estimated 42 percent of the non-Chinook (chum) salmon bycatch.

Table 1-5 shows the estimated pollock catch and salmon bycatch in the AFA pollock fisheries in the Bering Sea in 2011, by fishery sector and vessel length class. All vessels now have 100 percent observer coverage as a result of the implementation of the Amendment 91 Chinook bycatch management program.

Table 1-4. Number of vessels that participated in the 2010 AFA pollock fisheries, pollock catch, and estimated non-Chinook salmon bycatch, by vessel category

| Vessel category | Number of Vessels | Pollock (mt) | Percent of Pollock Catch | Number of non-Chinook salmon | Percent of non-Chinook Salmon |
|---|---|---|---|---|---|
| CDQ | 12 | 81,275 | 10% | 526 | 4% |
| Catcher/processor<br>Motherships* | 15<br>2 | 353,326 | 45% | 3,171 | 24% |
| CV 60 ft.-125 ft. | 55 | 153,322 | 20% | 5,584 | 42% |
| CV ≥ 125 ft. | 26 | 198,362 | 25% | 4,024 | 30% |
| Total | 98 | 786,285 | 100% | 13,222 | 100% |

*CPs and mothership sector harvests are combined for confidentiality reasons.
Source: NMFS Alaska Catch Accounting System, 2/27/12

Table 1-5. Number of vessels that participated in the 2011 AFA pollock fisheries, pollock catch, and estimated non-Chinook salmon bycatch, by vessel category

| Vessel category | Number of Vessels | Pollock (mt) | Percent of Pollock Catch | Number of non-Chinook salmon | Percent of non-Chinook Salmon |
|---|---|---|---|---|---|
| CDQ | 15 | 116,978 | 10% | 3,769 | 2% |
| Catcher/processor | 15 | 423,680 | 36% | 44,356 | 23% |
| Motherships* | 3 | 109,856 | 9% | 24,399 | 13% |
| CV 60 ft.-125 ft. | 54 | 230,189 | 20% | 59,292 | 31% |
| CV ≥ 125 ft. | 26 | 288,904 | 25% | 59,625 | 31% |
| Total | 98 | 705,010 | 100% | 191,441 | 100% |

Source: NMFS Alaska Catch Accounting System, 2/27/12

## 1.5 Public Participation

The EA and RIR are being developed with several opportunities for public participation. This section describes these avenues for public participation.

### 1.5.1 Scoping

Scoping is an early and open process for determining the scope of issues to be addressed in an EA or EIS and for identifying the significant issues related to the proposed action. A principal objective of scoping and public involvement process is to identify a range of reasonable management alternatives that will delineate critical issues and provide a clear basis for distinguishing among those alternatives and selecting a preferred alternative. Through the notice of intent, NMFS notified the public that a NEPA analysis and decision-making process for this proposed action has been initiated so that interested or affected people may participate and contribute to the final decision.

Scoping is the term used for involving the public in the NEPA process at its initial stages. Scoping is designed to provide an opportunity for the public, agencies, and other interest groups to provide input on potential issues associated with the proposed action. Scoping is used to identify the environmental issues related to the proposed action and identify alternatives to be considered in the analysis. Scoping is accomplished through written communications and consultations with agency officials, interested members of the public and organizations, Alaska Native representatives, and state and local governments.

The formal scoping period began with the publication of a Notice of Intent in the *Federal Register* on January 8, 2009 (74 FR 798). Public comments were due to NMFS by March 23, 2009. In the Notice of Intent, NMFS requested written comments from the public on the range of alternatives to be analyzed and on the environmental, social, and economic issues to be considered in the analysis. This scoping report summarizes issues and alternatives raised in public comments submitted during this scoping period.

Additionally, members of the public have the opportunity to comment during the Council process. The Council has noticed the public when it is scheduled to discuss non-Chinook salmon bycatch issues. The Council process, which involves regularly scheduled and noticed public Council meetings, ad-hoc industry meetings, and Council committee meetings, started before this formal scoping process and will continue after this formal scoping process is completed.

### 1.5.2 Summary of Alternatives and Issues Identified During Scoping

NMFS received four written comments from the public and interested parties.

#### 1.5.2.1 Alternative management measures identified during scoping

The Council and NMFS will consider the alternatives identified during scoping in the analysis. The Council and NMFS will determine the range of alternatives to be analyzed that best accomplish the proposed action’s purpose and need. The analysis describes the alternatives raised during scoping that were considered but not carried forward, and discuss the reasons for their elimination from further detailed study. Comments identified the following alternatives for consideration:

- Analyze a range of hard caps from 50,000 non-Chinook salmon to 400,000 non-Chinook salmon and their likely impacts to Western Alaska.
- The hard cap should be from 70,000 non-Chinook to 77,000 non-Chinook salmon.
- The hard cap should be less than or equal to 70,000 non-Chinook salmon because this amount appears to allow in-river escapement, subsistence harvest consistent with the Alaska National Interest Lands Conservation Act, and Canadian border passage goals to be achieved, while providing for traditional in-river commercial fishing opportunities.

- Any pollock fishery management actions aimed at reducing salmon bycatch by altering time, area, and/or fishing methods must be used in conjunction with a hard cap threshold beyond which additional bycatch is prohibited.
- Develop a research and monitoring plan to identify information needed to establish an optimal bycatch level based on improved genetic stock-specific information.

#### 1.5.2.2 Issues identified during scoping

The comments received through the scoping process identified the following issues. To the extent practicable and appropriate, the analysis will take these issues into account.

- NEPA mandates the preparation of an EIS because the proposed chum salmon bycatch measures would be a significant action because they are likely to be controversial and to have substantial environmental, social, and economic impacts.
- The purpose of the proposed action should be to reduce BSAI salmon bycatch to levels which facilitate and provide for healthy returns of in-river fish both in Alaska and the Yukon River in Canada. Healthy returns mean adequate escapement and sufficient opportunity to meet subsistence harvest needs. Healthy returns also would allow for the taking of additional fish for historical non-subsistence harvest and would allow the United States to meet its international treaty obligations to Canada.
- Evaluate the impacts of anticipated climate change and how changes to ocean temperatures are impacting oceanic circulation and nutrient flow, and how these changes affect salmon diet, competition, predation, and migration.
- Identifying salmon bycatch stock of origin and age at maturity would assist significantly in understanding the impact of pollock fishery bycatch to in-river salmon returns not only in Alaska but for Pacific Northwest threatened and endangered salmon stocks as well. Collecting samples of salmon from the pollock fishery bycatch could inform non-Chinook salmon management decisions in both marine and in-river fisheries.
- Relying on inaccurate data could make NMFS think there are more fish in the sea than there actually are.

## 1.6 Tribal governments and Alaska Native Claims Settlement Act regional and village corporations

NMFS is obligated to consult and coordinate with federally recognized tribal governments and Alaska Native Claims Settlement Act (ANCSA) regional and village corporations on a government-to-government basis pursuant to Executive Order (E.O.) 13175, the Executive Memorandum of April 29, 1994, on "Government-to-Government Relations with Native American Tribal Governments," and Section 161 of the Consolidated Appropriations Act of 2004 (P.L. 108-199, 188 Stat. 452), as amended by Section 518 of the Consolidated Appropriations Act of 2005 (P.L. 108-447, 118 Stat. 3267). More information about E.O. 13175 is in section 1.10.11.

On January 16, 2009, as a first step in the consultation process, NMFS mailed letters to approximately 660 Alaska tribal governments, ANCSA corporations, and related organizations providing information about the proposed action and analysis and soliciting consultation and coordination with interested tribal governments and ANCSA corporations. NMFS received one comment from a tribal government, which was included in the scoping report. NMFS received a consultation request from the Native Village of St. Michael. A representative of St. Michael was contacted by NMFS by telephone, but no formal consultation meeting was scheduled. St. Michael participated in a one of the 2011 consultation meetings described below.

On June 1, 2011, NMFS held a tribal consultation teleconference with representatives of six Norton Sound and Bering Strait tribal governments: Native Village of Elim/Elim IRA Council; Native Village of Gambell; Native Village of Savoonga; Native Village of Shishmaref/Shishmaref IRA Council; Native Village of Teller/Teller Traditional Council; and Mary's Igloo Traditional Council. Each of the tribes had submitted resolutions to NMFS requesting a consultation and requesting the Council adopt a hard cap of 30,000 chum salmon for the Bering Sea pollock fishery. These resolutions were in response to the continuing decline of regional salmon stocks, which the tribes reported has severely impacted their subsistence practices and traditions. A representative of Kawerak, Inc., also participated in the consultation. The consultation was scheduled to occur prior to the Council's meeting in Nome.

During the consultation, NMFS staff provided an overview of chum salmon bycatch management and then listened to the representatives' concerns. The representatives emphasized the cultural and nutritional significance of salmon, the importance of subsistence use of salmon, and concerns with the status of some chum salmon stocks. Several representatives requested information on the prohibited species donation program (PSD program) and expressed interest in participation in the program by western Alaska communities. Also discussed were environmental changes tribal members have observed in recent years, science and research needs in the area, interest in collaborative research and funding for tribes and regional non-profit corporations to conduct research, the cumulative impact of salmon interception in the False Pass salmon fisheries and salmon bycatch in the pollock fisheries, how NMFS and the Council collaborate to ensure that tribal concerns are addressed, how NMFS provides information and education about fisheries issues to the tribes, and the tribes' request that NMFS to hire a tribal liaison. The issues and NMFS's responses are summarized in a report posted on the NMFS Alaska Region web site.[9]

On June 6, 2011, NMFS sent a letter to the Council summarizing the issues discussed in the tribal consultation. NMFS requested the Council address the tribes' recommendation for a 30,000 hard cap by either including it in the alternatives analyzed or providing an explanation why this cap does not meet the purpose and need for the action.

In mid June 2011, NMFS received consultation requests from the Native Village of Koyuk and the Native Village of St. Michael. Each submitted a resolution requesting the Council adopt a hard cap of 30,000 chum salmon for the Bering Sea pollock fishery. NMFS informed the tribal representatives that a consultation was conducted on this issue on June 1, and the representatives were asked to contact NMFS if they would like a separate consultation.

On August 18, 2011, the draft report of the consultation was sent to the participants, and comments on the draft were solicited. Included with the draft report was NMFS's preliminary summary letter to the Council; the June 2011 Council action on Bering Sea chum salmon bycatch; the agenda for the September meeting of the Council's Rural Community Outreach Committee, which was scheduled to discuss future outreach on chum salmon bycatch; and information from the U.S. Food and Drug Administration on seafood safety following the March 2011 Japanese nuclear power plant incident. On September 9, 2011, the final report of the consultation was sent to the participants, the Native Village of Koyuk, the Native Village of St. Michael, the Council's Rural Community Outreach Committee, and other interested parties and posted on the NMFS Alaska Region web site.

In September 2011, NMFS invited 20 tribes in the Norton Sound and Bering Strait area, Kawerak, Inc., and other interested parties to participate in a teleconference following up on some of the issues raised during the June 1 tribal consultation. NMFS held the teleconference on October 6, 2011. Representatives of the following tribes participated in the teleconference: Native Village of Brevig Mission; Native Village of Savoonga; Native Village of St. Michael; and Nome Eskimo Community. Also participating

[9] http://alaskafisheries.noaa.gov

were representatives from Kawerak, Inc., and staff from Senator Donald Olson's office, Representative Neal Foster's office, and the Council.

During the teleconference, NMFS staff summarized the June 1 tribal consultation and provided an overview of the PSD program. Council staff summarized the status of the Council's review of the proposed management measures to minimize non-Chinook salmon bycatch in the Bering Sea pollock fishery and noted that a public, statewide teleconference on these measures would be held in spring 2012. Issues raised by the tribal representatives included the significance of subsistence use of salmon, the quality of salmon distributed through the PSD program, clarification of some concerns addressed during the tribal consultation, and pollock fishery closures. A summary of these issues and NMFS's responses will be posted on the NMFS Alaska Region web site and distributed to the teleconference participants, the Council, and other interested parties.

## 1.7 Cooperating Agencies

The Council for Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA emphasize agency cooperation early in the NEPA process. The State of Alaska Department of Fish and Game (ADF&G) is a cooperating agency and has agreed to participate in the development of this analysis and provide data, staff, and review for this analysis. ADF&G has an integral role in the development of this analysis because it manages the commercial salmon fisheries, collects and analyzes salmon biological information, and represents people who live in Western and Interior Alaska.

## 1.8 Community Outreach

One of the Council's policy priorities is to improve communication with and participation by Alaska Native and rural communities in the federal fisheries management process. The Council developed an outreach plan to solicit and obtain input on the proposed action from Alaska Natives, communities, and other affected stakeholders. This outreach effort, specific to chum salmon bycatch management, dovetails with the Council's overall community and Native stakeholder participation policy.

The Council's Rural Community Outreach Committee identified this action as an important project for outreach efforts to rural communities. An outreach plan was developed in late 2009 and is continually refined.[10] The outreach plan includes attending several regional meetings in rural Alaska, as well as other meetings, in order to explain the proposed action, provide preliminary analysis, and receive direct feedback from rural communities prior to the final analysis. The majority of these meetings will occur in early 2011. A summary of verbal comments received during outreach meetings is attached as Appendix X and was presented to the Council in June 2011.

## 1.9 Statutory Authority for this Action

Under the Magnuson-Stevens Act (16 USC 1801, *et seq.*), the United States has exclusive fishery management authority over all marine fishery resources found within the EEZ. The management of these marine resources is vested in the Secretary of Commerce (Secretary) and in the regional fishery management councils. In the Alaska Region, the Council has the responsibility for preparing FMPs and FMP amendments for the marine fisheries that require conservation and management, and for submitting its recommendations to the Secretary. Upon approval by the Secretary, NMFS is charged with carrying out the federal mandates of the Department of Commerce with regard to marine and anadromous fish.

The Bering Sea pollock fishery in the EEZ off Alaska is managed under the BSAI FMP. The salmon bycatch management measures under consideration would amend this FMP and federal regulations at 50

[10] http://www.alaskafisheries.noaa.gov/npfmc/current_issues/bycatch/ChumOutreach1010.pdf

CFR 679. Actions taken to amend FMPs or implement other regulations governing these fisheries must meet the requirements of federal law and regulations.

## 1.10 Relationship of this Action to Federal Laws, Policies, and Treaties

While NEPA is the primary law directing the preparation of this EA, a variety of other federal laws and policies require environmental, economic, and socioeconomic analyses of proposed federal actions. This section addresses the CEQ regulations at 40 CFR 1502.2(d) that require an EA to state how alternatives considered in it and decisions based on it will or will not achieve the requirements of sections 101 and 102(1) of NEPA and other environmental laws and policies. This EA and RIR contain the required analysis of the proposed federal action and its alternatives to ensure that the action complies with these additional federal laws and executive orders:

- National Environmental Policy Act (NEPA)
- Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act)
- Endangered Species Act (ESA)
- Marine Mammal Protection Act (MMPA)
- Administrative Procedure Act (APA)
- Regulatory Flexibility Act (RFA)
- Information Quality Act (IQA)
- Coastal Zone Management Act (CZMA)
- Alaska National Interest Lands Conservation Act (ANILCA)
- American Fisheries Act (AFA)
- Executive Order 12866: Regulatory planning and review
- Executive Order 13175: Consultation and Coordination with Indian Tribal Governments
- Executive Order 12898: Environmental Justice
- Pacific Salmon Treaty and the Yukon River Agreement

The following provides details on the laws and executive orders directing this analysis. None of the alternatives under consideration threatens a violation of Federal, state, or local law or requirements imposed for the protection of the environment.

### 1.10.1 National Environmental Policy Act

NEPA establishes our national environmental policy, provides an interdisciplinary framework for environmental planning by federal agencies, and contains action-forcing procedures to ensure that federal decision-makers take environmental factors into account. NEPA does not require that the most environmentally desirable alternative be chosen, but does require that the environmental effects of all the alternatives be analyzed equally for the benefit of decision-makers and the public.

NEPA has two principal purposes:

1. To require federal agencies to evaluate the potential environmental effects of any major planned federal action, ensuring that public officials make well-informed decisions about the potential impacts.

2. To promote public awareness of potential impacts at the earliest planning stages of major federal actions by requiring federal agencies to prepare a detailed environmental evaluation for any major federal action significantly affecting the quality of the human environment.

NEPA requires an assessment of the biological, social, and economic consequences of fisheries management alternatives and provides that members of the public have an opportunity to participate in the decision-making process. In short, NEPA ensures that environmental information is available to government officials and the public before decisions are made and actions are taken.

Title II, Section 202 of NEPA (42 U.S.C. 4342) created the CEQ. The CEQ is responsible for, among other things, the development and oversight of regulations and procedures implementing NEPA. The CEQ regulations provide guidance for federal agencies regarding NEPA's requirements (40 CFR part 1500) and require agencies to identify processes for issue scoping, for the consideration of alternatives, for developing evaluation procedures, for involving the public and reviewing public input, and for coordinating with other agencies — all of which are applicable to the Council's development of FMPs.

NOAA Administrative Order 216-6 describes NOAA's policies, requirements, and procedures for complying with NEPA and the implementing regulations issued by the CEQ. This Administrative Order provides comprehensive and specific procedural guidance to NMFS and the Council for preparing and adopting FMPs.

Federal fishery management actions subject to NEPA requirements include the approval of FMPs, FMP amendments, and regulations implementing FMPs. Such approval requires preparation of the appropriate NEPA analysis (Categorical Exclusion, EA, or EIS).

### 1.10.2 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Act authorizes the United States to manage its fishery resources in the EEZ. The management of these marine resources is vested in the Secretary and in regional fishery management councils. In the Alaska Region, the Council is responsible for preparing FMPs for marine fishery resources requiring conservation and management. NMFS is charged with carrying out the federal mandates with regard to marine fish. The NMFS Alaska Region and Alaska Fisheries Science Center research, draft, and review the management actions recommended by the Council. The Magnuson-Stevens Act established the required and discretionary provisions of an FMP and created ten National Standards to ensure that any FMP or FMP amendment is consistent with the Act.

The Magnuson-Stevens Act emphasizes the need to protect fish habitat. Under the law, the Council has amended its FMPs to identify essential fish habitat (EFH). For any actions that may adversely impact EFH, the Magnuson-Stevens Act requires NMFS to provide recommendations to federal and state agencies for conserving and enhancing EFH. In line with NMFS policy of blending EFH assessments into existing environmental reviews, NMFS intends the analysis contained in Chapter 7of this EA to also serve as an EFH assessment.

The actions under examination in the EA and RIR are chum salmon bycatch minimization measures for the Bering Sea pollock fishery. While each FMP amendment must comply with all ten national standards, National Standards 1 and 9 directly guide the proposed action. National Standard 9 of the Magnuson-Stevens Act requires that conservation and management measures shall, to the extent practicable, minimize bycatch. National Standard 1 of the Magnuson-Stevens Act requires that conservation and management measures prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the U.S. fishing industry.

### 1.10.3 Endangered Species Act (ESA)

The ESA is designed to conserve endangered and threatened species of fish, wildlife, and plants. The ESA is administered jointly by NMFS and the U.S. Fish and Wildlife Service (USFWS). With some exceptions, NMFS oversees cetaceans, seals and sea lions, marine and anadromous fish species, and marine plant species. USFWS oversees walrus, sea otter, seabird species, and terrestrial and freshwater wildlife and plant species.

The listing of a species as threatened or endangered is based on the biological health of that species. Threatened species are those likely to become endangered in the foreseeable future (16 U.S.C. 1532(20)). Endangered species are those in danger of becoming extinct throughout all or a significant portion of their range (16 U.S.C. 1532(6)). Species can be listed as endangered without first being listed as threatened.

Currently, with the listing of a species under the ESA, the critical habitat of the species must be designated to the maximum extent prudent and determinable (16 U.S.C. 1533(b)(6)(C)). The ESA defines critical habitat as those specific areas that are essential to the conservation of a listed species and that may be in need of special consideration. Federal agencies are prohibited from undertaking actions that destroy or adversely modify designated critical habitat.

Federal agencies have a mandate to conserve listed species, and federal actions, activities, or authorizations (hereafter referred to as federal actions) must be in compliance with the provisions of the ESA. Section 7 of the ESA provides a mechanism for consultation by the federal action agency with the appropriate expert agency (NMFS or USFWS). Informal consultations are conducted for federal actions that have no adverse affects on the listed species. The action agency can prepare a biological assessment to determine if the proposed action would adversely affect listed species or modify critical habitat. The biological assessment contains an analysis based on biological studies of the likely effects of the proposed action on the species or habitat.

Formal consultations, resulting in biological opinions, are conducted for federal actions that may have an adverse affect on the listed species. Through the biological opinion, a determination is made about whether the proposed action poses “jeopardy” or “no jeopardy” of extinction or adverse modification or destruction of designated critical habitat for the listed species. If the determination is that the proposed or on-going action will cause jeopardy or adverse modification of critical habitat, reasonable and prudent alternatives may be suggested which, if implemented, would modify the action to no longer pose the jeopardy of extinction or adverse modification to critical habitat for the listed species. These reasonable and prudent alternatives must be incorporated into the federal action if it is to proceed. A biological opinion with the conclusion of no jeopardy or adverse modification of critical habitat may contain conservation recommendations intended to further reduce the negative impacts to the listed species. These recommendations are advisory to the action agency (50 CFR 402.14(j)). If the likelihood exists of any take[11] occurring during promulgation of the action, an incidental take statement may be appended to a biological opinion to provide for the amount of take that is expected to occur from normal promulgation of the action. An incidental take statement is not the equivalent of a permit to take a listed species.

This EA contains pertinent information on the ESA-listed species that occur in the action area and that have been identified in previous consultations as potentially impacted by the Bering Sea pollock fishery. Analysis of the impacts of the alternatives is in the chapters addressing those resource components.

### 1.10.4 Marine Mammal Protection Act (MMPA)

Under the MMPA, NMFS has a responsibility to conserve marine mammals, specifically cetaceans and pinnipeds (other than walrus). The USFWS is responsible for sea otter, walrus, and polar bear. Congress found that certain species and stocks of marine mammals are or may be in danger of extinction or depletion due to human activities. Congress also declared that marine mammals are resources of great international significance.

The primary management objective of the MMPA is to maintain the health and stability of the marine ecosystem, with a goal of obtaining an optimum sustainable population of marine mammals within the

[11] The term “take” under the ESA means “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct” (16 U.S.C. 1532(19)).

carrying capacity of the habitat. The MMPA is intended to work in concert with the provisions of the ESA. The Secretary is required to give full consideration to all factors regarding regulations applicable to the "take" of marine mammals, including the conservation, development, and utilization of fishery resources, and the economic and technological feasibility of implementing the regulations. If a fishery affects a marine mammal population, the Council or NMFS may be requested to consider measures to mitigate adverse impacts. This EA analyzes the potential impacts of the pollock fishery and changes to the fishery under the alternatives on marine mammals.

### 1.10.5 Administrative Procedure Act (APA)

The APA requires federal agencies to notify the public before rule making and provide an opportunity to comment on proposed rules. General notice of proposed rulemaking must be published in the *Federal Register*, unless persons subject to the rule have actual notice of the rule. Proposed rules published in the *Federal Register* must include reference to the legal authority under which the rule is proposed and explain the nature of the proposal including a description of the proposed action, why it is being proposed, its intended effect, and any relevant regulatory history that provides the public with a well-informed basis for understanding and commenting on the proposal. The APA does not specify how much time the public must be given for prior notice and opportunity to comment; however, section 304 (b) of the Magnuson-Stevens Act provides that proposed regulations that implement an FMP or FMP amendment, or that modify existing regulations, must have a public comment period of 15 to 60 days.

After the end of a comment period, the APA requires that comments received be summarized and responded to in the final rule notice. Further, the APA requires that the effective date of a final rule is no less than 30 days after its publication in the *Federal Register*. This delayed effectiveness, or "cooling off" period, is intended to give the affected public time to become aware of, and prepared to comply with the requirements of the rule. For fishery management regulations, the primary effect of the APA, in combination with the Magnuson-Stevens Act, NEPA, and other statutes, is to allow for public participation and input into the development of FMPs, FMP amendments, and regulations implementing FMPs. Regulations implementing the proposed salmon bycatch reduction measures will be published in the *Federal Register* in accordance with the APA and the Magnuson-Stevens Act.

### 1.10.6 Regulatory Flexibility Act (RFA)

The RFA requires federal agencies to consider the economic impact of their regulatory proposals on directly regulated small entities, analyze alternatives that minimize adverse economic impacts on this class of small entities, and make their analyses available for public comment. The RFA applies to a wide range of small entities, including small businesses, not-for-profit organizations, and small governmental jurisdictions. The Small Business Administration has established size criteria for all major industry sectors in the United States, including fish harvesting and fish processing businesses.

The RFA applies to any regulatory actions for which prior notice and comment is required under the APA. After an agency begins regulatory development and determines that the RFA applies, unless an agency can certify that an action subject to the RFA will not have a significant economic impact on a substantial number of small entities, the agency must prepare an initial regulatory flexibility analysis (IRFA) to accompany a proposed rule. Based upon the IRFA, and received public comment, assuming it is still not possible to certify, the agency must prepare a final regulatory flexibility analysis to accompany the final rule. NMFS has published revised guidelines, dated August 16, 2000, for RFA analyses; they include criteria for determining if the action would have a significant impact on a substantial number of small entities.

This analysis contains a draft IRFA that identifies the small entities directly regulated by the proposed action. The preamble to the proposed regulations that will be published in the *Federal Register* will contain the IRFA that evaluates the adverse impacts of this action on directly regulated small entities, in compliance with the RFA.

### 1.10.7 Information Quality Act (IQA)

The IQA directs the Office of Management and Budget (OMB) to issue government-wide policy and procedural guidance to all federal agencies to ensure and maximize the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by federal agencies. The OMB's guidelines require agencies to develop their own guidelines for ensuring and maximizing the quality, objectivity, utility, and integrity of information disseminated by the agency. NOAA published its guidelines in September 2002.[12] Pursuant to the IQA and the NOAA guidelines, if the Council recommends an action alternative, this EA/RIR/IRFA will undergo a pre-dissemination review during NMFS's review of the Council's submission.

### 1.10.8 Alaska National Interest Lands Conservation Act (ANILCA)

Among other things, Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA) creates a priority for "subsistence uses" over the taking of fish and wildlife for other purposes on public lands (16 U.S.C. 3114). ANILCA also imposes obligations on federal agencies with respect to decisions affecting the use of public lands, including a requirement that they analyze the effects of those decisions on subsistence uses and needs (16 U.S.C. 3120).

ANILCA defines "public lands" as lands situated "in Alaska" which, after December 2, 1980, are federal lands, except those lands selected by or granted to the State of Alaska, lands selected by an Alaska Native Corporation under the Alaska Native Claims Settlement Act (ANCSA), and lands referred to in section 19(b) of ANCSA (16 U.S.C. 3102(3)).

The U.S. Supreme Court has ruled that ANILCA's use of "in Alaska" refers to the boundaries of the State of Alaska and concluded that ANILCA does not apply to the outer continental shelf (OCS) region (*Amoco Prod. Co. v. Village of Gambell*, 480 U.S. 531, 546-47 (1987)). The action area for Chinook salmon bycatch management is in the Bering Sea EEZ, which is in the OCS region.

Although ANILCA does not directly apply to the OCS region, NMFS aims to protect such uses pursuant to other laws, such as NEPA and the Magnuson-Stevens Act. The RIR evaluates the consequences of the proposed actions on subsistence uses. Thus NMFS and the Council remain committed to ensuring that federal fishery management actions consider the importance of subsistence uses of salmon and protecting such uses from any adverse consequences. One of the reasons NMFS and the Council have proposed implementing salmon bycatch reduction measures is to protect the interests of salmon subsistence users.

### 1.10.9 American Fisheries Act (AFA)

The AFA established a cooperative management program for the Bering Sea pollock fishery. Among the purposes of the AFA was to tighten U.S. vessel ownership standards and to provide the pollock fleet the opportunity to conduct its fishery in a more economically rational manner while protecting non-AFA participants in other fisheries. Since the passage of the AFA, the Council has taken an active role in the development of management measures to implement the various provisions of the AFA. The AFA EIS was prepared to evaluate sweeping changes to the conservation and management program for the Bering Sea pollock fishery and to a lesser extent, the management programs for the other groundfish fisheries of the Gulf of Alaska and BSAI, the king and Tanner crab fisheries of the BSAI, and the scallop fishery off Alaska (NMFS 2002). Under the Magnuson-Stevens Act, the Council prepared Amendments 61/61/13/8 to implement the provisions of the AFA in the groundfish, crab, and scallop fisheries. Amendments

[12] http://www.noaanews.noaa.gov/stories/iq.htm

61/61/13/8 incorporated the relevant provisions of the AFA into the FMPs and established a comprehensive management program to implement the AFA. The EIS evaluated the environmental and economic effects of the management program that was implemented under these amendments, and developed scenarios of alternative management programs for comparative use. The AFA EIS is available on the NMFS Alaska Region website.[13]

NMFS published the final rule implementing the AFA on December 30, 2002 (67 FR 79692). The structure and provisions of the AFA constrain the types of measures that can be implemented to reduce salmon bycatch in the pollock fishery. The RIR contains a detailed discussion of the pollock fishery under the AFA and the relationship between the chum salmon bycatch management and the AFA.

### 1.10.10 Executive Order 12866: Regulatory planning and review

The purpose of Executive Order 12866, among other things, is to enhance planning and coordination with respect to new and existing regulations, and to make the regulatory process more accessible and open to the public. In addition, Executive Order 12866 requires agencies to take a deliberative, analytical approach to rule making, including assessment of costs and benefits of the intended regulations. For fisheries management purposes, it requires NMFS to (1) prepare an RIR for all regulatory actions; (2) prepare a unified regulatory agenda twice a year to inform the public of the agency's expected regulatory actions; and (3) conduct a periodic review of existing regulations.

The purpose of an RIR is to assess the potential economic impacts of a proposed regulatory action. As such, it can be used to satisfy NEPA requirements and serve as a basis for determining whether a proposed rule will have a significant impact on a substantial number of small entities under the RFA. The RIR is frequently combined with an EA and an IRFA in a single document that addresses the analytical requirements of NEPA, RFA, and Executive Order 12866. Criteria for determining "significance" for Executive Order 12866 purposes, however, are different than those for determining "significance" for NEPA or RFA purposes. A "significant" rule under Executive Order 12866 is one that is likely to:

- Have an annual effect on the economy (of the nation) of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal governments or communities;
- Create serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in Executive Order 12866.

Although fisheries management actions rarely have an annual effect on the national economy of $100 million or more or trigger any of the other criteria, the Secretary of Commerce with the OMB, makes the final determination of significance under this Executive Order, based in large measure on the analysis in the RIR. An action determined to be significant is subject to OMB review and clearance before its publication and implementation.

The RIR identifies economic impacts and assesses of costs and benefits of the proposed salmon bycatch reduction measures.

[13] http://www.alaskafisheries.noaa.gov/sustainablefisheries/afa/eis2002.pdf

### 1.10.11 Executive Order 13175: Consultation and coordination with Indian tribal governments

Executive Order 13175 on consultation and coordination with Indian tribal governments establishes the requirement for regular and meaningful consultation and collaboration with Indian tribal governments in the development of federal regulatory practices that significantly or uniquely affect their communities; to reduce the imposition on unfunded mandates on Indian tribal governments; and to streamline the application process for and increase the availability of waivers to Indian tribal governments. This Executive Order requires federal agencies to have an effective process to involve and consult with representatives of Indian tribal governments in developing regulatory policies and prohibits regulations that impose substantial, direct compliance costs on Indian tribal communities.

Additionally, Congress extended the consultation requirements of Executive Order 13175 to Alaska Native corporations in Division H, Section 161 of the Consolidated Appropriations Act of 2004 (Public Law 108-199; 188 Stat. 452), as amended by Division H, Section 518 of the Consolidated Appropriations Act of 2005 (Public Law 108-447, 118 Stat. 3267). Public Law 108-199 states in Section 161 that "The Director of the Office of Management and Budget shall hereafter consult with Alaska Native corporations on the same basis as Indian tribes under Executive Order No. 13175." Public Law 108-447, in Section 518, amends Division H, Section 161 of Public Law 108-199 to replace Office of Management and Budget with all federal agencies.

### 1.10.12 Executive Order 12898: Environmental Justice

Executive Order 12898 requires that federal agencies make achieving environmental justice part of their mission by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low income populations in the United States. Salmon bycatch in the pollock fisheries impacts the in-river users of salmon in western and Interior Alaska, many of whom are Alaska Native. Additionally, a growing number of Alaska Natives participate in the pollock fisheries through the federal CDQ Program and, as a result, coastal native communities participating in the CDQ Program derive substantial economic benefits from the pollock fishery.

### 1.10.13 Pacific Salmon Treaty and the Yukon River Agreement

In 2002, the United States and Canada signed the Yukon River Agreement to the Pacific Salmon Treaty. The Yukon River Agreement states that the “Parties shall maintain efforts to increase the in-river run of Yukon River origin salmon by reducing marine catches and by-catches of Yukon River salmon. They shall further identify, quantify and undertake efforts to reduce these catches and by-catches” (Art. XV, Annex IV, Ch. 8, Cl. 12). The Yukon River Agreement also established the Yukon River Panel as an international advisory body to address the conservation, management, and harvest sharing of Canadian-origin salmon between the United States and Canada. This proposed action is an element of the Council’s efforts to reduce bycatch of salmon in the pollock fishery and ensure compliance with the Agreement. Additionally, in developing the alternatives under consideration, NMFS and the Council have considered the recommendations of the Yukon River Panel. This EA and RIR address the substantive issues involving the portion of chum salmon taken as bycatch in the Bering Sea pollock fishery that originated from the Yukon River as well as the impacts of salmon bycatch in the pollock fishery on returns of Chinook salmon to the Canadian portion of the Yukon River.

# 2 Description of Alternatives

This analysis is focused on alternative measures to minimize chum (non-Chinook) salmon bycatch in the Bering Sea pollock fishery. This chapter provides a detailed description of the following three alternatives:

**Alternative 1: Status Quo (No Action)**

**Alternative 2: Hard cap**

**Alternative 3: Triggered closure with RHS exemption**

The alternatives analyzed in this environmental assessment and the Regulatory Impact Review (RIR) represent a complex suite of components, options, and suboptions. However, each of the alternatives involves a limit or "cap" on the number of non-Chinook salmon that may be caught in the Bering Sea pollock fishery and closure of all or a part of the Bering Sea to pollock fishing once the cap is reached. These closures would occur when a non-Chinook salmon bycatch cap was reached even if a portion of the pollock total allowable catch (TAC) has not yet been harvested. Alternative 2 components and options represent a change in management of the pollock fishery because if the non-Chinook salmon prohibited species catch (PSC) limits are reached before the full harvest of the pollock allocation, then directed fishing for pollock must stop either throughout the entire Bering Sea or for a specific time frame. Under Alternative 3, like Alternative 1, reaching the cap closes specific areas important to pollock fishing unless participants are parties in a rolling hot spot closure system approved by NMFS. Note that the alternatives are not mutually exclusive and mixing and matching of components of each may be done to create a combined management approach which would represent a new alternative.

To best present the alternatives in comparative form, this chapter is organized into sections that describe in detail each alternative's components, options, and suboptions. To avoid unnecessary repetition, many aspects of the alternatives are presented in this chapter only, and cross-referenced later in the document as applicable.

This chapter also describes how management of the pollock fishery would change under each of the alternatives and how non-Chinook salmon bycatch would be monitored. Estimated costs and the impacts of these changes on the pollock fishery are discussed in the RIR.

## 2.1 Alternative 1: Status Quo (No Action)

Alternative 1 retains the current program of Chum Salmon Savings Area (SSA) closures in the Bering Sea triggered by separate non-Community Development Quota (non-CDQ) and CDQ non-Chinook salmon PSC limits, along with the exemption to these closures by pollock vessels participating in a Rolling Hot Spot intercooperative agreement (RHS ICA) approved by NMFS. The RHS ICA regulations were implemented in 2007 through Amendment 84 to the BSAI FMP. The regulations were revised in 2011 to remove those provisions of the ICA that were for Chinook bycatch management given the new program in place under Amendment 91. Closure of the Chum SSA is designed to reduce the total amount of chum incidentally caught by closing areas with historically high levels of salmon bycatch. The RHS ICA operates in lieu of regulatory closures of the Chum SSA and requires industry to identify and close areas of high salmon bycatch and move to other areas. Only vessels directed fishing for pollock are subject to the Chum SSA closure and ICA regulations. The ICA for 2011 and the list of vessels and CDQ groups participating in it are appended to this document (Appendix 2).

### 2.1.1 Chum Salmon Savings Area

Alternative 1 would keep the existing Chum SSA closures in effect (Figure 2-1). The Chum Salmon Savings Area was established in 1994 by emergency rule, and then formalized in the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI FMP) in 1995 under Amendment 35 (ADF&G 1995) This area is closed to all trawling from August 1 through August 31. Additionally, if 42,000 non-Chinook salmon are caught in the Catcher Vessel Operational Area (CVOA) during the period August 15 through October 14, the area remains closed for the remainder of the period September 1 through October 14. As catcher/processors are prohibited from fishing in the CVOA during the B season, unless they are participating in a CDQ fishery, only catcher vessels and CDQ fisheries are affected by the PSC limit. (Figure 2-1).

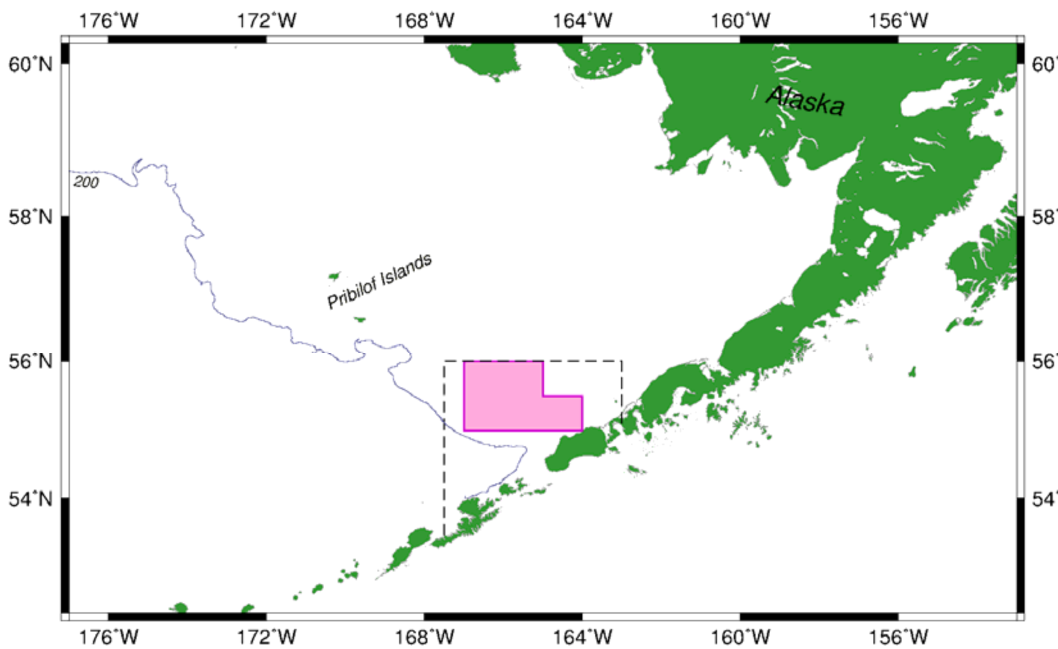



Figure 2-1 Chum Salmon Savings Area (CSSA), shaded and Catcher Vessel Operational Area (CVOA), dotted line

### 2.1.2 PSC limits for the CDQ Program

Under the status quo, the CDQ Program receives an annual allocation of 10.7 percent of the Bering Sea non-Chinook salmon PSC limits as a prohibited species quota (PSQ) reserve. The non-Chinook PSQ reserve is 4,494 salmon annually and the remaining 37,506 non-Chinook salmon make up the PSC limit for the non-CDQ pollock fisheries. NMFS further allocates the PSQ reserves among the six CDQ groups based on percentage allocations approved by NMFS on August 8, 2005. More information about the CDQ allocations is in a *Federal Register* notice published on August 31, 2006 (71 FR 51804). For non-Chinook salmon, the percentage allocations of the PSQ reserve among the CDQ groups are as follows:

| | |
|---|---|
| Aleutian Pribilof Island Community Development Association (APICDA) | 14% |
| Bristol Bay Economic Development Corporation (BBEDC) | 21% |

| | |
|---|---|
| Central Bering Sea Fishermen's Association (CBSFA) | 5% |
| Coastal Villages Region Fund (CVRF) | 24% |
| Norton Sound Economic Development Corporation (NSEDC) | 22% |
| Yukon Delta Fishery Development Corporation (YDFDC) | 14% |

Unless exempted because of participation in the RHS ICA, a CDQ group is prohibited from directed fishing for pollock in the Chum SSA when that group's non-Chinook salmon PSQ is reached. NMFS does not issue fishery closures through rulemaking for the CDQ groups. All CDQ groups are participating in the RHS ICA approved in 2011, so they currently are exempt from closure of the Chum SSA.

### 2.1.3 Rolling Hotspot System Intercooperative Agreement

Regulations implemented under Amendment 84 to the BSAI FMP exempt vessels directed fishing for pollock from closures of both the Chum and Chinook Salmon Savings Areas if they participate in an RHS ICA approved by NMFS (NPFMC 2005). The fleet voluntarily started the RHS program in 2001 for chum salmon and in 2002 for Chinook salmon. The exemption to regulatory area closures for vessels that participated in the RHS was implemented in 2006 and 2007 through an exempted fishing permit. The North Pacific Fishery Management Council (Council) developed Amendment 84 to attempt to resolve the bycatch problem through the American Fisheries Act (AFA) pollock cooperatives. These regulations were implemented in late 2007 and the first RHS ICA approved by NMFS under these regulations was in effect starting in January 2008 (Appendix 2). The ICA was amended for the 2011 season to remove regulations related to the Chinook SSA (and all provisions under the ICA related to Chinook bycatch management) following implementation of Amendment 91.

See section 2.3.7.1 for further explanation of some issues the Council should consider if amending the current ICA regulations under either Alternative 1 or 3.

The RHS provides real-time salmon bycatch information so that the fleet can avoid areas of high chum or Chinook salmon bycatch rates. Using a system of base bycatch rates, the ICA assigns vessels to certain tiers, based on bycatch rates relative to the base rate, and implements area closures for vessels in certain tiers. Monitoring and enforcement are carried out through private contractual arrangements.

Parties to the current RHS ICA include the AFA cooperatives and the CDQ groups. In addition, the ICA must identify a third-party salmon bycatch data manager (an "entity retained to facilitation vessel bycatch avoidance behavior and information sharing") and "at least one third party group," which could include "any organizations representing western Alaska who depend on non-Chinook salmon and have an interested in non-Chinook salmon bycatch regulation but do not directly fish in a groundfish fishery" (§ 679.21(g). All vessels and CDQ groups that are participating in the Bering Sea pollock fishery in 2012, except the *Ocean Peace*, participate in the currently approved RHS ICA. Under Amendment 84 and based on the structure of the voluntary RHS ICA in effect prior to Amendment 84, the ICA allows participation by only AFA cooperatives or CDQ groups. Although the regulations at § 679.21(g) do not specifically prohibit participation by individual vessel owners, the fact that the "participants" paragraph of the regulations specifically refer only to AFA cooperatives and CDQ groups implies that individual vessel owners may not be parties to an ICA. The fact that the *Ocean Peace* is not a member of an AFA cooperative may explain why it is not a party to the currently approved ICA.

Federal regulations require the ICA to describe measures that parties to the agreement will take to monitor salmon bycatch and redirect fishing effort away from areas in which salmon bycatch rates are relatively high. It also must include intra-cooperative enforcement measures and various other regulatory conditions. The ICA data manager monitors salmon bycatch in the pollock fisheries and announces area closures for areas with relatively high salmon bycatch rates. Federal regulations describe the process through which NMFS reviews a proposed ICA and approves those that contain the required provisions. However, once approved, NMFS does not independently monitor whether the industry operates under the provisions of its ICA. The efficacy of closures and bycatch reduction measures are reported to the Council annually and the Council, with input from the public, determines whether the RHS ICA is continuing to meet its goals for minimizing or reducing chum salmon bycatch.

Many modifications have been made to the ICAs for operation under the RHS program since it was initially approved for exemption to SSAs under Amendment 84. A description of the structure of the program is provided in Sections 2.1.2.1 through 2.1.2.5 below. Details within each section note where changes to the ICA have occurred since 2006 (the voluntary agreement in place prior to that in regulation under Amendment 84).

The ICA is structured based upon a cooperatives' bycatch rate as compared with a pre-determined "Base Rate." Once the Base Rate is determined (see Section 2.1.2.1), all provisions for fleet behavior, closures and enforcement are based upon the relation of the cooperative's rate to the Base Rate. Tier assignments (Section 2.1.2.2) are calculated from the cooperatives' proportional bycatch rate to the Base Rate with higher tiers corresponding to higher bycatch rates. These tiers then determine how access to specific areas will be determined following designation of "hot spot" closures. These areas are then to be avoided by cooperatives in higher tiers.

#### 2.1.3.1 Base Rate: calculation

The structure of the ICA is based upon cooperatives' bycatch rates in comparison with a calculated Base Rate established prior to the start of the season. The Base Rate (BR) is initially established as 0.19 (from June 10$^{th}$ to July 1$^{st}$) in chum/mt of pollock harvest. Prior to the 2006 ICA, the BR was a season fixed rate of 0.062. This was based upon a roughly 80 percent of the 2003 season average and was established such that no unnecessary closures would be enacted in periods of low abundance.[14] Beginning July 1$^{st}$ the chum BR is subject to a weekly in-season adjustment each Friday (announced on Thursday) based on a 3-week rolling average of the fleet's overall chum bycatch rate.

#### 2.1.3.2 Tier assignment based upon Base Rate

Once the Base Rate is established, cooperatives are placed into "tiers" based upon their percentage performance with respect to the base rate. Tier status is determined by a coop's "rolling two week" average bycatch rate. Closures are determined by Sea State based upon spatial information on "hot spot" bycatch areas.

Tier Assignment rates

i. Tier 1 – cooperatives with bycatch rates less than 75% of Base Rate.
ii. Tier 2 – cooperatives with bycatch rates equal to or greater than 75% of the Base Rate and equal to or less than 125% of the Base Rate.
iii. Tier 3 – cooperatives with bycatch rates greater than 125% of the Base Rate.

#### 2.1.3.3 Impacts of assignment to tier

Cooperatives are subject to savings closures based upon their tier assignments. Cooperatives assigned to Tier 1 are not constrained by savings closures. Cooperatives assigned to Tier 2 are subject to savings closures for 4 days: Friday at 6:00 pm to Tuesday at 6:00 pm. Cooperatives assigned to Tier 3 are subject to savings closures for 7 days: Friday at 6:00 pm to the following Friday at 6:00 pm.

[14] A one-time inseason adjustment used to occur on September 1. This adjustment recalculated the Base Rate according to the average bycatch by members over the previous 3-week period (August 10 through 31).

Closure areas are rolling and are determined by Sea State based upon the bycatch rate within specified areas.

For B season, closures are determined according to the following criteria:

1. Savings Closures are based on the chum salmon bycatch and pollock harvest for the 4- to 7-day period, depending on data quality, immediately preceding each closure announcement.
2. Chum salmon bycatch in an area must exceed the chum salmon Base Rate in order for the area to be eligible for a Savings Closure.
3. Pollock harvest in a potential Savings Closure area must be a minimum of 2 percent of the total fleet pollock harvest for the same time period in order to be eligible as a Savings Closure.
4. Current Savings Closures are exempt from the 2 percent minimum harvest rule described in item 3, above, and may continue as a Savings Closure if surrounding bycatch conditions indicate there has likely been no change in bycatch conditions for the area.
5. The Bering Sea will be managed as two regions during the B season: a region east of 168° W. longitude (the Eastern Region) and a region west of 168° W. longitude (the Western Region).
6. Total Savings Closure area.
   i. Chum salmon
      a. The Eastern Region Savings Closures may cover up to 3,000 square miles. Note this was increased from 1,000 square miles prior to Amendment 84.
      b. The Western Region Savings Closures may cover up to 1,000 square miles.
7. There may be up to two Savings Closure areas at any one time within each region.
8. Closure areas will be described by a series of latitude and longitude coordinates and will be shaped as Sea State deems appropriate.
9. Sea State also provides additional non-binding hot-spot avoidance notices, outside of the savings closures, to the cooperatives as they occur throughout the season

One change from the previous ICA inclusive of Chinook bycatch management is the prioritization of Chinook closures over chum closures in the B season. Previously, within a single region Savings Closures must be either a chum closure or a Chinook closure, but not both. In the event Base Rates for both chum and Chinook are exceeded within a region during a week, the Savings Closure within that region was a Chinook closure. This was due to the elevated conservation concerns with respect to western Alaskan Chinook stocks. In those cases, Sea State issued a non-binding avoidance recommendation for the area of high chum bycatch.

#### 2.1.3.4 "Vessel Performance Lists"

"Vessel Performance Lists" (formerly called "Dirty Twenty Lists") refer to lists that are published and made available to all members and include the 20 vessels with the highest chum (and previously Chinook) bycatch rates over the Base Rate. Prior to Amendment 84 this list reported the 20 vessels with the highest bycatch rate in excess of the Tier 1 rate. Lists are published by highest rate by week, highest rate for the past 2 weeks, and highest rates for the season-to-date. Only vessels with bycatch rates over the base rate appear on the list. Only vessels with more than 500 mt of groundfish catch are included in the season-to-date list. The season-to-date list was based on appearances on the weekly list. Accumulative points are assigned to vessels as they appear on the weekly list. Vessels in the number 1 slot on the weekly list receive 20 points, those in the number 2 slot receive 19 points and so on. The vessel's points are totaled each week, and the vessels with the 20 highest scores appear on the seasonal list. A vessel must have harvested over 500 mt of pollock before being eligible for the seasonal list. Previously this was calculated as the vessel's number of appearances on the weekly list divided by the number of weeks fished in the B season. Note this season list is no longer part of the 2011 ICA.

#### 2.1.3.5 RHS ICA monitoring

Monitoring and enforcement of the bycatch agreement is done by Sea State using the Base Rate as a trigger for Savings Area closures and determining the Tier Assignment of the vessel. Prior to Amendment 84 there was no enforcement monitoring by Sea State and enforcement was left to the individual cooperatives. The Vessel Monitoring System (VMS) is the main tool for monitoring and enforcement. There are VMS requirements and fines for not complying. See section 5.f of the revised ICA for a more detailed description of the RHS ICA monitoring considerations.

Penalties for savings closure violations are placed in a bank account designed for holding funds which are then used to fund research at the discretion of the cooperatives. Penalty money collected under the agreement is intended to be used in salmon stock identification research. To date the violation funds have been used to fund the Geiger-Pella project on sampling protocol (Geiger and Pella, 2009). The violation fund put in $25,000 and Alaska Department of Fish & Game put in the remainder. In 2010, $47,602 was given to the University of Alaska (Tony Gharrett) as matching funds with Alaska Sustainable Salmon Fund money for a project entitled "Shared Chum Salmon Baseline Development Project." The remainder of the violation funds are awaiting an applicable project and have not yet been allocated.

A list of fines collected is contained in Table 2-1. The first violations occurred in 2005 before the exempted fishing permit seasons and the implementation of Amendment 84. At that time the penalty for the first violation by a vessel in a year was 50 percent of the ex-vessel value of the pollock caught in the violating tow. Beginning in 2006 (the EFP and Amendment 84 years), first violations in a year were set at $10,000, second violations were set at $15,000, and the third and subsequent violations in a year were set at $20,000. The *Northern Hawk* violation was a double-violation as the captain made two tows before he realized he was inside the closure area. There is currently a pending violation for the *Hazel Lorraine* from the 2010 B season. Additional information on 2011 B-season violations will be available in 2012 (J. Gruver, United Catcher Boats, pers. comm).

Table 2-1. Enforcement violation fines incurred under the Rolling Hot Spot/ICA from 2005 – 2009

| Year | Coop. | Date | Vessel | Amount |
|---|---|---|---|---|
| 2005. | | | | |
| | Akutan | 7/19/2005 | Royal American | $1,700.00 |
| | Northern Victor | 7/18/2005 | Storm Petrel | $2,094.30 |
| | | | Annual Total | $3,794.30 |
| 2006 | | | | |
| | Akutan | 10/20/2006 | Golden Dawn | $10,000.00 |
| | Akutan | 9/30/2006 | Royal American | $10,000.00 |
| | Akutan | 10/8/2006 | Bristol Explorer | $10,000.00 |
| | Akutan | 10/18/2006 | Arctic Explorer | $10,000.00 |
| | | | Annual Total | $40,000.00 |
| 2007 | | | | |
| | Akutan | 1/31/2007 | Hazel Lorraine | $10,000.00 |
| | Arctic | 10/8/2007 | Ocean Explorer | $10,000.00 |
| | PCC | 2/16/2007 | Northern Hawk | $25,000.00 |
| | UniSea | 9/11/2007 | Nordic Star | $10,000.00 |
| | Westward | 9/11/2007 | Pacific Prince | $10,000.00 |
| | | | Annual Total | $65,000.00 |
| 2009 | | | | |
| | Akutan | 11/2/2009 | Predator | $10,000.00 |
| | | | Annual Total | $10,000.00 |
| | | | **Total Enforcement Fines:** | **$118,794.30** |

#### 2.1.3.6 Comparison of Penalties under MSA and RHS ICA program

Per the Council's request in June 2011, a comparison was made between penalties imposed under a private contractual agreement such as the ICA and those imposed under the Magnuson Stevens Fishery Conservation and Management Act (MSA). The following was prepared by NOAA General Counsel to provide additional information to the Council on these differences.

Under the MSA, Civil Penalties and Permit Sanctions, 16 USC 1858, the Secretary of Commerce has the authority to impose penalties up to $140,000.[15] Generally, NOAA assesses penalties for violations of the MSA in accordance with NOAA's "Policy for the Assessment of Civil Administrative Penalties and Permit Sanctions" (Penalty Policy).[16] The Policy utilizes the statutory factors identified by the MSA and other statues commonly enforced by NOAA to create a system for determining appropriate penalties.[17] Those factors used are: the nature, circumstances, extent and gravity of the alleged violation; the alleged violator's degree of culpability; the alleged violator's history of prior offenses; and the alleged violator's ability to pay the penalty.[18] The Penalty Policy uses a matrix method to identify the initial base penalty, to which adjustments may be made depending on application of the adjustment factors: History of Compliance; Commercial vs. Recreational Activity; Activity after Violation/Cooperation; and Proceeds of the Unlawful Activity and Any additional Economic Benefit.[19]

[15] Magnuson Stevens Fishery Conservation and Management Act, 16 USC 1858(a); For violations that occur after Dec. 11, 2008, the maximum civil penalty for each violation is $140,000. 73 Fed.Reg. 75321 (Dec. 11. 2008).
[16] The Penalty Policy is published at 76 Fed.Reg. 20959 (Apr. 14, 2011).
[17] See Penalty Policy, p. 3.
[18] Id. See, also, NOAA's civil procedure regulations at 15 CFR 904.108(a).
[19] See Penalty Policy, pp. 8-9.

Under the current Penalty Policy, the Magnuson-Stevens Act Schedule for Offense Level Guidance[20] closed area violations are classified as a Level III Offense under the penalty matrix for the Magnuson-Stevens Act (MSA)[21]. The second axis of the penalty matrix in the Penalty Policy focuses on the degree of mental culpability of the alleged violator and provides four levels of culpability: intentional, reckless, negligent, and unintentional. Thus, the matrix provides the following for a Level III first offense: [22]

| Gravity Offense Level | Level of Culpability | | | |
|---|---|---|---|---|
| | Unintentional | Negligent | Reckless | Intentional |
| III | $5,000-$10,000 | $10,000-$15,000 | $15,000-$20,000 | $20,000-$40,000 |

Generally, under the MSA penalty matrix, the initial base penalty for a closed area offense would be set at the midpoint of the penalty range in the appropriate matrix box corresponding with the culpability of the alleged violator.[23]

In addition to the monetary penalties authorized pursuant to the MSA, seizure and forfeiture of the ex-vessel value of all fish unlawfully harvested in the closed area is consistent with NOAA's enforcement policy that forfeiture of the illegal catch "is considered in most cases as only the initial step in remedying a violation by removing the ill-gotten gains of the offense." See, 50 CFR 600.740(B).

When applying the Penalty Policy in a closed area violation case where the evidence shows, for example, that the violation arose out of the negligence of the operator, the initial base penalty amount would likely be $12,500 (mid-point of the box corresponding to negligent culpability), plus forfeiture of the value of the catch harvested unlawfully from the closed area. If the evidence showed that a violation was unintentional, the initial base penalty in accordance with the MSA penalty matrix would be $7,500. On the other hand, if the evidence showed that a violation was intentional, then the initial base penalty amount could rise to $30,000. In addition, as explained above, any adjustment(s) to the penalty based upon the alleged violator's cooperation or history of prior offenses would be made after establishing the initial base penalty.

It is important to note that if the Agency's assessed penalty is challenged in the course of an enforcement action, the administrative law judge hearing that matter is not bound by the penalty amount proposed by the Agency, and the administrative law judge may increase or decrease the amount in his or her penalty assessment. It is also important to note that the Agency has the authority to settle any particular case which could include some reduction in the penalty amount actually paid.[24]

John Gruver provided some data regarding Cooperative enforcement of the Rolling Hotspot program, including fines that have been assessed against vessels from 2005 through 2009. However, there are insufficient data to determine how the facts in any particular case would or could have been considered in an Agency closed area enforcement action. Nonetheless, from the information provided by Mr. Gruver, it

[20] See Appendix 3 of the Penalty Policy.
[21] See Appendix 2 of the Penalty Policy.
[22] See Penalty Policy, p. 25
[23] See Penalty Policy, p. 7, Section V.
[24] See 16 USC 1858(e).

appears that the current Cooperative policy of penalizing a first tow at $10,000, and a second tow at $15,000, appears to be different from NOAA's penalty policy in a number of ways:

A. the value of the fish unlawfully harvested in the closed area are not seized or otherwise included in the monetary penalty; and
B. the statutory factors required to be considered by the Secretary of Commerce for assessing a penalty are not considered in the Cooperative's internal enforcement action. This is particularly evident with regard to consideration of culpability, since the Cooperative imposes a flat penalty depending upon the number of tows in the closure area in a year;[25]

The Fine Summary (in section 2.1.3.5) also does not explain whether the Cooperative's penalties take into account prior offenses by the vessel owner or manager. Specifically, although no single vessel has apparently been subjected to penalties in two years, it appears that the cooperative Akutan Catcher Vessel Association has numerous instances where one of its vessels incurred a fine for fishing in a closure area. The fines against these vessels do not seem to be affected by their association with Akutan Catcher Vessel Association. This is different than in the context of an Agency enforcement action where the Agency has the discretion to hold the vessel owner, vessel manager, and the cooperative, jointly responsible for the actions of the operator of a vessel.

#### 2.1.3.7 Annual Performance Review

The inter-cooperative produces an annual report to the Council which contains the following:

1. Number of salmon taken by species and season.
2. Estimate of number of salmon avoided as demonstrated by the movement of fishing effort away from salmon hot-spots.
3. A compliance/enforcement report which will include the results of an internal compliance audit and an external compliance audit if one has been done.
4. List of each vessel's number of appearances on the weekly vessel performance lists (note this is a requirement of the AFA coop reports).
5. Acknowledgement that the Agreement term has been extended for another year (maintaining the 3-year lifespan) and report of any changes to the Agreement that were made at the time of the renewal.

An annual third party audit is also conducted to ensure compliance (or report on non-compliance) with the provisions of the ICA. The third party audit is made available to the public and the Council in conjunction with the annual performance review.

### 2.1.4 Chinook Salmon Bycatch Management Measures under Amendment 91

The Council took final action on Amendment 91, Chinook salmon bycatch management measures in the Bering Sea pollock fishery in April 2009. NMFS approved regulations implementing Amendment 91 on August 30, 2010 (72 FR 53026), and the fishery has been operating under the requirements since January 2011. Amendment 91 established two Chinook salmon PSC limits (60,000 Chinook salmon and 47,591 Chinook salmon) for the Bering Sea pollock fishery. For each PSC limit, NMFS issues A season and B season Chinook salmon PSC allocations to the catcher/ processor sector, the mothership sector, the inshore cooperatives, and the CDQ groups. When a PSC allocation is reached, the affected sector, inshore cooperative, or CDQ group is required to stop fishing for pollock for the remainder of the season even if its pollock allocation had not been fully harvested.

NMFS issues transferable allocations of the 60,000 Chinook salmon PSC limit to those sectors that participate in an incentive plan agreement (IPA) and remain in compliance with the performance

[25] The fine amount for the first tow in a closure area in a year is $10,000, $15,000 for the second tow, and $20,000 for the third and each additional tows in the closure area.

standard. Sector and cooperative allocations would be reduced if members of the sector or cooperative decided not to participate in an IPA. Vessels and CDQ groups that do not participate in an IPA fish under a restricted opt-out allocation of Chinook salmon. If a whole sector does not participate in an IPA, all members of that sector would fish under the opt-out allocation.

The IPA component is an innovative approach for fishery participants to design industry agreements with incentives for each vessel to avoid Chinook salmon bycatch at all times and thus reduce bycatch below the PSC limits. To ensure participants develop effective IPAs, the final rule required that participants submit annual reports to the Council that evaluate whether the IPA is effective at providing incentives for vessels to avoid Chinook salmon at all times while fishing for pollock. The sector-level performance standard ensures that the IPA is effective and that sectors cannot fully harvest the Chinook salmon PSC allocations under the 60,000 Chinook salmon PSC limit in most years. Each year, each sector is issued an annual threshold amount that represents that sector's portion of 47,591 Chinook salmon. For a sector to continue to receive Chinook salmon PSC allocations under the 60,000 Chinook salmon PSC limit, that sector must not exceed its annual threshold amount three times within 7 consecutive years. If a sector fails this performance standard, it will permanently be allocated a portion of the 47,591 Chinook salmon PSC limit. Under Amendment 91, NMFS would issue transferable allocations of the 47,591 Chinook salmon PSC limit to all sectors, cooperatives, and CDQ groups if no IPA is approved, or to the sectors that exceed the performance standard.

<u>Transferability:</u> Transferability of PSC allocations was included in Amendment 91 to mitigate the variation in the encounter rates of Chinook salmon bycatch among sectors, CDQ groups, and cooperatives in a given season by allowing eligible participants to obtain a larger portion of the PSC limit in order to harvest their pollock allocation or to transfer surplus allocation to other entities. Entities that receive transferable salmon bycatch allocations have to be created by a contract among the group of eligible AFA participants in that sector. Transferable allocations must be issued to an entity that represents all members of the group eligible to receive the transferable allocation. The entity performs the following functions with NMFS:

- receives an allocation of a specific amount of salmon bycatch on behalf of all members of the entity;
- is authorized to transfer all or a portion of the entity's salmon bycatch allocation to another entity or receive a transfer from another entity (authorized to sign transfer request forms); and
- is responsible for any penalties assessed for exceeding the entity's salmon bycatch allocation (i.e., the entity must have an agent for service of process with respect to all owners and operators of vessels that are members of the entity).

The entities that are recognized by NMFS and receive transferable allocation of Chinook under Amendment 91 are:

- The seven inshore cooperatives that are entities recognized by NMFS through the pollock permitting process. They file contracts with NMFS and are issued permits for specific amounts of pollock. 50 CFR 679.7(k)(5)(ii) prohibits an inshore cooperative from exceeding its annual allocation of pollock. These entities also receive a transferable allocation of Chinook salmon.
- The six CDQ groups that are entities recognized by NMFS to receive groundfish, halibut, crab, and PSQ reserves. 50 CFR 679.7(d)(5) prohibits a CDQ group from exceeding its groundfish, crab, halibut PSC, and transferable Chinook salmon bycatch allocations.
- <u>The CP Salmon Cooperative representing the AFA catcher/processor sector</u>, which includes all members of the Pollock Conservation Cooperative (PCC), the seven catcher vessels named in the AFA, and the catcher/processor *Ocean Peace*.
- <u>The Mothership Fleet Cooperative representing the AFA mothership sector</u>, which includes the catcher vessels authorized under the AFA to deliver to the motherships named in the AFA (*Excellence*, *Ocean Phoenix*, and *Golden Alaska*).

Transferable allocations of Chinook salmon PSC were implemented under Amendment 91, and since the entities involved in the Chinook salmon PSC allocations are impacted by the current non-Chinook salmon actions a brief description is provided below. Further details of the Chinook salmon allocations are found in the Final Bering Sea Chinook Salmon Bycatch Management EIS/RIR.[26]

NMFS only issues transferable allocations of Chinook salmon PSC limit to those sectors that participate in an IPA and remain in compliance with the performance standard. Sector and cooperative allocations are reduced if members of the sector or cooperative decide not to participate in an IPA. Vessels and CDQ groups that do not participate in an IPA fish under a restricted opt-out allocation of Chinook salmon. If a whole sector does not participate in an IPA, all members of that sector fish under the opt-out allocation.

NMFS issues Chinook salmon PSC allocations to the catcher/processor sector, the mothership sector, the seven inshore cooperatives, and the six CDQ groups. Separate allocations are issued for the A season and the B season. Thus there are 15 different Chinook salmon bycatch accounts each season. Separate allocations are made for the A season and the B season for a total of up to 30 transferable bycatch allocation accounts.

Transfers are requests to NMFS from holders of Chinook salmon PSC allocations to move a specific amount of a Chinook salmon PSC from a transferor's (sender's) account to a transferee's (receiver's) account. NMFS's approval is required for any transfer. Chinook salmon remaining in an entity's account from the A season can be used in the B season (''rollover'') but an entity can only transfer PSC allocations to another entity within a season. An entity can also receive transfers of Chinook salmon bycatch to cover overages (''post-delivery transfers'').

Under Amendment 91, requests for transfers may be submitted either electronically or non-electronically through a form available on the NMFS Alaska Region Web site (http:// alaskafisheries.noaa.gov/). The catch accounting system is programmed with an online front-end application that reviews the transferor's catch account during a transfer request to ensure sufficient Chinook salmon is available to transfer and, if it is, to make that transfer effective immediately.

IPAs were submitted and approved for all sectors for the 2011 fishing year. Thus NMFS allocated sector and seasonal proportions of the 60,000 Chinook cap in 2011.

Chinook salmon allocations remaining from the A season can be used in the B season (''rollover''). Entities can transfer PSC allocations within a season and can also receive transfers of Chinook salmon PSC to cover overages (''post-delivery transfers'').

Increased observer coverage and monitoring requirements: The transferable hard caps implemented under Amendment 91 placed new constraints on the Bering Sea pollock fishery, including the need to change observer sampling protocol to census salmon. Under this program, each entity (the catcher/processor sector, the mothership sector, each inshore cooperative, and each CDQ group)) that receives a transferable Chinook salmon bycatch allocation is prohibited from exceeding that allocation. Therefore, the Chinook bycatch limits, if reached, could prevent the full harvest of a pollock allocation to the AFA sectors, inshore cooperatives, or CDQ groups. Amendment 91 significantly increased the economic incentives to under report or misreport the amount of Chinook salmon bycatch or to discard or hide Chinook salmon before they can be counted by an observer. Thus, the monitoring requirements in the Bering Sea pollock fishery changed significantly in 2011 to enable Chinook salmon bycatch accounting.

[26] http://www.alaskafisheries.noaa.gov/sustainablefisheries/bycatch/default.htm

While monitoring and enforcement provisions were put in place specifically to account for Chinook salmon, the methods are also applied to non-Chinook salmon. The monitoring of bycatch of all species of salmon is accomplished through (1) requirements for 100 percent observer coverage for all vessels and processing plants; (2) salmon retention requirements; (3) specific areas to store and count all salmon, regardless of species; (4) video monitoring on at-sea processors; and (5) electronic reporting of salmon by species by haul (for catcher/processors) or delivery (for motherships and shoreside processors). Full retention of all salmon regardless of species is required because it is difficult to differentiate Chinook salmon from other species of salmon without direct identification by the observer. Therefore, although the monitoring was put into place to account for Chinook salmon, all species of salmon are counted using the same methods. Further details about the monitoring provisions implemented under Amendment 91 can be found in the Final Bering Sea Chinook Salmon Bycatch Management EIS/RIR.[27]

Catch Accounting: With the implementation of Amendment 91, the rate-based estimation procedure for salmon caught in the Bering Sea pollock fishery was replaced by a census of salmon. This census is used in the Catch Accounting System (CAS) to enumerate all species of salmon, including non-Chinook salmon species, caught by all sectors in the Bering Sea pollock fishery. The monitoring and observer requirements described in the previous section ensure that information about vessel-specific incidental salmon catch is always obtained and represents all salmon caught during a fishing trip.

Amendment 91 removed from regulations the 29,000 Chinook salmon PSC limit in the Bering Sea, the Chinook Salmon Savings Areas in the Bering Sea, exemption from Chinook Salmon Savings Area closures for participants in the RHS ICA, and Chinook salmon as a component of the RHS ICA. Amendment 91 did not change any regulations affecting the management of Chinook salmon in the Aleutian Islands or non-Chinook salmon in the BSAI.

Details of the Chinook Incentive Plan Agreements (IPAs) implemented in 2011 and 2012

All of the participants in the Bering Sea pollock fishery are subject to one of the IPA agreements. There are three IPA agreements currently in place:

- The Inshore Chinook Salmon Savings Incentive Plan Agreement
- The Mothership Salmon Savings Incentive Plan Agreement
- The Catcher Processor 'Chinook Salmon Bycatch Reduction Incentive Plan and Agreement.'

As well as generally adhering to the requirements of Amendment 91, the three agreements share a number of characteristics. The inshore and mothership sector are both based on the same general 'Salmon savings incentive plan' (SSIP) model, so they share additional features. Below the common features of the three plans are listed, then the features common to the mothership and inshore plans are described, and finally important specific features of each plan are noted.[28]

Features common to all current IPAs

In addition to generally adhering to the Amendment 91 requirements described above, all three agreements have the following characteristics:

- The Fixed A-Season Chinook Salmon Conservation Area (CSCA) continues from the closure first imposed in 2008.
- A rolling hotspot (RHS) program exists for each sector, although details vary. Closures are imposed in "core areas" where bycatch has traditionally occurred to avoid closing areas that are actually low-

[27] http://alaskafisheries.noaa.gov/sustainablefisheries/bycatch/default.htm

[28] This description comes from the amended IPAs that can be found at http://fakr.noaa.gov/sustainablefisheries/bycatch/default.htm

bycatch relative to historically fished areas. This feature is designed to avoid closing areas that the fleet may move to in order to avoid higher-bycatch areas.
- Large fees apply for any fishing violations inside of the RHS closure boundaries.
- The base rate of the RHS programs is 0.035 Chinook/MT pollock, though this adjusts during each season.
- VMS and observer data sharing are both required
- A small "buffer" is taken from each entity allocation and kept in reserve to ensure that the entity does not exceed its overall allocation.

<u>Features common to the Inshore and Mothership Salmon Savings Incentive Plan Agreements</u>
- Vessels can earn "salmon credits" in some years to use in higher bycatch years, subject to the 60,000 Chinook overall limit.
- Proportional pollock and share of salmon can be freely moved ("Paired transfers") but there are taxes and restrictions on other transfers. The tax declines as the sector's bycatch total approaches the cap.
- There is a "SSIP B" that would operate if the sector exceeds its share of the 47,591 standard in 2 of 6 years to prevent a third year above this standard.

<u>Features unique to the Inshore Salmon Savings Incentive Plan Agreement</u>
- Vessels earn one salmon credit for 3 saved – expire in 5 years.
- There is an insurance pool to cover possible vessel allocation overages, where vessels would pay back what's used plus a penalty if the vessel exceeds its holdings. If vessel was behaving conservatively, they are "qualified" users and pay a 50% assessment on top of repayment. If "unqualified," pay 200%.
- In periods of low salmon encounters (< 25% of the sector's share of the 47,591 Annual Threshold Amount), there's a rolling hotspot closure (RHC) program. When aggregate bycatch increases during a year, the closures ("Chinook Savings Areas") go away because the threat of the cap already provides an avoidance incentive. Other RHC program details include:
    - Base rate calculated weekly on 2-week moving average (note this was a correction in the amendment); beginning with Jan 20-29 period
    - Vessels > base rate are Tier 2, < base rate = Tier 1. Tier 2 vessels may not fish in the closures for 1 week, while there no restrictions on Tier 1
    - Weekly reports include each vessel's tier status and weekly 3-week rolling average bycatch rate
    - Up to 3 areas can be closed at a time, not to exceed 1000 square miles.
- Because inter-sector transfers do not change the annual threshold limit, there are strict controls on inter-sector transfers.
- "Mop-up" transfers allowed at end of season
- "Hardship transfers" allow salmon and pollock to be sent together without transfer taxes if a boat stops fishing for some reason.

<u>Features unique to the Mothership Salmon Savings Incentive Plan Agreement</u>
- Chinook account is done at the fleet level, but the rewards and punishments are returned to vessels at the end of the season.
- Special rules allow for how vessels may transfer their salmon to other fleets and sectors at the end of the season to provide opportunities to trade Chinook when this can occur without exceeding the annual use limit.
- Fleets earn one salmon credit for 2.29 salmon saved, and the credits expire in 3 years (first-in, first-out). Credits cannot be transferred between fleets or sectors.
- The rolling hotspot program is called a rolling hotspot closure (RHC) program and functions on a fleet level.

- The RHC program lasts throughout the season.
- Vessels must declare by January 15 to which fleet its pollock will be assigned and its Chinook will be assigned pro-rata.
- Transfers can be made to other fleets, the CP sector, or an inshore cooperative. They cannot use credits in years that they transfer.

Features unique to the Catcher Processor 'Chinook Salmon Bycatch Reduction Incentive Plan and Agreement'

- Three areas in the B season form the "Chinook conservation area" that is closed from October 15-31 if the Chinook base rate is above 0.015 Chinook/MT for September.
- There is full transferability within the sector, without transfer fees.
- There is the need and ability to decide collectively whether or not to exceed the sector's share of 47,591 for 2 of 7 years.
- There are limits on the size and number of RHS closures.
  - 500 sq mile & 2 areas W of 168W
  - 2 areas E of 168W
  - Max 4 areas total, 1500 sq miles total.
- RHS closures put in place for 1-week at the vessel's level compared to the base rate. Under some conditions, closures can be imposed on some vessels with a high aggregate bycatch rate for a second week.

## 2.2 Alternative 2: Hard Cap

Alternative 2 would establish separate chum salmon PSC caps for the pollock fishery in the B season. When the hard cap is reached, all directed fishing for pollock must cease for either the remainder of the year (Option 1a) or until August 1 (Option 1b). Only those non-Chinook salmon caught by vessels participating in the directed pollock fishery would accrue towards the cap. When the cap is reached, directed fishing for pollock would be prohibited during the applicable time frame.

Alternative 2 contains components, and options for each component, to determine (1) the total hard cap amount and time frame over which the cap is applied, (2) whether and how to allocate the cap to sectors, (3) whether and how salmon bycatch allocations can be transferred among sectors, and (4) whether and how the cap is allocated to and transferred among catcher vessel (CV) cooperatives.

If none of the options under Components 2 through 4 are selected, the Alternative 2 hard cap would apply at the fishery level and would be divided between the CDQ and non-CDQ fisheries. The CDQ Program would receive an allocation of 10.7 percent of a fishery level hard cap. The CDQ Program allocation would be further allocated among the six CDQ groups based on percentage allocations currently in effect. Each CDQ group would be prohibited from exceeding its chum salmon cap. This prohibition would require the CDQ group to stop directed fishing for pollock once its cap was reached because further directed fishing for pollock would likely result in exceeding the cap.

The remaining 89.3 percent of a fishery level hard cap would be apportioned to the non-CDQ sectors (inshore CV sector, offshore CP sector, and mothership sector) combined. The inshore CV sector contains up to seven cooperatives, each composed of multiple fishing vessels associated with a specific inshore processor. There also is a possibility than an inshore open access sector could form, if one or more catcher vessels do not join an inshore cooperative. All bycatch of non-Chinook salmon by any vessel in any of these three AFA sectors would accrue against the fishery level hard cap, and once the cap was reached, NMFS would simultaneously prohibit directed fishing for pollock by all three of these sectors.

Under Alternative 2, existing regulations related to the non-Chinook salmon PSC limit of 42,000 salmon and triggered closures of the Chum SSA in the Bering Sea would be removed from 50 CFR part 679.21.

Per Council direction (June 2010), the impact of implementing specific cap levels for Alternative 2 was analyzed based on a subset of the range of cap levels, as indicated in the tables under each component and option.

### 2.2.1 Component 1: Setting the Hard Cap

Component 1 would establish the annual hard cap based upon a range of numbers as shown below. Component 1 sets the overall cap; this could be either applied at the pollock fishery level to the CDQ and non-CDQ fisheries (not allocated by sector within the non-CDQ sectors), or may be subdivided by sector (Component 2) and the inshore sector allocation further allocated among the inshore cooperatives (Component 4).

#### 2.2.1.1 Range of numbers for a hard cap

There are two options considered under the establishment of a non-Chinook PSC limit for vessels fishing in the directed pollock fishery. These options differ by whether the cap is established for the entire B season (Option 1a) or for June and July only (Option 1b).

*Option 1a: Apply a non-Chinook PSC limit to vessels participating in the directed pollock fishery for the entire B season*

Under this option the hard cap (non-Chinook PSC limit) would be established for vessels fishing in the directed pollock fishery according to the range of suboptions as shown below and would be applicable for the entire B season. Once reached, this cap would require all vessels affected by the cap to stop fishing for the remainder of the season.

The range of non-Chinook salmon PSC hard caps considered is shown below. As shown below, the CDQ Program would be allocated 10.7 percent of the fishery level cap with the remainder allocated to the combined non-CDQ fishery.

Range of suboptions for Option 1a cap for non-Chinook with allocations for CDQ Program (10.7%) and remainder for non-CDQ fishery (89.3%)

| | Non-Chinook | CDQ | Non-CDQ |
|---|---|---|---|
| i) | **50,000** | 5,350 | 44,650 |
| ii) | 75,000 | 8,025 | 66,975 |
| iii) | 125,000 | 13,375 | 111,625 |
| iv) | **200,000** | 21,400 | 178,600 |
| v) | 300,000 | 32,100 | 267,900 |
| vi) | **353,000** | 37,771 | 315,229 |

For analytical purposes only, a subset of the cap numbers included in the six suboptions will be used in the impact analysis to assess the impacts of operating under a given hard cap. This subset approximates the upper and lower endpoints of the suboption range, and a midpoint (in **bold** above).

*Option 1b: Apply a non-Chinook PSC limit to vessels participating in the directed pollock fishery during June and July*

Under this option the hard cap (non-Chinook PSC limit) would be established for vessels fishing in the directed pollock fishery during June and July. Once reached, this cap would require all vessels affected by the cap to stop fishing until August 1.

The range of cap suboptions under Option 1b are shown in the table below. They represent the proportion of non-Chinook PSC caught in June and July relative to the B season total during 2003 through 2011. **Bolded** suboptions represent the subset for the analysis.

Range of suboptions for Option 1b cap for non-Chinook with allocations for CDQ Program (10.7%) and remainder for non-CDQ fishery (89.3%)

| | Non-Chinook | CDQ | Non-CDQ |
|---|---|---|---|
| 1) | **15,600** | **1,669** | **13,931** |
| 2) | 23,400 | 2,504 | 20,896 |
| 3) | 39,000 | 4,173 | 34,827 |
| 4) | **62,400** | **6,677** | **55,723** |
| 5) | 93,600 | 10,015 | 83,585 |
| 6) | **110,136** | **11,785** | **98,351** |

The cap numbers initially represented a range of rounded historical averages over different 3-, 5- and 10-year time periods ranging from 1997 through 2006. The Council chose to modify these averages based both on more recent year averages as well as downward adjustments that the Council made in their

December 2009 motion (for complete Council motions from December 2009 and June 2010 see Appendix 1 to Chapter 2). For comparison, Table 2-2 shows the resulting change in these time periods for historical averaging by using the most recent time frame as opposed to averaging only from time frames 2006 and earlier.

Table 2-2. Comparison of historical averages using previous time frame (1997-2006) time periods with more recent (1997-2009) 3-, 5-, and 10-yr averages

| Period (current alternative set) | Average (# of salmon) | Period | Average (# of salmon) |
|---|---|---|---|
| 2004-2006 | 484,895 | 2007-2009 | 51,629 |
| 2002-2006 | 344,898 | 2005-2009 | 233,820 |
| 1997-2006 | 201,195 | 2000-2009 | 199,489 |
| 1997-2001 | 57,493 | | |

### 2.2.2 Component 2: Sector Allocation

If this component is selected, the hard cap would be apportioned to the sector level. This would result in separate sector level caps for the CDQ sector, the inshore CV sector, the mothership sector, and the offshore catcher/processor (CP) sector.

The bycatch of non-Chinook salmon would be counted on a sector level basis. If the total non-Chinook salmon bycatch in a non-CDQ sector reaches the cap for that sector, NMFS would close directed fishing for pollock by that sector for the remainder of the season. The remaining sectors may continue to fish until they reach their sector level cap. The CDQ Program would continue to be managed as the status quo, with further allocation of the CDQ salmon bycatch cap among the six CDQ groups, transferable allocations within the CDQ Program, and a prohibition against a CDQ group exceeding its salmon bycatch cap.

For analytical purposes, a subset of the sector level cap options that provides the greatest contrast will be used for detailed analysis.

#### 2.2.2.1 Option 1: Sector level caps based on pollock allocation under AFA

**Option 1)** 10% of the cap to the CDQ sector, and the remaining allocated as follows: 50% inshore CV sector; 10% for the mothership sector; and 40% for the offshore CP sector. This results in sector level caps of 45% inshore CV, 9% mothership, and 36% offshore CP.

This option would set the sector level hard caps based on the percentage established for pollock allocations under the AFA. Application of these percentages results in the following range of sector level caps, based upon the range of caps in Component 1, Option 1 (Table 2-3).

#### 2.2.2.2 Options 2-6: Historical average of non-Chinook salmon bycatch by sector and blended adjustment of pro-rata and historical

Under Option 2, sector level caps would be set for each sector based on a range of sector allocation percentages. Table 2-6 summarizes the range of sector allocations resulting from Options 1 through 6 and suboptions under each.

**Option 2**) Historical average of percent bycatch by sector, based on:

i. 3-year (2007-2009)

ii. 5-year (2005-2009)
iii. 10-year (2000-2009)
iv. 14-year (1997-2009)

**Option 3**) Allocation based on 75% pro-rata and 25% historical
i. 3-year (2007-2009)
ii. 5-year (2005-2009)
iii. 10-year (2000-2009)
iv. 14-year (1997-2009)

**Option 4**) Allocation based on 50% pro-rata and 50% historical
i. 3-year (2007-2009)
ii. 5-year (2005-2009)
iii. 10-year (2000-2009)
iv. 14-year (1997-2009)

**Option 5**) Allocation based on 25% pro-rata and 75% historical
i. 3-year (2007-2009)
ii. 5-year (2005-2009)
iii. 10-year (2000-2009)
iv. 14-year (1997-2009)

**Option 6)** Allocate 10.7% to CDQ, remainder divided 44.77% to Inshore CV, 8.77% to Mothership and 35.76% to Catcher Processors.

Table 2-3. Sector percentage allocations resulting from Options 1 through 6. Note that percentage allocations under Option 6 for the remaining sections are not included at this time. The allocation included for analytical purposes are shown in **bold**.

| Time Period for Average | Option | % historical: pro-rata | CDQ | Inshore CV | Mothership | Offshore CPs |
|---|---|---|---|---|---|---|
| NA (AFA) | 1 | 0:100 | 10.0% | 45.0% | 9.0% | 36.0% |
| 2007-2009 | 2i | 100:0 | 4.4% | 75.6% | 5.6% | 14.4% |
| | 3i | 75:25 | 5.8% | 67.9% | 6.5% | 19.8% |
| | 4i | 50:50 | 7.2% | 60.3% | 7.3% | 25.2% |
| | 5i | 25:75 | 8.6% | 52.6% | 8.2% | 30.6% |
| **2005-2009** | **2ii** | **100:0** | **3.4%** | **81.5%** | **4.0%** | **11.1%** |
| | 3ii | 75:25 | 5.0% | 72.4% | 5.3% | 17.3% |
| | **4ii** | **50:50** | **6.7%** | **63.3%** | **6.5%** | **23.6%** |
| | 5ii | 25:75 | 8.3% | 54.1% | 7.8% | 29.8% |
| 2000-2009 | 2iii | 100:0 | 4.4% | 76.0% | 6.2% | 13.4% |
| | 3iii | 75:25 | 5.8% | 68.3% | 6.9% | 19.1% |
| | 4iii | 50:50 | 7.2% | 60.5% | 7.6% | 24.7% |
| | 5iii | 25:75 | 8.6% | 52.8% | 8.3% | 30.4% |
| 1997-2009 | 2iv | 100:0 | 4.4% | 74.2% | 7.3% | 14.1% |
| | 3iv | 75:25 | 5.8% | 66.9% | 7.8% | 19.5% |
| | 4iv | 50:50 | 7.2% | 59.6% | 8.2% | 25.0% |
| | 5iv | 25:75 | 8.6% | 52.3% | 8.6% | 30.5% |
| **Suboption (10.7% to CDQ)** | **6** | **NA** | **10.7%** | **44.77%** | **8.77%** | **35.76%** |

For analysis the following range of sector allocations will be examined:

| Option | CDQ | Inshore CV | Mothership | CP |
|---|---|---|---|---|
| 2ii (sector allocation 1) | 3.4% | 81.5% | 4.0% | 11.1% |
| 4ii (sector allocation 2) | 6.7% | 63.3% | 6.5% | 23.6% |
| Suboption (sector allocation 3) | 10.7% | 44.77% | 8.77% | 35.76% |

Based on the cap levels noted under Component 1 for analysis, the sector level caps under Component 2, and the cooperative provisions under Component 3 to be analyzed, the following shows the sector level caps to be evaluated in this analysis (Table 2-4). Note that cooperative level caps to the inshore CV sector will be analyzed qualitatively (see Section 2.2.4 for cooperative provisions and allocations).

Table 2-4. Alternative 2 non-Chinook salmon sector level caps for analysis (note sector level numbers refer to options as listed in Table 2-3 above)

| Hard cap | Sector allocation | CDQ | CV | MS | CP |
|---|---|---|---|---|---|
| | 1 | 1,700 | 40,750 | 2,000 | 5,550 |
| 50,000 | 2 | 3,350 | 31,650 | 3,250 | 11,800 |
| | 3 | 5,350 | 22,385 | 4,385 | 17,880 |
| 200,000 | 1 | 6,800 | 163,000 | 8,000 | 22,200 |
| | 2 | 13,400 | 126,600 | 13,000 | 47,200 |
| | 3 | 21,400 | 89,540 | 17,540 | 71,520 |
| | 1 | 12,002 | 287,695 | 14,120 | 39,183 |
| 353,000 | 2 | 23,651 | 223,449 | 22,945 | 83,308 |
| | 3 | 37,771 | 158,038 | 30,958 | 126,233 |

### 2.2.3 Component 3: Sector Transfer

The two options under this component may be selected only if the hard cap is apportioned among the sectors under Component 2. Options 1 and 2 are mutually exclusive, which means that either Option 1 to allow sector level transferable allocations or Option 2 to require NMFS to reapportion salmon bycatch from one sector to the other sectors in a season could be selected.

If sector level caps under Component 2 are selected, but neither Option 1 (transfers) or Option 2 (reallocations) are selected under Component 3, the sector level cap would not change during the year and NMFS would close directed fishing for pollock through notice in the *Federal Register* once each sector reached its sector level cap. There could be no movement of salmon bycatch hard cap allocations between the catcher/processor, mothership, inshore, or CDQ sectors. The short delay associated with inseason closures would require NMFS to closely monitor pollock catch and salmon bycatch in order to project when a sector might reach its salmon bycatch hard cap. NMFS would use observer counts and the monitoring requirements put into place for Amendment 91 to determine the amount of salmon bycatch made by each sector.

Because the CDQ sector level cap would be allocated to the CDQ groups, the CDQ caps would continue to be managed as they are under status quo, with further allocation of the non-Chinook salmon bycatch cap among the six CDQ groups, transferable allocations within the CDQ Program, and a prohibition against a CDQ group exceeding is salmon bycatch allocation.

#### 2.2.3.1 Option 1: Transferable salmon bycatch caps

**Option 1)** Allocate salmon bycatch caps to each sector and allow the entity representing each non-CDQ sector and the CDQ groups to transfer salmon bycatch cap among the sectors and CDQ groups.

To provide sectors and cooperatives more opportunity to fully use their pollock allocations, the ability to transfer sector level non-Chinook salmon caps could be implemented as part of Alternative 2. If sectors are issued transferable non-Chinook salmon caps, then these entities could request NMFS to move salmon bycatch cap amounts from one entity's account to another entity's account during a fishing season. Transferable caps would not constitute a "use privilege" and, under the suboptions, only a portion of the residual salmon bycatch cap may be transferred.

**Suboption:** Limit transfers to the following: a) 50%, b) 70%, or c) 90% of available salmon bycatch cap.

If a transferring entity had completed harvested its pollock without reaching its non-Chinook salmon bycatch cap, it could only transfer up to a specific percent of that salmon bycatch cap to another entity with pollock still remaining for harvest in that season. Under this circumstance, this transfer provision would mean that not all of the salmon bycatch cap would be available for use by entities other than the original recipient of the cap.

Transfers are voluntary requests to NMFS, initiated by the entity receiving a salmon bycatch cap, for NMFS to move a specific amount of a salmon bycatch cap from one entity's account to another entity's account.

Option 1 would require that each sector receiving a transferable salmon bycatch cap be represented by an entity that could:

- represent all vessels eligible to participate in the particular AFA sector and receive an amount of non-Chinook salmon bycatch cap on behalf of those vessels,
- be authorized by all members of the sector to transfer all or a portion of the sector's non-Chinook salmon bycatch cap to another sector or to receive a chum salmon bycatch cap transfer from another sector on behalf of the members of the sector,
- be responsible for any penalties assessed for exceeding the sector's non-Chinook salmon bycatch cap (i.e., have an agent for service of process with respect to all owners and operators of vessels that are members of the entity).

More information about the entities necessary to receive transferable non-Chinook salmon bycatch caps is in Section 0.

Under Option 1, each CDQ group allocation may be transferred between CDQ groups as well as among other AFA entities. Once sector level salmon bycatch hard caps are allocated to an entity representing an AFA sector or to a CDQ group, each entity receiving a transferable cap would be prohibited from exceeding that cap. NMFS would report any overages of the cap to NOAA Office of Law Enforcement for enforcement action.

A non-Chinook salmon bycatch transfer between different entities in the pollock fishery would require NMFS approval before the transaction could be completed. Per existing agency practice with other fishery programs with transferrable allocations, NMFS would review the transferring entities catch record to ensure sufficient amounts of salmon bycatch hard cap allocation was available to transfer. NMFS has developed the internal processes that allow quota share and allocation holders in various Alaska fisheries to conduct transfers through the NMFS web site. Such a process would be extended to transferable non-Chinook salmon bycatch allocations. The transfer process would be conducted through an online web site that allows entities to log onto a secure NMFS web site and make a salmon bycatch allocation transfer.

### 2.2.3.2 Option 2: Reallocate unused salmon bycatch to other sectors

**Option 2)** NMFS manages the sector level caps for the non-CDQ sectors and would reallocate unused salmon bycatch caps to other sectors still fishing in a fishing season based on the proportion of pollock remaining for harvest.

A "reallocation" is a management action taken by NMFS to move salmon bycatch caps that remain in a season after a sector had stopped directed fishing for pollock to another AFA sector, CDQ sector, or the inshore open access fishery through a notice in the *Federal Register*. Reallocations are an alternative to transferable caps that allow one sector to voluntarily transfer unused salmon bycatch cap amounts to another sector.[29]

Under this option, if a non-CDQ AFA sector has completed harvest of its pollock allocation without reaching its sector level bycatch cap, and sufficient salmon bycatch cap remains to be reallocated, NMFS would reallocate the unused amount of salmon bycatch cap to other AFA sectors, including CDQ groups. Any reallocation of salmon bycatch caps by NMFS would be based on the proportion each sector represented of the total amount of pollock remaining for harvest by all sectors through the end of the season. Successive reallocations would occur as each non-CDQ sector completes harvest of its pollock allocation.

For example, if the catcher/processor sector completed harvest of its pollock allocation, but still had some remaining salmon bycatch hard cap, and if the mothership sector, inshore sector, and CDQ sector had remaining pollock, NMFS would reallocate the catcher/processor sector's remaining non-Chinook salmon allocation to the other pollock sectors. This is portrayed in the following table, in which there is a 1,000 non-Chinook salmon bycatch hard cap allocation remaining in the catcher/processor sector level hard cap (Table 2-5).

Table 2-5. Example of a non-Chinook salmon bycatch sector level cap reallocation to remaining sectors from catcher/processor sector level hard cap

| Sector | Pollock remaining | Percent of total pollock remaining | Reallocation of 1,000 salmon |
|---|---|---|---|
| Inshore | 20,000 t | 77 | 770 |
| Mothership | 5,000 t | 20 | 200 |
| CDQ Program | 1,000 t | 3 | 30 |
| Total | 26,000 t | 100 | 1,000 |

Reallocations of non-Chinook salmon bycatch hard caps among AFA sectors could include the CDQ sector as a recipient of reallocations. Any salmon bycatch hard cap reallocated to the CDQ sector during a year would be further allocated among the CDQ groups, based on each group's percentage allocation of salmon bycatch. However, reallocations from the CDQ sector to other AFA sectors are not practicable under the current allocation structure of the CDQ sector. A percentage of the current salmon PSC limits currently are allocated to the CDQ sector. These PSC allocations are then further allocated among the six CDQ groups as transferable salmon PSQ. Therefore, once allocated among the CDQ groups, NMFS could not reallocate salmon bycatch from one or more CDQ groups through a reallocation.

Regulatory guidelines would be needed to allow NMFS to reallocate salmon bycatch. For example, the following process could be used for reallocations:

[29] NMFS uses the term "rollover" to mean when a seasonal allocation is underharvested and the remaining amount rolls over to the next season.

*If, during a fishing season, the Regional Administrator determines that a non-CDQ AFA sector has completed harvest of its pollock allocation without reaching its sector level hard cap and sufficient salmon bycatch hard cap remains to be reallocated, the Regional Administrator would reallocate the projected unused amount of salmon bycatch hard cap to other AFA sectors (including CDQ), through notification in the Federal Register. Any reallocation of salmon bycatch hard cap by the Regional Administrator would be based on the proportion each sector represents of the total amount of pollock remaining for harvest by all sectors through the end of the season. Successive reallocation actions would occur as each sector completes harvest of its pollock allocation.*

### 2.2.4 Component 4: Cooperative provisions

Options under this component may be selected only if sector level bycatch caps are set under Component 2. Component 4 would further subdivide the inshore CV sector level bycatch cap to the inshore cooperatives and the inshore open access fishery (if the inshore open access fishery exists in a particular year). Each inshore cooperative would manage its cap and would be required to stop directed fishing for pollock once the cooperative's cap is reached. NMFS would close the inshore open access fishery once that fishery's cap is reached.

The cap of salmon to the inshore CV cooperatives or to the inshore open access fishery would be based upon the proportion of total inshore CV sector pollock catch history associated with the vessels in the cooperative or inshore open access fishery, respectively. The annual pollock quota for this sector is allocated by applying a formula that allocates catch to a cooperative, or the inshore open access fishery, according to the sum of the catch history for the vessels in the cooperative or the inshore open access fishery, respectively. Under 50 CFR 679.62(a)(1), the individual catch history of each vessel is equal to the sum of inshore pollock landings from the vessel's best 2 out of 3 years from 1995 through 1997, and includes landings to catcher/processors for vessels that made landings of 500 mt or more in 1995, 1996, or 1997.

Each year, NMFS issues fishing permits to cooperatives based on the cooperative's permit application, which lists all cooperative member catcher vessels. Fishing in the inshore open access fishery is possible should a vessel leave a cooperative, and the inshore CV pollock allocation allows for an allocation to an inshore open access fishery under these circumstances.

The range of inshore cooperative level caps in this analysis is based on the 2010 pollock allocations, and the options for the range for the inshore CV sector is based on Alternative 2 caps for analysis. All inshore sector CVs have been part of a cooperative since 2005 except two vessels in 2010. However, if this component is selected, regulations would accommodate allocations of the non-Chinook salmon bycatch cap to the inshore open access fishery, if, in the future, a vessel or vessels did not join a cooperative.

Table 2-6. Alternative 2 inshore catcher vessel sector non-Chinook salmon bycatch limits by cooperative based on 2010 pollock allocations.

| Hard cap | Sector Allocation | Akutan CV Assoc | Arctic Enterprise | Northern Victor Fleet | Peter Pan Fleet | Unalaska | Unisea Fleet | Westward Fleet | Open access AFA |
|---|---|---|---|---|---|---|---|---|---|
| 2010 pollock allocation | | 32.02% | 0.00% | 9.38% | 2.88% | 10.49% | 25.95% | 18.49% | 0.00% |
| 50,000 | 1 | 13,050 | 0 | 3,822 | 1,172 | 4,276 | 10,576 | 7,534 | 0 |
| | 2 | 10,136 | 0 | 2,968 | 910 | 3,321 | 8,214 | 5,851 | 0 |
| | 3 | 7,169 | 0 | 2,099 | 644 | 2,349 | 5,810 | 4,139 | 0 |
| 200,000 | 1 | 52,199 | 0 | 15,286 | 4,688 | 17,104 | 42,305 | 30,135 | 0 |
| | 2 | 40,542 | 0 | 11,873 | 3,641 | 13,284 | 32,858 | 23,406 | 0 |
| | 3 | 28,674 | 0 | 8,397 | 2,575 | 9,395 | 23,239 | 16,554 | 0 |
| 353,000 | 1 | 92,131 | 0 | 26,980 | 8,274 | 30,188 | 74,668 | 53,189 | 0 |
| | 2 | 71,557 | 0 | 20,955 | 6,426 | 23,447 | 57,994 | 41,311 | 0 |
| | 3 | 50,610 | 0 | 14,821 | 4,545 | 16,583 | 41,017 | 29,218 | 0 |

While NMFS recognizes inshore cooperatives as entities, the sector as whole is not represented by an entity recognized by NMFS. If Component 4 is not selected, non-Chinook salmon bycatch allocations would not be issued to the inshore cooperatives, as Chinook salmon currently is allocated under Amendment 91. This would require the inshore cooperatives and any catcher vessels not in a cooperative would to create an umbrella entity that represented all participants in the inshore sector. As noted below, creating a new a different entity for allocations of non-Chinook salmon that does not exist for allocations of Chinook salmon would increase the complexity of the salmon bycatch management measures.

### 2.2.4.1 Cooperative transfer options

These options would only apply if the sector level bycatch caps under Component 2 and the inshore CV sector level cap is further allocated among the inshore cooperatives and the inshore open access fishery (if the inshore open access fishery existed in a particular year) under Component 4. Option 1 or Option 2 or both could be selected.

When a salmon inshore cooperative cap is reached, the cooperative must stop fishing for pollock and may:

**Option 1)** Transfer (lease) its remaining pollock to another inshore cooperative for the remainder of the season or year. Allow inter-cooperative transfers of pollock to the degree currently authorized by the AFA.

**Option 2)** Transfer salmon bycatch cap amounts from other inshore cooperatives (industry initiated)

**Suboption**: Limit transfers to the following: a) 50%, b) 70%, or c) 90% of available salmon

Option 1, would allow an inshore cooperative to transfer pollock to another inshore cooperative after the first cooperative's Chinook salmon allocation is reached. This option provides another means in addition to the transfer of the Chinook salmon bycatch allocations to match available pollock and available salmon bycatch for the inshore cooperatives.

Sections 206(a) and (b) of the AFA establish the allocation of the TAC of pollock among the different AFA sectors, including the CDQ Program. Section 213(c) allows the Council to supersede some provisions of the AFA under certain circumstances. However, section 213(c) specifically does not allow the Council to supersede the sector allocations of pollock in sections 206(a) and 206(b). Therefore, the AFA's allocation requirements effectively preclude the transfer of pollock from *one sector to another*. However, the AFA would allow the transfer of pollock among the inshore cooperatives. Such transfers would be subject to the 90 percent processor delivery requirement in section 210(b), which requires that 90 percent of the pollock allocated to an inshore cooperative must be delivered to the inshore processor associated with that cooperative. The AFA specifically requires that this provision be included in the inshore cooperative contracts and NMFS regulations contain this contract requirement in the inshore cooperative permitting requirements at § 679.4(l)(6).

Although not prohibited by the AFA, NMFS regulations currently do not authorize the transfer of pollock among the inshore cooperatives. Thus far, regulations authorizing inter-cooperative transfers of pollock have not been recommended to NMFS by the Council. However, regulations could be amended to allow pollock transfers among inshore cooperatives, subject to the requirement that the inshore cooperative contracts continue to include the 90 percent processor delivery requirement. These regulatory amendments could be made without requiring the Council to supercede requirements of the AFA.

Full transferability of pollock among the inshore cooperatives by superseding the 90 percent processor delivery requirements of subsections 210(b)(1) and (b)(6), could be allowed as long as the findings required in section 213(c)(1) of the AFA are made. To supersede this requirement, the Council would have to provide a rationale that explained why the proposed action mitigated adverse effects on fishery cooperatives and how it took into account all factors affecting the fisheries, including rationale explaining that the action was imposed fairly and equitably, to the extent practicable, among and within the sectors in the pollock fishery.

Option 1 would require NMFS to monitor the pollock harvest for each cooperative and track amounts of transferred pollock among cooperatives. By way of example, NMFS has implemented management programs that allow the transfer of fish among entities in various BSAI and Gulf of Alaska fisheries. These programs use a combination of electronic reporting done by the processing plant, online account access for cooperatives, and NMFS approval and tracking of transfers. Option 1 would be similar to other programs in that annual allocations of pollock would be tracked for each cooperative using the existing NMFS's Catch Accounting System (CAS) and electronic reporting system (eLandings). The CAS is configured to track cooperative-specific amounts of pollock, but in its current configuration does not accommodate pollock transfers. Thus, adjustment to the CAS would be needed to accommodate programming complexities associated with transfers, business rules, and CAS account structure.

Pollock transfers would require NMFS approval before the transaction could be completed. Upon receipt of a transfer application, NMFS would review a cooperative's catch to ensure its salmon cap was reached and that an adequate amount of pollock was available. The transfer process could be through eLandings or using a paper application process. NMFS prefers online transfers because paper-based transfers increase staff burden, the time required to complete a transfer, and may only be completed during business hours.

Online accounting of pollock is dependent on the CAS structure, which is the primary repository for catch data. The online interface would need to allow harvesters and NMFS to check account balances, make and accept transfers of pollock, and allow account balances to be updated based on transferred pollock and inseason reallocations of pollock from the ICA and the Aleutian Islands, should such reallocations occur. The online system would not allow cooperatives to receive transfers of pollock if they do not have any remaining Chinook salmon bycatch allocation. Thus, pollock allocation amounts and associated CAS account structure is dependent on whether salmon bycatch is allocated to the cooperative level and transferability of salmon is allowed. Any changes to the CAS required for salmon allocation transfers would need to interface with pollock transfer accounting.

A summary of the components, options and suboptions of Alternative 2 is contained in Table 2-7.

Table 2-7. Summary of Alternative 2 components, options, and suboptions for analysis.

| Component | Option | | | | |
|---|---|---|---|---|---|
| **Setting the hard cap (Component 1)** | Option 1a: Cap established for B season. Select cap from a range of numbers* | **Non-Chinook total** | **CDQ** | **Non-CDQ** | |
| | | 50,000 | 5,350 | 44,650 | |
| | | 200,000 | 21,400 | 178,600 | |
| | | 353,000 | 37,771 | 315,229 | |
| | Option 1b: Cap established for June and July. Select cap from a range of numbers* | 15,600 | 1,669 | 13,931 | |
| | | 62,400 | 6,677 | 55,723 | |
| | | 110,136 | 11,785 | 98,351 | |
| **Sector allocation (Component 2)*** | Range of sector allocations* | CDQ | Inshore CV | Mothership | Offshore CP |
| | Option 2ii | 6.7% | 63.3% | 6.5% | 23.6% |
| | Option 4ii | 3% | 70% | 6% | 21% |
| | Option 6 | 10.7% | 44.77% | 8.77% | 35.76% |
| **Sector transfers and rollovers (Component 3)** | No transfers (Component 3 not selected) | | | | |
| | Option 1 | Caps are transferable among sectors and CDQ groups within a fishing season | | | |
| | | Suboption: Maximum amount of transfer limited to: | | a | 50% |
| | | | | b | 70% |
| | | | | c | 90% |
| | Option 2 | NMFS rolls over unused salmon PSC to sectors still fishing in a season, based on proportion of pollock remaining to be harvested. | | | |
| **Cooperative Allocation and transfers (Component 4)** | No allocation | Allocation managed at the inshore CV sector level. (Component 4 not selected) | | | |
| | Allocation | Allocate cap to each cooperative based on that cooperative's proportion of pollock allocation. | | | |
| | Option: Cooperative Transfers | Option 1 | Lease pollock among cooperatives in a season or a year | | |
| | | Option 2 | Transfer salmon PSC (industry initiated) | | |
| | | Suboption Maximum amount of transfer limited to the following percentage of salmon remaining: | | a | 50% |
| | | | | b | 70% |
| | | | | c | 90% |

*Table reflects subset of numbers for analysis.

### 2.2.5 Management and Monitoring Under Alternative 2

Alternative 2 would establish a hard cap to limit non-Chinook salmon bycatch in the pollock fishery. When the hard cap is reached all directed fishing for pollock must cease. Only those non-Chinook salmon caught by vessels participating in the directed fishery for pollock would accrue towards the cap, and fishery closures on reaching the hard cap would apply only to directed fishing for pollock. Several different options as to the scale of management for the hard cap are provided under this alternative: at the fishery level (separate hard caps for the CDQ Program and the remaining three AFA sectors combined); at the sector level (each of the four AFA sectors including the CDQ sector receive a sector level hard cap with the CDQ sector level hard cap allocated to the individual CDQ groups); and at the cooperative level.

The observer and monitoring requirements currently in place to account for Chinook salmon bycatch under Amendment 91 also enable NMFS to monitor non-Chinook salmon bycatch under a hard cap. Therefore, NMFS does not anticipate changes to observer requirements or additional monitoring provisions under the hard cap alternative. Catch accounting would rely on the information described for Alternative 1 (status quo) in section 0.

As described in the status quo, NMFS currently monitors allocations of Chinook salmon PSC that are allocated to 15 entities, each with two seasonal allocations. ***NMFS strongly recommends that if the Council includes sector and cooperative level allocations of non-Chinook salmon PSC under either Alternative 2 or 3 that those allocations are made to the same sector entities that have been created for allocations of Chinook salmon.*** In other words, the non-Chinook PSC allocations would be made to:

- to the entity representing the catcher/processor sector (currently the CP Salmon Corporation);
- the mothership sector (currently the Mothership Fleet Cooperative);
- the seven inshore cooperatives; and
- the six CDQ groups

Consistent allocation categories for Chinook and non-Chinook salmon would greatly simplify administrative functions for NMFS and the industry. Existing contracts and application to NMFS establishing these entities could be modified to incorporate the responsibility for receiving and managing non-Chinook salmon PSC allocations.

## 2.3 Alternative 3: Trigger closure with RHS exemption

Alternative 3 would create new boundaries for the Chum Salmon Savings Area. The existing Chum Salmon Savings Area and associated trigger cap would be removed from regulation. The new boundaries would encompass the area of the Bering Sea where historically 80 percent of non-Chinook prohibited species catch occurred from 2003 through 2011 B season (Figure ES-3). The trigger caps that would close this area are described below. The area closure would apply to pollock vessels that are not in an RHS system when total non-Chinook salmon PSC from all vessels (those in an RHS system and those not in an RHS system) reaches the trigger cap level. The trigger cap would be allocated between the CDQ and non-CDQ pollock fisheries, as currently is done under status quo. The non-CDQ allocation of the trigger cap would not be further allocated among the AFA sectors or inshore cooperatives, unless options to do so were selected under Components 2 through 6.

Component 1 of this alternative sets the trigger PSC cap level for this large scale closure. PSC from all vessels will accrue towards the cap level selected. However if the cap level is reached, the triggered closure would not apply to participants in the RHS program. Under Component 2, however, in addition to the large closure for non-RHS participants, a select triggered area closure would apply to RHS participants. Four options of triggered closure areas and time frames are provided under Component 2. Component 3 then sets the trigger PSC cap level for the area selected under Component 2.

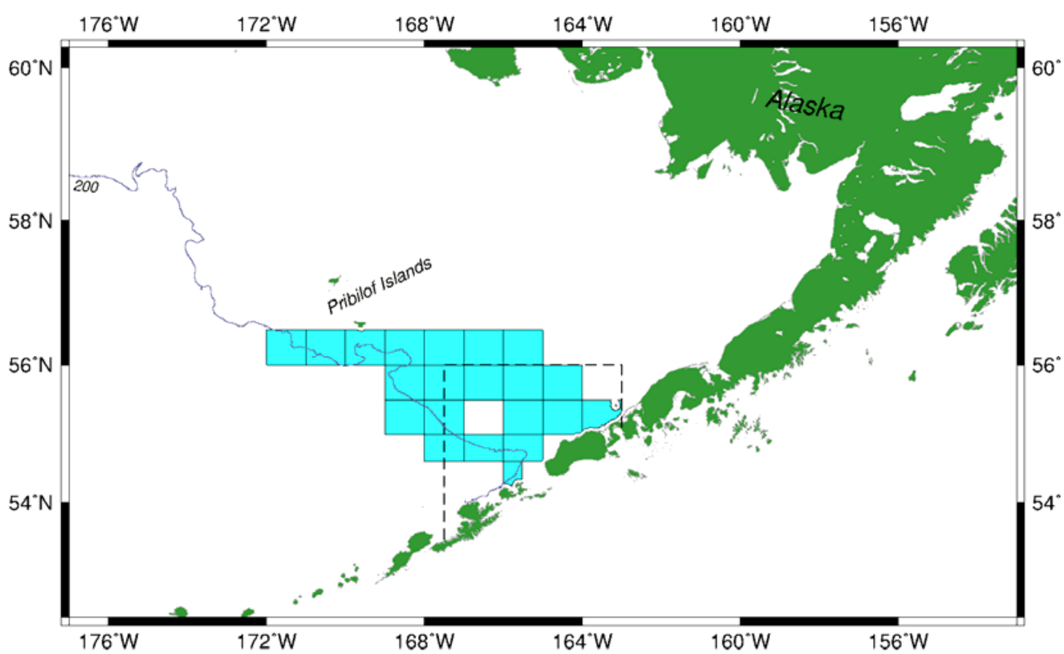



Figure 2-2. Selected area closures covering 80% of B season 2003 through 2011 chum bycatch.

### 2.3.1 Component 1: 80% Closure aggregate trigger PSC cap levels

The range of non-Chinook salmon PSC caps considered is shown below. As listed here, the CDQ sector allocation of the fishery level cap would be 10.7 percent, with the remainder apportioned to the combined non-CDQ fishery.

Range of suboptions for trigger PSC cap levels for non-Chinook with allocations for CDQ (10.7%) and remainder for non-CDQ fishery.

| | Non-Chinook | CDQ | Non-CDQ |
|---|---|---|---|
| 1) | **25,000** | **2,675** | **22,325** |
| 2) | 50,000 | 5,350 | 44,650 |
| 3) | **75,000** | **8,025** | **66,975** |
| 4) | 125,000 | 13,375 | 111,625 |
| 5) | **200,000** | **21,400** | **178,600** |

For analytical purposes only, a subset of the cap levels included in the six suboptions were used in this document to assess the impacts of operating under a given hard cap. This subset approximates the upper and lower endpoints of the suboption range, and a midpoint (**bolded**).

NMFS would issue pollock fishery closures once either the non-CDQ fishery or a non-CDQ sector reached its salmon bycatch limit. Vessel operators would be prohibited from directed fishing for pollock in a non-Chinook salmon savings area once NMFS closed the area to a fishery or sector. The CDQ sector would not be subject to pollock fishery closures; instead, CDQ groups would have to stop fishing for pollock in the closed areas once they had reached their non-Chinook bycatch allocation.

Vessels participating in the RHS would operate under a different fishery level cap than any vessels not participating in the RHS. NMFS would continue to manage triggered area closures for vessels not participating in the ICA as described in status quo. Vessels participating in the RHS would be exempt from NMFS's area closures, and would instead be subject to the RHS closures.

The process currently used to monitor salmon bycatch and issue salmon savings area closures would continue for these closures. NMFS would have to determine whether a vessel was directed fishing for pollock and then match that vessel with its fishery component (CDQ or non-CDQ) or sector. NMFS currently uses a combination of VMS, industry reported catch information, and observer data to monitor vessel activities in special management areas, such as habitat conservation areas and species-specific savings areas (e.g., salmon savings area). These data sources are used by NMFS on a daily basis to monitor fishery limits. Information from VMS is useful for determining vessel location in relation to closure areas, but it may not conclusively indicate whether a vessel is fishing, transiting through a closed area, or targeting a particular species.

### 2.3.2 Component 2: Trigger closure areas and timing for RHS participants:

In addition to the RHS, vessels in the RHS system would be subject to:

*Option 1: a trigger closure encompassing 80% of historical non-Chinook salmon PSC estimates.*

<u>Suboption 1a) Trigger closure would apply for the B season (June-October; Figure 2-3)</u>

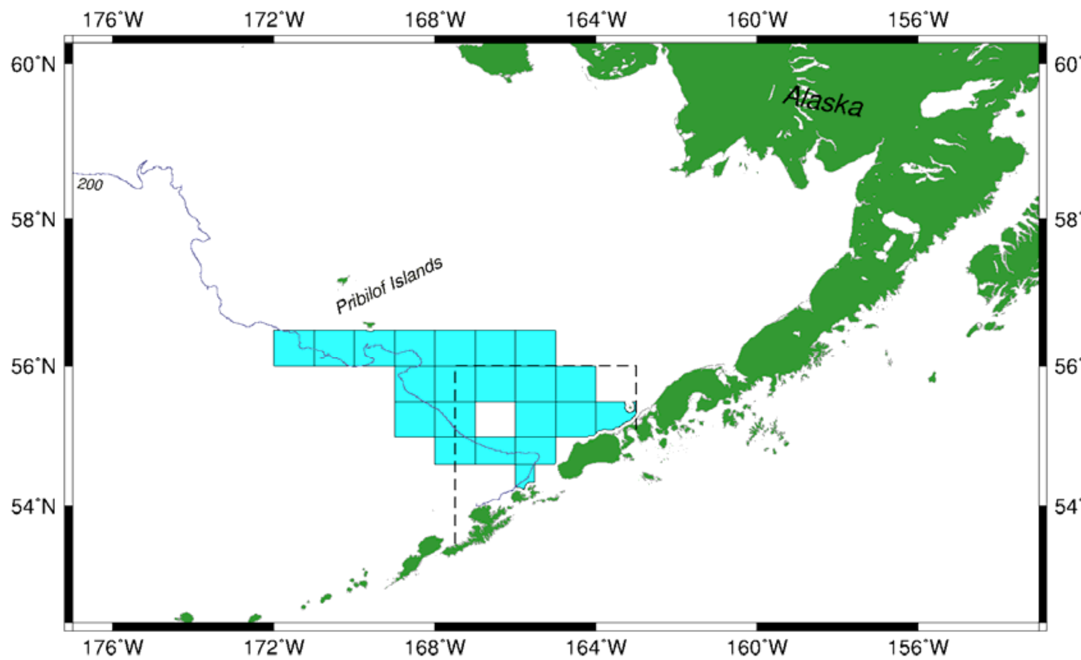



Figure 2-3. Selected area closures covering 80% of B season (option 1a) 2003-2011 chum bycatch.

<u>Suboption 1b) Trigger closure would only apply in June and July (Figure 2-4).</u>

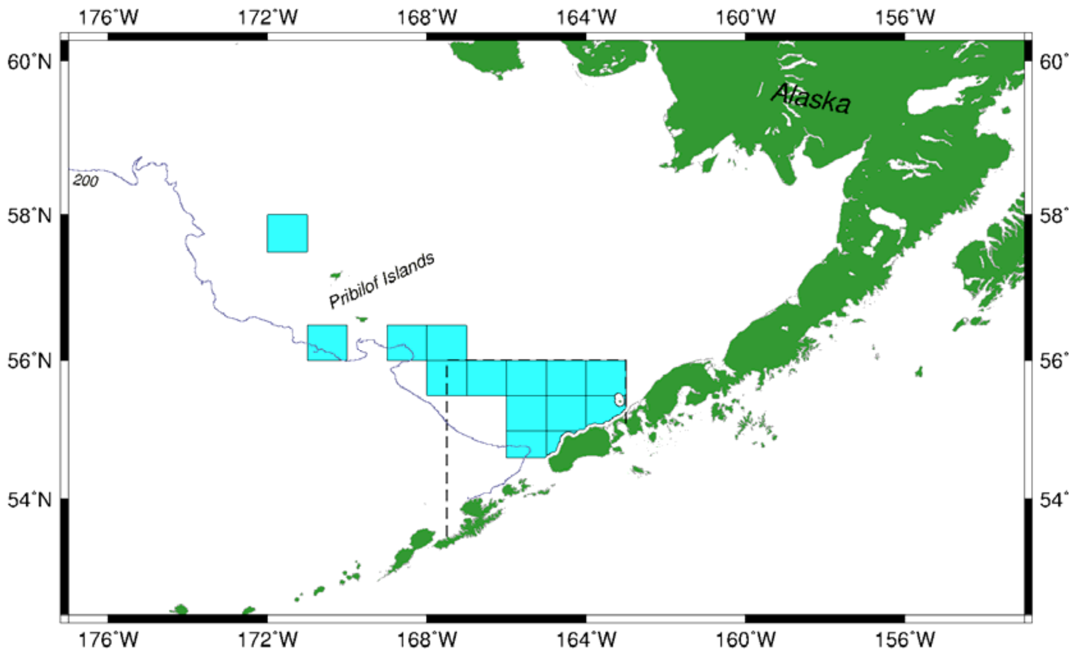



Figure 2-4. Selected area closures covering 80% of June-July 2003 (option 1b) through 2011 chum bycatch.

*Option 2: a trigger closure encompassing 60% of historical non-Chinook salmon PSC estimates*

<u>Suboption 2a) Trigger closure would apply for the B season (June-October) (Figure 2-5).</u>

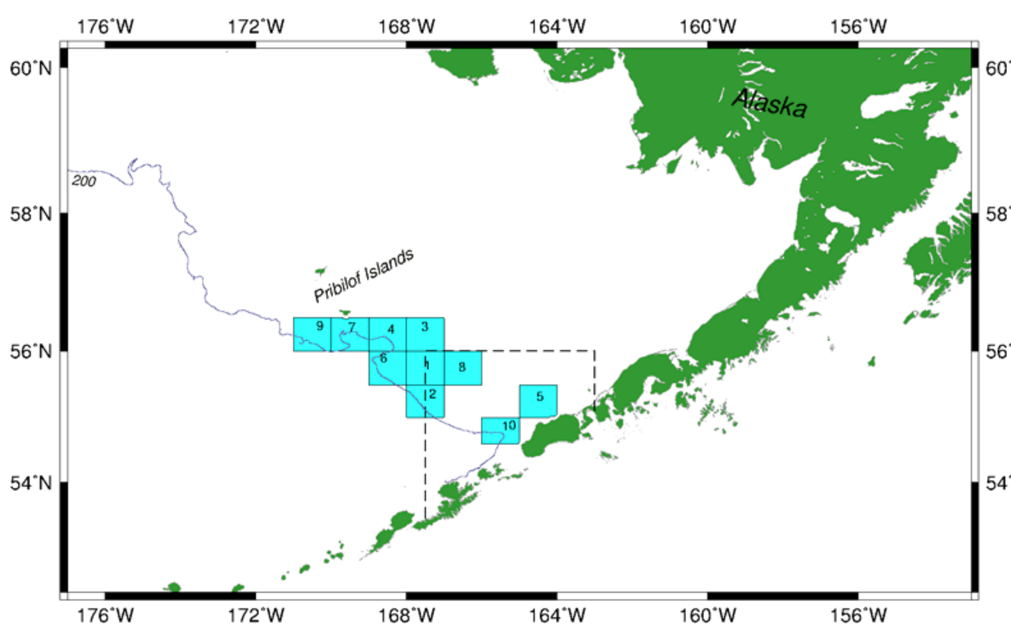



Figure 2-5 Selected area closures covering 60% of B season 2003 through 2011 chum bycatch.

Suboption 2b) Trigger closure would only apply in June and July (Figure 2-6).

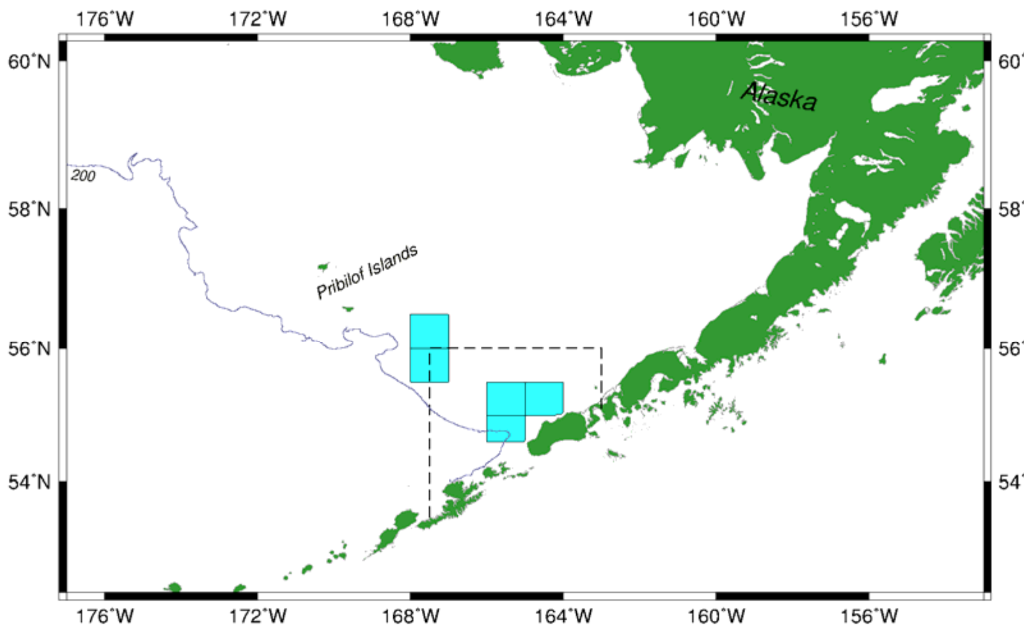



Figure 2-6. Selected area closures covering 60% of June-July 2003 through 2011 chum bycatch.

### 2.3.3 Component 3: PSC cap levels for trigger closures for RHS participants

PSC cap level options for a given closure selected under Component 2 are shown below. Note that caps for both Option 1 and Option 2 under Component 2 are shown. If Suboption 1b or 2b is selected, then the June-July cap would reflect the proportion of bycatch in June and July.

Range of suboptions for trigger PSC cap levels for non-Chinook with allocations for CDQ (10.7%) and remainder for non-CDQ fishery for RHS participants.

| | Total Annual cap (Option 1a or 2a) | CDQ | Non-CDQ | June-July cap (Option 1b or 2b) Total June/July | CDQ | Non-CDQ |
|---|---|---|---|---|---|---|
| 1) | 25,000 | 2,675 | 22,325 | 7,800 | 835 | 6,965 |
| 2) | 50,000 | 5,350 | 44,650 | 15,600 | 1,669 | 13,931 |
| 3) | 75,000 | 8,025 | 66,975 | 23,400 | 2,504 | 20,896 |
| 4) | 125,000 | 13,375 | 111,625 | 39,000 | 4,173 | 34,827 |
| 5) | 200,000 | 21,400 | 178,600 | 62,400 | 6,677 | 55,723 |

### 2.3.4 Component 4: Sector allocation of trigger cap for RHS participants

The trigger cap selected along with the applicable trigger closure under Component 2 could be allocated to the sector level. Sector allocations are identical to the options as shown under Alternative 2 Component 2.

If this component is selected, the trigger cap would be apportioned at the sector level. This would result in separate sector level caps for the CDQ sector, the inshore catcher vessel sector (CV) sector, the mothership sector, and the offshore catcher/processor sector (CP) sector. The management of sector allocations would be the same as under Alternative 2. Allocating salmon caps to individual sectors would increase the complexity of NMFS's salmon bycatch monitoring efforts, as it would increase the number of salmon bycatch caps that NMFS would have to monitor.

The bycatch of non-Chinook salmon would be counted on a sector level basis. If the total salmon bycatch in a non-CDQ sector reaches the cap for that sector, NMFS would close directed fishing for pollock by that sector in the specific areas for the remainder of the season. The remaining sectors may continue to fish outside the closures until they reach their sector cap level. The CDQ allocations would continue to be managed as they are under status quo, with further allocation of the CDQ salmon bycatch cap among the six CDQ groups, transferable allocations within the CDQ groups, and a prohibition against a CDQ group exceeding its salmon bycatch allocation.

When a sector reaches its salmon bycatch cap, NMFS would close the area(s) selected to directed fishing for pollock by that sector for the remainder of the season. The remaining sectors may continue to fish in the area(s) until they reach their sector level salmon bycatch cap. Pollock fishing could continue outside of the closure areas until either the pollock allocation to the sector is reached or the pollock fishery reaches a seasonal or annual closure date.

If sector level caps under Component 4 are selected, but not selected are Option 1 (transfers) or Option 2 (reallocations) under Component 5, the sector level cap would not change during the year and NMFS would close directed fishing for pollock in the specified area once each sector reached its sector level cap. Because the CDQ sector level cap would be allocated to the CDQ groups, the CDQ allocations would continue to be managed as they are under status quo, with further allocation of the salmon bycatch trigger cap among the six CDQ groups, transferable allocations within the CDQ groups, and a prohibition against a CDQ group exceeding its salmon bycatch allocation.

### 2.3.5 Component 5: Sector level rollovers and transferability provisions

Rollover and transferability options by sector are the same as listed under Alternative 2, Component 3 (see section 2.2.3).

**Option 1)** Allocate salmon bycatch caps to each sector and allow the entity representing each non-CDQ sector and the CDQ groups to transfer salmon bycatch cap among the sectors and CDQ groups.

**Suboption:** Limit transfers to the following: a) 50%, b) 70%, or c) 90% of available salmon bycatch cap.

**Option 2)** NMFS manages the sector level caps for the non-CDQ sectors and would reallocate unused salmon bycatch caps to other sectors still fishing in a fishing season based on the proportion of pollock remaining for harvest.

The two options under this component may be selected only if the trigger cap is apportioned among the sectors under Component 4. Options 1 and 2 are mutually exclusive, which means that either Option 1 to allow sector level transferable allocations or Option 2 to require NMFS to reallocate salmon bycatch from one sector to the other could be selected.

Under Option 1 caps are transferable among sectors and CDQ groups within a fishing season. If transferable sector allocations are selected, NMFS would not actively manage the pollock fisheries by issuing fishery closures once the trigger cap was reached for each sector. Rather, the trigger closures would be managed similar to current management of the trigger closures under the CDQ Program. Each sector would receive a transferable trigger cap allocation, and vessels participating in that sector would be prohibited from fishing inside the area(s) selected after the sector's trigger cap is reached.

Transfers are voluntary requests initiated by the entity receiving a salmon bycatch trigger cap for NMFS to move a specific amount of a salmon bycatch trigger cap from one entity's account to another entity's account.

Option 1 would require that each sector receiving a transferable allocation be represented by an entity that could:

- represent all vessels eligible to participate in the particular AFA sector and receive an allocation of a specific amount of salmon bycatch on behalf of all of those vessels,
- be authorized by all members of the sector to transfer all or a portion of the sector's salmon bycatch cap to another sector or to receive a salmon bycatch transfer from another sector on behalf of the members of the sector,
- be responsible for any penalties assessed for exceeding the sector's salmon bycatch cap (i.e., have an agent for service of process with respect to all owners and operators of vessels that are members of the entity).

If transferable salmon bycatch trigger caps are allocated to an entity representing an AFA sector or to a CDQ group, each entity receiving a transferable trigger cap would be responsible for not fishing within the closure area(s) once the trigger cap was reached. Any fishing in an area closure would be reported to NOAA Office of Law Enforcement for an enforcement action against the responsible entity.

If transferable trigger caps were selected, transfers could be allowed between individual CDQ groups and any of the three non-CDQ sectors. A transferable salmon trigger cap would allow a sector or CDQ group to obtain additional salmon bycatch to allow that sector or CDQ group to continue to fish within the areas subject to closure for a longer period of time in a season. It is also possible that a sector or CDQ group could be closed out of an area after reaching its salmon bycatch cap; if it transferred in more salmon bycatch cap, the area would reopen for that sector or CDQ group.

For ICA management of subdivision of the seasonal trigger caps at the sector level, inshore cooperative, or individual vessel level, NMFS would have to revise the salmon bycatch ICA regulations at 50 CFR 679.21 to incorporate any changes made to the Chum salmon savings areas proposed under this alternative. NMFS would approve an ICA if it met applicable regulatory requirements, but would not enforce the contractual conditions of an ICA. Each CDQ group could opt to participate in an ICA. Vessel operators fishing for pollock CDQ would then be exempt from salmon savings area closures. If a CDQ group was not part of a salmon bycatch ICA, vessel operators would be prohibited from fishing within a closed non-Chinook salmon savings area once that group's seasonal or annual non-Chinook salmon allocation had been caught.

Option 2 would require NMFS to reallocate salmon bycatch from one sector to the other by publication of a reallocation in the *Federal Register*. Option 2 could apply if the non-CDQ trigger caps were allocated among the inshore, catcher/processor, and mothership sectors and the (1) management of the trigger caps was not allowed, (2) transferable trigger caps among the sectors were not allowed, or (3) the non-CDQ AFA sectors could not form the entity necessary to receive transferable salmon bycatch caps. Under Option 2, NMFS would reallocate the salmon bycatch trigger caps among the sectors. A reallocation of salmon bycatch would occur if a sector completed harvest of its pollock allocation and had some salmon bycatch trigger cap allocation remaining in a season. That remaining salmon bycatch trigger cap could be reallocated to other sectors still fishing based on the proportion of pollock remaining to be harvested by each sector.

### 2.3.6 Component 6: Cooperative allocation of trigger cap for inshore CV RHS participants

The trigger cap selected along with the applicable trigger closure under Components 2 and 3 could be further allocation within the inshore sector to the cooperatives level. Transferability options are the same as listed under Alternative 2, Component 4.

Option 1, would allow an inshore cooperative to transfer pollock to another inshore cooperative after the first cooperative's Chinook salmon allocation is reached. This option provides another means in addition to the transfer of the Chinook salmon bycatch allocations to match available pollock and available salmon bycatch for the inshore cooperatives. More information about this option is in section 2.2.4.1.

A summary of the components and options and suboptions for Alternative 3 is shown in Table 2-8.

Table 2-8 Summary of Alternative 3 components, options and suboptions

| | | | | | |
|---|---|---|---|---|---|
| **Component 1:Fleet PSC management with non-participant triggered closure** | Area | Triggered closure encompassing 80% of historical PSC. Participants in RHS would be exempt from the regulatory closure if triggered. | | | |
| | Option 1: cap | Select a cap from a range of numbers: 25,000 –200,000 | | | |
| **Component 2: Trigger Closure area and timing for RHS participants** | **Option 1:** Area 80% | Triggered closure encompassing 80% of historical PSC for all RHS participants | | | |
| | Suboption a: timing | Applies to remainder of B season if triggered | | | |
| | Suboption b: Timing | Applies in June and July if triggered | | | |
| | **Option 2**: Area 60% | Triggered closure encompassing 60% of historical PSC for all RHS participants | | | |
| | Suboption a: timing | Applies to remainder of B season if triggered | | | |
| | Suboption b: timing | Applies in June and July if triggered | | | |
| **Component 3: PSC Cap levels for closure selected under Component 2 for RHS participants** | Option 1a: PSC cap established for B season closure | Select cap from range of numbers: 25,000 – 200,000 | | | |
| | Option 1b: PSC cap established for June/July proportion | Select cap from range of numbers: 7,800 – 62,400 | | | |
| **Component 4: Allocating the trigger cap to sectors** | Range of sector allocations*: | CDQ | Inshore CV | Mothership | Offshore CP |
| | Option 1 | 10.0% | 45.0% | 9.0% | 36.0% |
| | Option 2ii | 6.7% | 63.3% | 6.5% | 23.6% |
| | Option 4ii | 10.7% | 44.77% | 8.77% | 35.76% |
| | Option 6 | 3.4% | 81.5% | 4.0% | 11.1% |
| **Component 5: Sector transfers and rollovers** | No transfers (Component 5 not selected) | | | | |
| | Option 1 | Caps are transferable among sectors and CDQ groups within a fishing season | | | |
| | | Suboption: Maximum amount of transfer limited to: | | a | 50% |
| | | | | b | 70% |
| | | | | c | 90% |
| | Option 2 | NMFS reallocates unused salmon PSC to sectors still fishing in a season, based on proportion of pollock remaining to be harvested. | | | |
| **Component 6: Inshore Cooperative Allocation and transfers** | No allocation | Allocation managed at the inshore CV sector level. (Component 6 not selected) | | | |
| | Allocation | Allocate cap to each inshore cooperative based on that cooperative's proportion of pollock allocation. | | | |
| | Option: Cooperative Transfers | Option 1 | Lease pollock among cooperatives in a season or a year | | |
| | | Option 2 | Transfer salmon PSC (industry initiated) | | |
| | | Suboption Maximum amount of transfer limited to the following percentage of salmon remaining: | | a | 50% |
| | | | | b | 70% |
| | | | | c | 90% |

### 2.3.7 Management and Monitoring under Alternative 3

Area closures could be managed in a number of different ways, depending on the combination of components and options selected. Trigger closures would require a sector to stop pollock fishing in certain closure areas when its allocation of non-Chinook salmon PSC is reached. Depending on the selection of subsequent components in this alternative, salmon may be allocated at the fishery level (CDQ and non-CDQ), to each sector (inshore, mothership, catcher/processor, and CDQ), or among the inshore cooperatives.

Similar to status quo (rolling hot-spot [RHS] system in regulation), participants in the RHS would be exempt from the regulatory closure system. Monitoring and enforcement of this alternative is similar to status quo in which ICA members are managed under the RHS and NMFS closes the trigger area for non-ICA members. Monitoring and enforcement of the bycatch agreement under this alternative is done by Sea State using the Base Rate as a trigger for savings area closures and determining the tier assignment of the vessel. A description of management and monitoring by Sea State are contained under Alternative 1.

The observer and monitoring requirements currently in place to account for Chinook salmon bycatch under Amendment 91 would be the same methods to account for non-Chinook salmon bycatch. Therefore, NMFS does not anticipate changes to observer requirements or additional monitoring provisions under the closure with the RHS exemption alternative. Catch accounting would rely on the information described for Alternative 1 (status quo) in section 0.

The current census data collection program is highly responsive to management needs and provides timely data, especially considering the logistics of the sectors and variation in operation type. However, even with this highly responsive system, a June and July cap results in a very short time period for NMFS to monitor and insure a timely trigger area closure. NMFS would need to project non-Chinook salmon harvest during the week required to publish a *Federal Register* notice and get census information. These projections may result in a trigger closure being made prior to or after the cap being reached.

The U.S. Coast Guard has identified at-sea enforcement issues related to aerial surveillance for enforcing trawl closures. They note some issues in distinguishing between pelagic and non-pelagic trawl gear. This alternative would restrict only vessels using pelagic trawl gear (if their sector or cooperative level cap was reached) from directed fishing for pollock within the area closures. All directed fishing for pollock in the Bering Sea uses pelagic trawl gear only.

Due to the size of the Alaska region and the number of enforcement assets available, one of the most effective means of surveillance is by aircraft. While an aircraft can be used to identify the type of vessel (e.g., long line, trawl, seine, pot), there is no way for people in an aircraft to readily identify whether a trawl vessel is using pelagic or non-pelagic trawl gear.

Because of these definitions, the only time people in an aircraft would be able to determine whether a vessel was using pelagic or non-pelagic trawl gear would be if they witnessed a haul back and noted chafing gear on the foot rope or roller gear. By definition, this vessel would be using non-pelagic trawl gear. All other definitions used to identify whether a vessel is using pelagic or non-pelagic trawl gear must be conducted by a boarding team on the vessel.

#### 2.3.7.1 Recommended Revisions to the Current ICA Regulations

NMFS provides the following information and recommendations about current or future regulations governing the non-Chinook salmon bycatch reduction ICA. The regulations implementing Amendment 84 contain detailed requirements for the contents of the RHS ICA, including information about the participants (those parties signing the ICA and agreeing to abide by its provisions), specific bycatch reduction measures, and monitoring and enforcement provisions. In contrast, requirements for the incentive plan agreements (IPAs) implemented under Amendment 91 contain only general requirements for NMFS approval of a proposed IPA. NMFS required the detail in regulation for the non-Chinook salmon RHS ICA because when industry members participate in an ICA and are exempt from closure of the Chum SSA, the ICA becomes the primary non-Chinook salmon bycatch management measure in effect. Under Amendment 91, the transferable PSC allocations that when reached prevent further directed fishing for pollock and the performance standard are the primary regulatory tools for minimizing Chinook salmon bycatch. The IPAs are an additional important tool developed by the Council, but no exemptions to the hard caps under Amendment 91 are provided to participants in the IPA. In other words, Amendment 91 does not rely on the provisions of the IPA to minimize the bycatch of Chinook salmon to the same degree as Amendment 84 relies on the RHS ICA to minimize non-Chinook salmon bycatch.

In 2005, the Council recommended the RHS ICA that was in effect at that time as its preferred alternative for Amendment 84. In approving Amendment 84 and its implementing regulations, NMFS determined that the RHS ICA was consistent with the national standards, specifically that it minimized bycatch to the extent practicable. For NMFS to make that determination, it needed the assurance provided by detailed federal regulations that the ICA would remain in effect as it was described in the Council's preferred alternative. Without detailed regulations, NMFS would have limited ability to disapprove future proposed revisions to the ICA or to suspend the exemption from closures of the Chum SSA. Unfortunately, detailed contract provisions in federal regulation provide very little flexibility for the ICA participants to revise contract provisions to respond to new information or better methods without a regulatory amendment.

If the Council recommends a chum salmon bycatch management program under either Alternative 1 or Alternative 3 that provides exemptions to caps or area closures for participants in an approved ICA, NMFS will continue to require that the federal regulations contain sufficient detail to prevent later substantive revisions to the ICA that would reduce its effectiveness. It is difficult to define exactly where the line is between providing the necessary detail in the regulations to prevent weakening the ICA and providing flexibility to improve the ICA without lengthy regulatory amendments. At this time, NMFS is highlighting the issue and recommending that the Council carefully review the current RHS ICA regulations and consider the level of detail that will be needed in future regulations to ensure that the bycatch management measures in effect under an ICA exemption are sufficient to support the required determinations of consistency with the national standards.

The current non-Chinook salmon ICA regulations in § 679.21(g) are reproduced below with several notes that are explained in text after the follows:

(1) Requirements for the non-Chinook salmon bycatch reduction intercooperative agreement (ICA).

> (i) *Application*. The ICA representative identified in paragraph (g)(2)(i)(B) of this section must submit a signed copy of the proposed non-Chinook salmon bycatch reduction ICA, or any proposed amendments to the ICA, to NMFS at the address in paragraph (b)(6) of this section.
>
> (ii) Deadline. For any ICA participant to be exempt from closure of the Chum Salmon Savings Area as described at paragraph (e)(7)(ix) of this section and at § 679.22(a)(10), the ICA must be filed in compliance with the requirements of this section, and approved by NMFS. The proposed non-Chinook salmon bycatch reduction ICA or any amendments to an approved ICA must be postmarked or received by NMFS by December 1 of the year before the year in which the ICA is proposed to be effective. Exemptions from closure of the Chum Salmon Savings Area will expire upon termination of the initial ICA, expiration of the initial ICA, or if superseded by a NMFS-approved amended ICA.

(2) Information requirements. The ICA must include the following provisions:

(i) Participants. [30]
(A) The names of the AFA cooperatives and CDQ groups participating in the ICA. Collectively, these groups are known as parties to the ICA. Parties to the ICA must agree to comply with all provisions of the ICA.

(B) The name, business mailing address, business telephone number, business fax number, and business e-mail address of the ICA representative.

(C) The ICA also must identify one entity retained to facilitate vessel bycatch avoidance behavior and information sharing.

(D) The ICA must identify at least one third party group. Third party groups include any organizations representing western Alaskans who depend on non-Chinook salmon and have an interest in non-Chinook salmon bycatch reduction but do not directly fish in a groundfish fishery.

(ii) The names, Federal fisheries permit numbers, and USCG documentation numbers of vessels subject to the ICA.

(iii) Provisions that dictate non-Chinook salmon bycatch avoidance behaviors for vessel operators subject to the ICA, including:

(A) Initial base rate. The initial B season non-Chinook salmon base rate shall be 0.19 non-Chinook salmon per metric ton of pollock.

(B) Inseason adjustments to the non-Chinook base rate calculation. Beginning July 1 of each fishing year and on each Thursday during the B season, the B season non-Chinook base rate shall be recalculated. The recalculated non-Chinook base rate shall be the three week rolling average of the B season non-Chinook bycatch rate for the current year. The recalculated base rate shall be used to determine bycatch avoidance areas.

(C) ICA Chum Salmon Savings Area notices.[31] On each Thursday and Monday after June 10 of each year for the duration of the pollock B season, the entity identified under paragraph (g)(2)(i)(C) of this section must provide notice to the parties to the salmon bycatch reduction ICA and NMFS identifying one or more areas designated “ICA Chum Savings Areas” by a series of latitude and longitude coordinates. The Thursday notice must be effective from 6 p.m. A.l.t. the following Friday through 6 p.m. A.l.t. the following Tuesday. The Monday notice must be effective from 6 p.m. A.l.t. the following Tuesday through 6 p.m. A.l.t. the following Friday. For any ICA Salmon Savings Area notice, the maximum total area closed must be at least 3,000 square miles for ICA Chum Savings Area closures.

(D) Fishing restrictions for vessels assigned to tiers. For vessels in a cooperative assigned to Tier 3, the ICA Chum Salmon Savings Area closures announced on Thursdays must be

[30] Is participation in an RHS ICA limited to the AFA cooperatives and CDQ groups, and is it the Council’s intent that owners of vessels not in an AFA cooperative may not participate in the ICA?
[31] See explanation below about comments received by NMFS from the United Catcher Boats on this paragraph.

closed to directed fishing for pollock, including pollock CDQ, for seven days. For vessels in a cooperative assigned to Tier 2, the ICA Chum Salmon Savings Area closures announced on Thursdays must be closed through
6 p.m. Alaska local time on the following Tuesday. Vessels in a cooperative assigned to Tier 1 may operate in any area designated as an ICA Chum Salmon Savings Area.

(E) Cooperative tier assignments. Initial and subsequent base rate calculations must be based on each cooperative's pollock catch for the prior two weeks and the associated bycatch of non-Chinook salmon taken by its members. Base rate calculations shall include non-Chinook salmon bycatch and pollock caught in both the CDQ and non-CDQ pollock directed fisheries. Cooperatives with non-Chinook salmon bycatch rates of less than 75 percent of the base rate shall be assigned to Tier 1. Cooperatives with non-Chinook salmon bycatch rates of equal to or greater than 75 percent, but less than or equal to 125 percent of the base rate shall be assigned to Tier 2. Cooperatives with non-Chinook salmon bycatch rates of greater than 125 percent of the base rate shall be assigned to Tier 3.

(iv) Internal monitoring and enforcement provisions to ensure compliance of fishing activities with the provisions of the ICA. The ICA must include provisions allowing any party of the ICA to bring civil suit or initiate a binding arbitration action against another party for breach of the ICA. The ICA must include minimum annual uniform assessments for any violation of savings area closures of $10,000 for the first offense, $15,000 for the second offense, and $20,000 for each offense thereafter.[32]

(v) Provisions requiring the parties to conduct an annual compliance audit, and to cooperate fully in such audit, including providing information required by the auditor. The compliance audit must be conducted by a non-party entity, and each party must have an opportunity to participate in selecting the non-party entity. If the non-party entity hired to conduct a compliance audit discovers a previously undiscovered failure to comply with the terms of the ICA, the non-party entity must notify all parties to the ICA of the failure to comply and must simultaneously distribute to all parties of the ICA the information used to determine the failure to comply occurred and must include such notice(s) in the compliance report.

(vi) Provisions requiring data dissemination in certain circumstances. If the entity retained to facilitate vessel bycatch avoidance behavior and information sharing under paragraph (g)(2)(i)(C) of this section determines that an apparent violation of an ICA Chum Salmon Savings Area closure has occurred, that entity must promptly notify the Board of Directors of the cooperative to which the vessel involved belongs. If this Board of Directors fails to assess a minimum uniform assessment within 180 days of receiving the notice, the information used by the entity to determine if an apparent violation was committed must be disseminated to all parties to the ICA.

(3) NMFS review of the proposed ICA and amendments.

NMFS will approve the initial or an amended ICA if it meets all the requirements specified in paragraph (g) of this section. If NMFS disapproves a proposed ICA, the ICA representative may resubmit a revised ICA or file an administrative appeal as set forth under the administrative appeals procedures described at § 679.43.

[32] See explanation below about NMFS's recommendation that detailed penalty amounts should not be included in future ICA regulations.

(4) ICA Annual Report.

The ICA representative must submit a written annual report to the Council at the address specified in § 679.61(f). The Council will make the annual report available to the public.

(i) Submission deadline. The ICA annual report must be postmarked or received by the Council by April 1 of each year following the year in which the ICA is first effective.

(ii) Information requirements. The ICA annual report must contain the following information:

(A) An estimate of the number of non-Chinook salmon avoided as demonstrated by the movement of fishing effort away from Chum Salmon Savings Areas, and

(B) The results of the compliance audit required at § 679.21(g)(2)(v).

NMFS notes two issues related to current ICA regulations that it requests the Council consider in revising or developing new RHS ICA regulations.

Remove detailed enforcement provisions from current RHS ICA regulations

Current regulations at § 679.21(g)(iv) require the RHS ICA to include the following:

> *Internal monitoring and enforcement provisions to ensure compliance of fishing activities with the provisions of the ICA.* The ICA must include provisions allowing any party of the ICA to bring civil suit or initiate a binding arbitration action against another party for breach of the ICA. The ICA must include minimum annual uniform assessments for any violation of savings area closures of $10,000 for the first offense, $15,000 for the second offense, and $20,000 for each offense thereafter.

Despite including this provision in the final rule for Amendment 84, NMFS has determined that it may not include in federal regulations such specific requirements for the enforcement provisions or penalties that the ICA would impose on its participants. NMFS may include in regulation only RHS ICA provisions that NMFS would be authorized to implement directly. NMFS is not authorized to specify penalties for violations of the federal fishery regulations in federal regulation. Rather, NOAA General Counsel must retain discretion to assess penalties for violations of federal fishery regulations on a case-by-case basis. Therefore, in the future, under either Alternative 1 or Alternative 3, the Council could recommend that federal regulations require the RHS ICA to contain a description of the enforcement provisions and penalties that the ICA participants agree to assess on themselves for violation of the ICA provisions. However, the regulations could not include specific requirements for what these penalties must be.

United Catcher Boats' (UCB) Comment on Amendment 91: In a letter of comment on Amendment 91 (dated May 7, 2010), the United Catcher Boats recommended revisions to § 679.21(g)(2)(iii)(C), which currently reads as follows:

> ICA Chum Salmon Savings Area notices. On each Thursday and Monday after June 10 of each year for the duration of the pollock B season, the entity identified under paragraph (g)(2)(i)(C) of this section must provide notice to the parties to the salmon bycatch reduction ICA and NMFS identifying one or more areas designated "ICA Chum Savings Areas" by a series of latitude and longitude coordinates. The Thursday notice must be effective from 6 p.m. A.l.t. the following

> Friday through 6 p.m. A.l.t. the following Tuesday. The Monday notice must be effective from 6 p.m. A.l.t. the following Tuesday through 6 p.m. A.l.t. the following Friday. For any ICA Salmon Savings Area notice, the maximum total area closed must be at least 3,000 square miles for ICA Chum Savings Area closures.

UCB's comment on this requirement was:

> This section should be re-written to more accurately describe the original intention of Amendment 84. While the twice weekly notices are required, ICA Chum Salmon Savings Area closures only occur if and when areas with bycatch in excess of the base rate, as described in paragraph (g)(2)(iii)(B), are identified. The sentence, "For any ICA Salmon Savings Area notice, the maximum total area closed must be at least 3,000 square miles for ICA Chum Salmon Area closures" is confusing and does not accurately reflect the original intention of the 3,000 square mile standard. The original intention was to assure that the ICA, not the notice, contain language that allows for the maximum areas available for a Chum Salmon Savings Area closure to be no less than 3,000 square miles. There was never an intention to require 3,000 square miles be closed by each notice as this sentence may be interpreted to mean.

NMFS was unable to address this comment in the final rule on Amendment 91 because it was outside of the scope of the analysis prepared for that action. In the response to comments, NMFS recommended that this issue be addressed during the Council's consideration of chum salmon bycatch management measures.

## 2.4 Comparison of Alternatives

The following section provides an overview of the three broad alternatives under consideration and the over-arching management measures that would be imposed under each. Table 2-9 compares the three alternatives, the relative time frame of the management measures being considered by alternative or multiple options within alternatives where applicable, and the action under consideration. Both Alternatives 2 and 3 have options for a management action enacted in June and July only as compared to a similar action enacted for the entire B season. Note that the alternatives are not mutually exclusive thus measures for one alternative may be combined with those in another to form an additional alternative for consideration. For example, a June-July hard cap under Alternative 2 (Alternative 2, Component 1, Option 1b) could be combined with the B season closure to non-participants in the RHS system under Alternative 3 Component 1 to form a new management system that could be analyzed should the Council decide to mix and match amongst alternative components and options to tailor a specific program and objective for management.

Table 2-9 Comparison of over-arching management measures under the three alternatives considered in this analysis

| Alternative | Timing | Management action | | |
|---|---|---|---|---|
| 1-Status quo | B season | Exemption to regulatory closure of CSSA (Fig. 2.1) provided participation in current RHS program | | |
| 2-Hard cap | B season (Component 1, Option 1a) | Fishery sectors close for the season when sector-specific cap level is reached | | |
| | June-July (Component 1, Option 1b) | Fishery sectors close until July 31 when sector-specific cap level is reached | | |
| 3-Closure area with RHS exemption | | ***Closure area applies to*** | ***Closure Area*** | ***Basis period*** |
| | B season (Component 1) | **Non-**participants of RHS program when **fishery level** caps[1] reached | 80% of chum (Fig. 2.2) | B season |
| | B season (Component 2, Suboption 1a) | Participants of RHS program when **sector-level** caps reached | 80% of chum (Fig. 2.3) | B season |
| | June-July (Component 2, Suboption 1b) | Participants of RHS program when **sector-level** caps reached | 80% of chum (Fig. 2.4) | June-July |
| | B season (Component 2, Suboption 2a) | Participants of RHS program when **sector-level** caps reached | 60% of chum (Fig. 2.5) | B season |
| | June-July (Component 2, Suboption 2b) | Participants of RHS program when **sector-level** caps reached | 60% of chum (Fig. 2.6) | June-July |

## 2.5 Development of Alternatives

The alternatives in this analysis were developed through a public Council and stakeholder process. Many issues were aired and other possible management options, or points within the range of the options, were considered. Through an iterative process, the Council arrived at a draft suite of management options that best suit the problem statement, that represent a reasonable range of alternatives and options, and also represent a reasonable combination of management measures that can be analyzed and used for decision-making. These alternatives may still be modified by the Council in iterative reviews of this analysis. Currently the analysis is scheduled for initial review in April 2012. It is anticipated that some modification of the suite of alternatives may occur at initial review and initial review. The Council may select a preliminary preferred alternative at initial review in April 2012 and will select a preferred alternative at final action that may or may not comport with the preliminary preferred alternative.

The Council and NMFS also concurrently held a formal scoping period which provided another forum for the public to provide input to the development of alternatives. A scoping report was provided that summarized the comments for the Council. Chapter 1 includes a detailed discussion of the issues raised in scoping, which is referenced but not repeated here.

This section discusses the Council's process for developing alternatives, while the following section describes those alternatives that were originally discussed at the Council level and through the Council's Salmon Bycatch Workgroup, but which, for the reasons noted below, were not analyzed in detail.

The Council, in February 2007, established a Salmon Bycatch Workgroup (SBW) committee, comprising members representing the interests of western Alaska (4 members) and of the pollock industry (4 members). This committee had two Chairs, one from each of the major interest groups represented in its membership. The Council later (June 2007) appointed an additional member from the Alaska Board of Fisheries. The Council requested that the SBW provide recommendations to the Council regarding appropriate salmon cap levels, by species (Chinook and chum or "other" salmon), to be considered for the pollock fishery, as well as to work with staff to provide additional review of and recommendations for the development of alternatives for analysis.

The SBW met five times: in March 2007, May 2007, August 2007, November 2007, and January 2009. These meetings were open to the public and noticed in the *Federal Register* accordingly. Following each meeting, a report was compiled representing the recommendations and discussions by the committee, and provided to the Council at its subsequent meeting (April 2007, June 2007, October 2007, December 2007, and February 2009). In the spring of 2009 the Council bifurcated the analyses of chum and Chinook management measures and prioritized the analysis of Chinook management measures. Final action on Chinook management measures was taken by the Council in April 2009 (Amendment 91). The fishery is operating under the Amendment 91 regulations, which began in January 2011.

The Council refined alternatives for chum salmon management measures in December 2009, June 2010, and June 2011 (see Council motions in Appendix 1 to this Chapter). Modifications included changing the range of numbers for cap considerations, adopting the area closure system previously proposed and then removing that system and refining the provisions under what is now Alternative 3. Further modification of alternatives may occur iteratively in the course of finalizing the analysis prior to final action.

The process for selecting areas for closure considerations under Alternative 3 was as follows:

1) Match official NMFS regional office data from 2003 through 2011 at the week, NMFS-area, and sector level with the observer database and expand the observer data to obtain estimates of total catch in areas by day and locations
2) Match these data spatially with the ADF&G 6-digit statistic areas
3) Compute proportion of bycatch and pollock for each ADF&G area over all years (B-season only)
4) Sort by the difference between chum and pollock proportions
5) Cumulate the proportion to obtain the ADF&G areas to select for closure areas

Separate compilations were done for the B season and for June-July (Table 2-10 and Table 2-11 and Figure 2-7). B-season areas for 80 percent and 60 percent closures are shown in Figure 2-3 and Figure 2-5 respectively whereas the areas for the June-July closures are shown in Figures 2-4 and Figure 2-6.

Table 2-10. **B season** proportions by ADF&G Statistical area from 2003 through 2011 expanded observer data and cumulative proportions to determine area closures. Horizontal line represents the cut-off point for the "60%" historical chum level whereas all data shown covers the 80% historical level.

| | Proportion | | | Cumulative | |
|---|---|---|---|---|---|
| ADFG Area | Pollock | Chum | Chum-Poll | Pollock | Chum |
| 675530 | 1.2% | 12.4% | 11.1% | 1.2% | 12.4% |
| 675500 | 1.8% | 8.6% | 6.9% | 3.0% | 21.0% |
| 675600 | 1.6% | 6.3% | 4.7% | 4.6% | 27.3% |
| 685600 | 1.8% | 5.8% | 4.0% | 6.5% | 33.1% |
| 645501 | 4.6% | 8.3% | 3.7% | 11.1% | 41.4% |
| 685530 | 0.4% | 4.0% | 3.6% | 11.5% | 45.4% |
| 695600 | 0.9% | 3.4% | 2.5% | 12.4% | 48.8% |
| 665530 | 0.5% | 2.6% | 2.1% | 12.9% | 51.4% |
| 705600 | 2.2% | 4.0% | 1.8% | 15.1% | 55.4% |
| 655430 | 8.1% | 9.0% | 0.9% | 23.1% | 64.4% |
| 645530 | 0.7% | 1.6% | 0.8% | 23.9% | 66.0% |
| 655409 | 3.5% | 4.2% | 0.6% | 27.4% | 70.1% |
| 655600 | 0.5% | 1.0% | 0.5% | 27.9% | 71.1% |
| 665430 | 1.1% | 1.5% | 0.4% | 28.9% | 72.6% |
| 655530 | 1.1% | 1.5% | 0.4% | 30.0% | 74.1% |
| 665600 | 0.6% | 1.0% | 0.4% | 30.6% | 75.1% |
| 715600 | 0.3% | 0.7% | 0.4% | 30.9% | 75.7% |
| 675430 | 0.1% | 0.4% | 0.3% | 31.0% | 76.1% |
| 685500 | 0.1% | 0.3% | 0.2% | 31.0% | 76.4% |
| 635504 | 0.3% | 0.6% | 0.2% | 31.4% | 77.0% |
| 655500 | 3.5% | 3.7% | 0.2% | 34.9% | 80.7% |

Table 2-11 **June-July** proportions by ADF&G Statistical area from 2003 through 2011 expanded observer data and cumulative proportions to determine area closures. Horizontal line represents the cut-off point for the "60%" historical chum level whereas all data shown covers the 80% historical level.

| | Proportion | | | Cumulative | |
|---|---|---|---|---|---|
| ADFG Area | Pollock | Chum | Chum-Poll | Pollock | Chum |
| 645501 | 8.0% | 23.5% | 15.5% | 8.0% | 23.5% |
| 675530 | 1.2% | 16.1% | 14.9% | 9.2% | 39.7% |
| 655500 | 5.2% | 9.2% | 4.0% | 14.4% | 48.9% |
| 655430 | 5.8% | 9.1% | 3.3% | 20.2% | 58.0% |
| 675600 | 1.6% | 3.6% | 2.0% | 21.9% | 61.6% |
| 705600 | 1.9% | 3.9% | 2.0% | 23.8% | 65.5% |
| 665530 | 0.5% | 2.4% | 2.0% | 24.3% | 67.9% |
| 685600 | 2.0% | 3.4% | 1.4% | 26.3% | 71.3% |
| 655530 | 0.4% | 1.6% | 1.2% | 26.6% | 72.9% |
| 635504 | 0.6% | 1.7% | 1.1% | 27.3% | 74.7% |
| 645530 | 0.9% | 1.7% | 0.8% | 28.1% | 76.4% |
| 715730 | 1.2% | 1.9% | 0.7% | 29.3% | 78.3% |
| 635530 | 0.7% | 1.4% | 0.7% | 30.0% | 79.7% |
| 645434 | 0.6% | 1.2% | 0.6% | 30.6% | 80.9% |

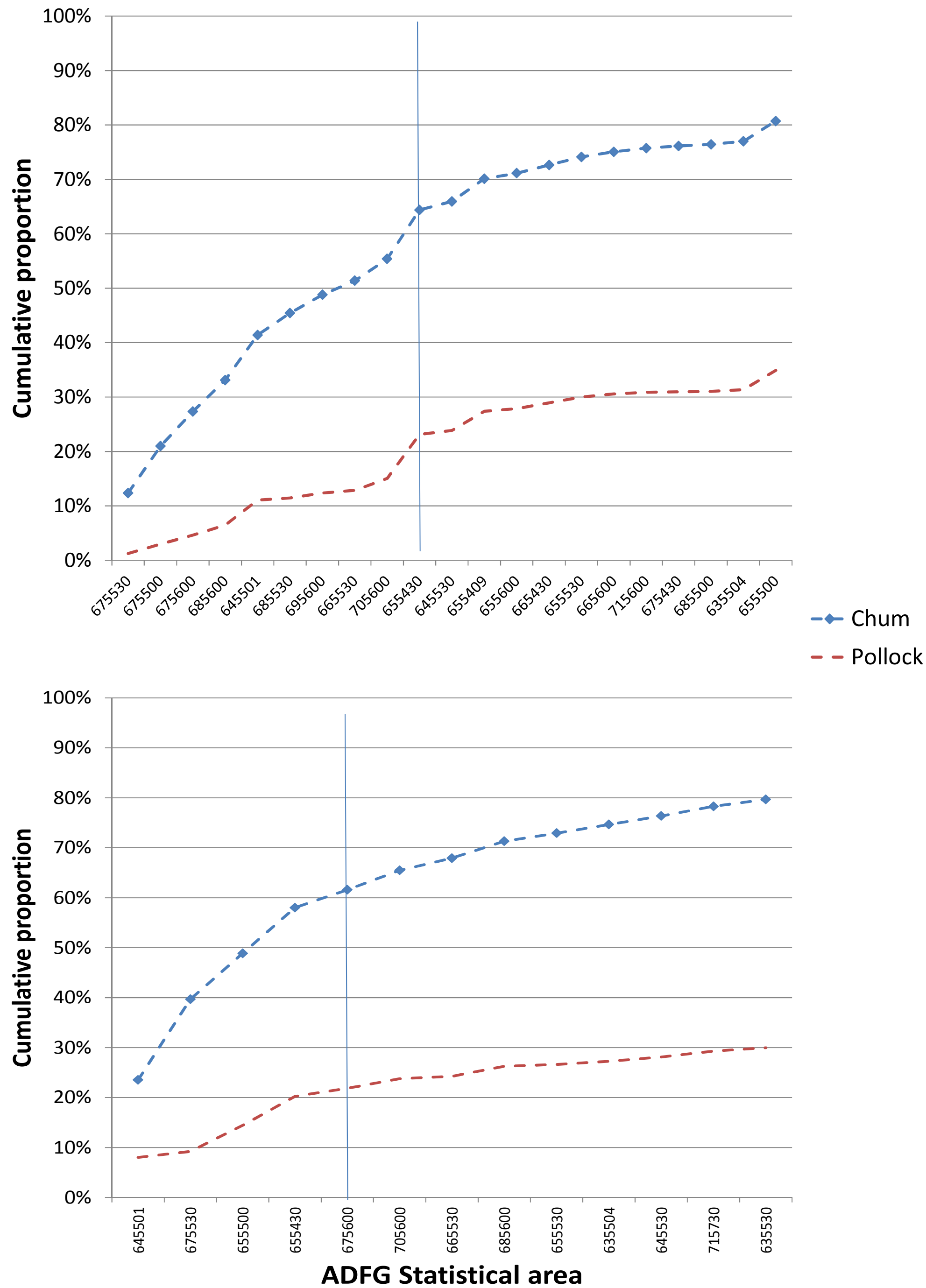



Figure 2-4 Cumulative proportion of chum and pollock catch for 2003 through 2011 for the B season (top panel) and for the June-July period (bottom).

## 2.6 Alternatives considered and eliminated from further analysis

Additional alternatives were considered by the Council over the time frame of the development of alternatives but were not carried forward for analysis. Modifications to the alternatives have focused on the range of hard caps and trigger caps under consideration, the years over which sector allocation percentages were considered and the area closures systems being considered. Modifications to these occurred iteratively, and the elimination of some of these from current consideration are described below.

The range of alternative hard caps for Alternative 2 were initially representative of the average bycatch over two extreme high and low time frames: 1997 through 2001 (representing the 5-year average prior to the approval of the Yukon River Agreement to the Pacific Salmon Treaty) and a high range of the 3-year average from 2004 through 2006. At that time the range under consideration was thus 58,176 to 488,045. At a subsequent Council meeting, the Council modified this range to round these numbers to 58,000 to 488,000 and then iteratively to modify this range to be 50,000 to 353,000. The Council likewise iteratively modified the years over which the historical sector allocation would be averaged to be more consistent with recent year history of bycatch by sector.

The suite of alternatives had previously included a separate alternative trigger closure system developed by staff at the request of the Council. This closure system was iteratively modified and most recently included in the initial review draft dated May 2011. At the June 2011 meeting, given indications that the proposed monthly closure system would limit the orderly conduct and efficient operation of this fishery and would be potentially less effective than other measures for minimizing bycatch to the extent practicable as stated in the purpose and need for this action, the Council moved to remove that alternative from further consideration. The Council did fold some of the concepts embodied in that system into the current Alternative 3 closure options. The previously considered closure system may be found in Chapter 2 of the May 2011 analysis.[33]

[33] http://www.alaskafisheries.noaa.gov/npfmc/PDFdocuments/bycatch/ChumEA511.pdf

# 3 Methods for Impact Analysis

The following description of the methodology attempts to outline the scientific basis to aid decision-makers and the public. The chapter presents the approach used to evaluate the impacts of alternatives on pollock catch (Chapter 4), Chum salmon (Chapter 5), Chinook salmon (Chapter 6) and the economic impacts (RIR). For the remaining resource categories considered in this analysis, marine mammals, seabirds, other groundfish, EFH, ecosystem relationships, and environmental justice, impacts of the alternatives were evaluated largely qualitatively based on results and trends from the quantitative analysis. Emphasis was placed on carrying forward estimates of uncertainties and interpretation of different assumptions.

## 3.1 Estimating Chum salmon bycatch in the pollock fishery

Overall, salmon bycatch levels are estimated based on extensive observer coverage using the NMFS Catch Accounting System (CAS). For the pollock fishery, the vast majority of tows are observed either directly at sea or at offloading locations aboard motherships or at shore-based processing plants. The observer data is used to allow inseason managers to evaluate when to open and close all groundfish fisheries based on bycatch levels of prohibited species, such as salmon and halibut, and catch levels of target groundfish species. The process of using observer data (in addition to other landings information) to set fishery season length relies on assuming that catch and bycatch rate information collected by observers is similar to catch and bycatch rates by unobserved fishing vessels. Data from observed vessels and processors is extrapolated to catch made by unobserved vessels.

The sampling intensity for salmon bycatch in the pollock fishery is very high in order to reduce the severity of potential sampling issues and to satisfy the demands of inseason management. Because sampling fractions are high for the pollock fishery, uncertainty associated with the magnitude of salmon bycatch is relatively low. Statistically rigorous estimators have been developed that suggest that for the Eastern Bering Sea pollock fishery, the levels of salmon bycatch are precisely estimated with coefficients of variation of around 5 percent (Miller 2005[34]). This indicates that, assuming that the observed fishing operations are unbiased relative to unobserved operations, the total salmon bycatch levels are precisely estimated for the fleet as a whole. Imprecision of the estimates of total annual Chinook salmon bycatch is considered negligible.

### 3.1.1 Monitoring Catcher/processors and motherships

Catcher/processors and motherships are required to carry two NMFS-certified observers during each fishing day. These vessels must also have an observer sampling station and a motion-compensated flow scale, which is used to weigh all catch in each haul. The observer sampling station is required to include a table, motion compensated platform scale, and other monitoring tools to assist observers in sampling. Each observer covers a 12 hour shift and all hauls are observed unless an observer is unable to sample (*e.g.,* due to illness or injury).

Estimates of the weight of each species in the catch are derived from sampling. A sample is a specific portion of the haul that is removed and examined by the observer. Catch in the sample is sorted by species, identified, and weighed by the observer. Species counts also are obtained for non-predominant species. Observer samples are collected using random sampling techniques to the extent possible on

[34] Miller's dissertation represents a thorough presentation of statistically sound methodology that accurately characterizes low variation in salmon bycatch estimates. However, NMFS recognizes the differences between its estimates and those presented in Miller 2005. See FEIS for Chinook salmon for details.

commercial fishing vessels. Observer samples are extrapolated to the haul level under the assumption that sample composition represents the composition of an entire haul. The sample proportion of each haul in the pollock fishery is relatively high because catch is generally not diverse and excellent sampling tools, such as flow scales and observer sample stations, are available.

Sampling for salmon is conducted as part of the overall species composition sampling for each haul. The observer collects and records information about the number of salmon in each sample and the total weight of each haul. NMFS estimates the total number of salmon in each haul by extrapolating the number of salmon in the species composition samples to the total haul weight. In the rare case that an observer on an AFA catcher/processor or mothership is unable to sample a haul for species composition, NMFS applies species composition information from observed hauls to non-observed hauls.

Catcher vessels deliver unsorted catch to the three motherships that participate in the AFA pollock fisheries. NMFS does not require these catcher vessels to carry observers because catch is not removed from the trawl's codend (the detachable end of the trawl net where catch accumulates) prior to it being transferred to the mothership. Observer sampling occurs on the mothership following the same estimation processes and monitoring protocols that are described above for catcher/processors.

While regulations require vessel personnel to retain salmon until sampled by an observer, salmon that are retained by catcher/processor and mothership crew outside of the observer's sample are not included in the observer's samples and are not used to estimate the total number of salmon caught. However, observers examine these salmon for coded-wire tags and may collect biological samples.

### 3.1.2 Monitoring catcher vessels delivering to shoreside processors or stationary floating processors

In 2011 regulations to implement Amendment 91 went into place, and with them a requirement for all catcher vessels to carry an observer during all of their fishing days (100% coverage) regardless of length. Prior to 2011, catcher vessels in the inshore sector were required to carry observers based on vessel length as follows:

> Catcher vessels 125 feet in length or greater are required to carry an observer during all of their fishing days (100 percent coverage).
>
> Catcher vessels greater than 60 feet in length and up to 125 feet in length are required to carry an observer at least 30 percent of their fishing days in each calendar quarter, and during at least one fishing trip in each target fishery category (30 percent coverage).
>
> Catcher vessels less than 60 feet in length are not required to carry an observer. However, no vessels in this length category participate in the Bering Sea pollock fisheries.

All salmon bycatch data through 2010 uses the following methodology to estimate bycatch in observed (and expansion to unobserved) vessels. Observers sample hauls onboard the catcher vessels to collect species composition and biological information. Observers use a random sampling methodology that requires observers to take multiple, equal sized, samples from throughout the haul to obtain a sample size of approximately 300 kilograms. Catch from catcher vessels delivering to shoreside processing plants or floating processors generally is either dumped or mechanically pumped from a codend (i.e., the end of the trawl net where catch accumulates) directly into recirculating seawater (RSW) tanks. Observers obtain random species composition samples by diverting portions of the catch as it flows from the codend to the RSW tanks.

This particular collection method is difficult and dangerous, as observers must obtain a relatively small amount of fish from the catch flowing out of the codend as it is emptied into the RSW tanks. A large codend may contain over 100 t of fish. This sampling is typically done on-deck, where the observer is exposed to the elements and subject to the operational hazards associated with the vessel crew's hauling, lifting, and emptying of the codend into the large hatches leading to the tanks. In contrast, the sampling methods used on catcher/processors and motherships allow observers to collect larger samples under more controlled conditions. On these vessels, the observer is able to collect samples downstream of the fish holding tanks, just prior to the catch sorting area that precedes the fish processing equipment. Additionally, the observer is below decks and has access to catch weighing scales and an observer sampling station.

Because the composition of catch in the pollock fishery is almost 100 percent pollock, species composition sampling generally works well for common species. However, for uncommon species such as salmon, a larger sample size is desired; however, large sample sizes are generally not logistically possible on the catcher vessels. Instead, estimates of salmon bycatch by catcher vessels are based on a full count or census of the salmon bycatch at the shoreside processing plant or stationary floating processor whenever possible.

Vessel operators are prohibited from discarding salmon at sea until the number of salmon has been determined by an observer, either on the vessel or at the processing plant, and the collection of any scientific data or biological samples from the salmon has been completed. Few salmon are reported discarded at sea by observed catcher vessels. However, any salmon reported as discarded at sea by the observer are added into the observer's count of salmon at the processing plant. Unlawful discard of salmon at sea may also subject a vessel operator to enforcement action.

### 3.1.3 Monitoring shoreside processors

AFA inshore processors are required to provide an observer for each 12 consecutive hour period of each calendar day during which the processor takes delivery of, or processes, groundfish harvested by a vessel directed fishing for pollock in the Bering Sea. NMFS regulates plant monitoring through a permitting process. Each plant that receives AFA pollock is required to develop and operate under a NMFS-approved catch monitoring and control plan (CMCP). Monitoring standards for CMCP are described in regulation at 50 CFR 679.28(g).

These monitoring standards detail the flow of fish from the vessel to the plant ensuring all groundfish delivered are sorted and weighed by species. CMCPs include descriptions and diagram of the flow of catch from the vessel to the plant, scales for weighing catch, and accommodations for observations. Depending on the plant, observers will physically remove all salmon from the flow of fish before the scale as it is conveyed into the plant, or supervise the removal of salmon by plant personnel. Observers assigned to the processing plant are responsible for reading the CMCPs and verifying the plant is following the plan laid out in the CMCP. Vessel observers complete the majority of a salmon census during an offload, with the plant observer providing breaks during long offloads.

One performance standard required in CMCPs is that all catch must be sorted and weighed by species. The CMCP must describe the order in which sorting and weighing processes take place. Processors meet this performance standard in different ways. Some processors choose to weigh all of the catch prior to sorting and then deduct the weight of non-pollock catch in order to obtain the weight of pollock. Other processors choose to sort the catch prior to weighing and obtain the weight of pollock directly. No matter how the weight of pollock is obtained, it will only be accurate if bycatch is effectively sorted, and methods must be in place to minimize the amount of bycatch that makes it past the sorters into the factory. CMCPs were not designed to track individual fish throughout the shoreside processing plant and the focus of the performance standards is on monitoring the large volumes of species such as pollock, not on monitoring small quantities of bycatch. Currently, the practice of deducting bycatch from the total catch weight of pollock provides an incentive for processors to report bycatch, including salmon.

### 3.1.4 Salmon accounting at shoreside processors

When a catcher vessel offloads at the dock, prohibited species such as crab, salmon, and halibut are identified and enumerated by the vessel observer during the offload. The observer monitors the offload and, with the assistance of the plant's processing crew, attempts to remove all salmon from the catch. Salmon that are missed during sorting will end up in the processing facility, which requires special treatment by the plant and the observers to ensure they are counted. These "after-scale" salmon (so called because they were initially weighed along with pollock) creates tracking difficulties for the plant and the observer.

Although after scale salmon are required to be given to an observer, there is no direct observation of salmon once they are moved past the observer and into the plant. Observers currently record after scale salmon as if they had collected them. However, such salmon can better be characterized as plant reported information. Further complications in plant based salmon accounting occur when multiple vessels are delivering simultaneously, making it difficult or impossible to determine which vessel's trip these salmon should be assigned to. Currently, plant personnel are very cooperative with saving after-scale salmon for observers at this stage of sampling and after scale salmon numbers are relatively low. However, if management measures create incentives for not reporting salmon, this reportedly high level of cooperation could be reduced. Additionally, complications occur when multiple vessels are delivering in quick succession to a plant because it is often impossible to assign salmon to a vessel.

### 3.1.5 NMFS Catch Accounting System

NMFS determines the number of non-Chinook salmon caught as bycatch in the Bering Sea pollock fishery using the NMFS's CAS. The CAS was developed to receive catch reports from multiple sources, evaluate data for duplication or errors, estimate the total catch by species or species category, and determine the appropriate "bin" or account to attribute the catch. Historically, these accounts have been established to mirror the myriad combinations of gear, area, sector, and season that are established in the annual groundfish harvest specifications. In general, the degree to which a seasonal or annual allocation requires active NMFS management is often inversely related to the size of the allocation. Typically, the smaller the catch limit, the more intensive the management required to ensure that it is not exceeded.

The CAS account structure is different for each major regulatory program, such as the Amendment 80 Program, the GOA Rockfish Program, the AFA pollock fishery, and the CDQ Program. For example, separate accounts are used to monitor Atka mackerel caught by Amendment 80 vessels and non-Amendment 80 vessels. To monitor this catch, accounts are created for all Atka mackerel caught, separate accounts if the vessel is in a cooperative or limited access sector, separate accounts for fish caught in or outside special harvest limit areas, and finally, seasonal accounts for all scenarios combined. This results in 10 separate accounts that had to be created by programmers for use by NMFS fisheries managers.

The AFSC's Fisheries Monitoring and Analysis Division provides observer data about groundfish catch and salmon bycatch, including expanded information to NMFS. NMFS estimates salmon bycatch for unobserved catcher vessels using algorithms implemented in its CAS. The haul-specific observer information is used by the CAS to create salmon bycatch rates from observed vessels that are applied to total groundfish catch in each delivery (trip level) by an unobserved vessel. The rate is calculated using the observed salmon bycatch divided by the groundfish weight, which results in a measure of salmon per metric ton of groundfish caught. Salmon bycatch rates are calculated separately for Chinook salmon and non-Chinook salmon.

The CAS is programmed to extrapolate information from observed vessels to unobserved vessels by matching the type of information available from observed vessels with that of an unobserved vessel. Surrogate bycatch rates are applied using the most closely available data from an observed catcher vessel by:

- processing sector (in this case, inshore sector)
- week ending date,
- fishery (pollock),
- gear (pelagic trawl),
- trip target,
- special area (such as the catcher vessel operational area), and
- federal reporting area.

If data are unavailable for an observed vessel within the same sector, then rates will be applied based on observer data from vessels in all sectors in the target fishery. If observer data are unavailable from the same week, then a three-week moving average (if the reporting area or special area is the same) or three-month moving average (if data with the same reporting or special areas are not available) is applied. Similarly, if data from the same Federal reporting area is unavailable, then observer data from the pollock fishery in the Bering Sea, as a whole, will be applied. However, this latter methodology is rarely used. NMFS generally receives adequate information to calculate bycatch rates for observed vessels that operate in a similar time and place as the unobserved catcher vessels.

The CAS methodology used to estimate prohibited species catch is the same for the inshore and offshore sectors; however, the methodology to obtain haul-specific estimates is different between the sectors. The offshore sector relies on robust sampling methods and the inshore sector uses a census approach.

Estimates of salmon, crab, and halibut bycatch for catcher processors and motherships in the pollock fishery rely on at-sea sampling. To estimate the bycatch of these species, at-sea observers take several "within haul" samples that are extrapolate to obtain an estimate of specie-specific catch for a sampled haul. The haul-specific estimate is used by CAS to calculate a bycatch rate that is applied to unobserved hauls. Thus, there are several levels of estimation: (1) from sample to haul, (2) sampled hauls to unsampled hauls within a trip, and potentially, (3) sampled hauls to unsampled hauls between vessels.

The extrapolation method for prohibited species, such as halibut, salmon, and crab are the same for observed vessels in the inshore pollock sector. Sampling of prohibited species for this sector is conducted by observers both at-sea and shoreside. The majority of catch is assessed by observers when a vessel offloads catch at a plant (shoreside). During an offload, observers count all prohibited species as they are removed from the vessel. Prior to 2011 any prohibited species catch that is discarded at-sea was assessed by onboard observers. The total amount of prohibited species at-sea discard was then added to the shoreside census information to obtain a total amount of specie-specific discard for a trip. NMFS used the total discard information (inshore discards plus at-sea discards) to create a bycatch rate that was applied to unobserved vessels. The catch accounting system used the shoreside information for salmon bycatch only if the offloading vessel also had an observer onboard. As a result, only salmon bycatch data from observed trips were used when calculating a bycatch rate. Since 2011, with 100% observer coverage it is prohibited to discard any salmon at sea prior to counting by an observer. For shorebased catcher vessels offloading at plants, the census information on salmon is used as the official total PSC salmon catch.

## 3.2 Estimating non-Chinook salmon saved and forgone pollock catch

The first step in the impact analysis was to estimate how Chum salmon bycatch (and pollock catch) might have changed in each year from 2003 to 2011 under the different alternatives. The years 2003 to 2011 were chosen as the analytical base years because that was the most recent 8 year time period reflective of recent fishing patterns at the time of initial Council action, with 2005 representing the highest historical bycatch of non-Chinook. Catch accounting changed beginning in the 2003 pollock fishery with the CAS. Since 2003, the CAS has enabled consistent sector-specific and spatially-explicit treatment of the non-Chinook salmon bycatch data for comparative purposes across years. Thus, starting the analysis in 2003 provides the most consistent and uniform data set that was available from NMFS on a sector-specific basis.

This analysis assumes that past fleet behavior approximates operational behavior under the alternatives, but stops short of estimating changes in fishing vessel operations. While it is expected that the vessel operators will change their behavior to avoid salmon bycatch and associated potential losses in pollock revenue, data were unavailable to accurately predict the nature of these changes.

In some cases, the alternative and options would have closed the pollock fisheries earlier than actually occurred. When an alternative would have closed the pollock fishery earlier, an estimate is made of (1) the amount of pollock TAC that remained and (2) the reduction in the amount of chum salmon bycatch as a result of the closure. The unharvested or forgone pollock catch and the reduction in chum salmon bycatch is then used as the basis for assessing the impacts of the alternative. For some alternatives, the closures are spatial rather than complete and fishing can continue elsewhere. The components of the pollock fishery that are excluded from the closure areas are redistributed to outside areas and assumed to be able to continue fishing at the rate that boats within their sector caught pollock and prohibited species such as chum and Chinook salmon. This estimate of forgone or redistributed pollock catch and reduction in chum salmon bycatch also is used as a basis for estimating the economic impacts of the alternatives.

The analysis used actual catch of chum salmon in the Bering Sea pollock fishery, by season, first at the fleet level (CDQ and non-CDQ), and then at the sector-level (inshore CV (S), Mothership (M), offshore CP (P), and CDQ) for the years 2003-2011. Weekly data from the NMFS Alaska Region were used to approximate when the potential cap would have been reached. The day when the fishery trigger areas would have closed was approximated as mid-week. This date was then used to compute the bycatch rate for the remaining open areas (assuming that the same amount of pollock would have been harvested). The cost of moving from the closed areas was evaluated qualitatively in the RIR. For the shore-based catcher-vessel fleet, average distances to fishing grounds with and without closure scenarios were computed for 2003-2011 data. *In all cases the analysis was at the sector-level in terms of caps.* In practice, there can be cooperative level caps but data limitations prevent analysis at this resolution.

For transferability between sectors, for analysis this is just a special case removing any sector specific chum salmon allocation. This would result in higher bycatch and lower pollock diverted or foregone.

The following sections present the approaches used to break down chum salmon bycatch to account for the fact that only some of the bycatch would have returned to a river system or hatchery in the year it was caught in the pollock fishery and further that the bycatch originates from broadly different regions. The lagged impact of the bycatch is presented in section 3.2.1 below and the stock composition of the bycatch is in section 3.2.2.

### 3.2.1 Estimating Chum salmon adult equivalent bycatch

To understand impacts on chum populations, a method was developed to estimate how the different bycatch numbers would propagate to adult equivalent spawning salmon. Estimating the adult equivalent bycatch is necessary because not all salmon caught as bycatch in the pollock fishery would otherwise have survived to return to their spawning streams. This analysis relies on analyses of historical data using a stochastic "adult equivalence" model similar to that developed for Chinook salmon. This approach strives to account for sources of uncertainty.

Adult-equivalency (AEQ) of the bycatch was estimated to translate how different trigger cap scenarios may affect chum salmon stocks. Compared to the annual bycatch numbers recorded by observers each year for management purposes, the AEQ mortality considers the extensive observer data on chum salmon length frequencies. These length frequencies are used to estimate the ages of the bycaught salmon, appropriately accounting for the time of year that catch occurred. Coupled with information on the proportion of salmon that return to different river systems at various ages, the bycatch-at-age data is used to pro-rate, for any given year, how bycatch affects future potential spawning runs of salmon.

Evaluating impacts to specific stocks was done by applying available genetics studies from samples collected in 2005-2009 (see section 3.2.2). Even though sample collection issues exist, stock composition estimates appear to have consistencies depending on the time of year and location.

#### 3.2.1.1 Estimating Chum salmon catch-at-age

In order to appropriately account for the impact of salmon bycatch in the groundfish fisheries, it is desirable to correct for the age composition of the bycatch. For example, the impact on salmon populations of a bycatch level of 10,000 adult mature salmon is likely greater than the impact of catching 10,000 juvenile salmon that have just emerged from rivers and only a portion of which are expected to return for spawning in several years' time. Hence, estimation of the age composition of the bycatch (and the measure of uncertainty) is critical. The method follows an expanded version of Kimura (1989) and modified by Dorn (1992). Length at age data are used to construct age-length keys for each time-area stratum and sex. These keys are then applied to randomly sampled catch-at-length frequency data. The stratum-specific age composition estimates are then weighted by the catch within each stratum to arrive at an overall age composition for each year. The actual data and resultant age-length keys are extensive but can be provided on request to NMFS AFSC.

The modification from Kimura's (1989) approach was simply to apply a two-stage bootstrap scheme to obtain variance estimates. In the first stage, for a given year, sampled tows were drawn with replacement from all tows from which salmon were measured. In the second stage, given the collection of tows from the first stage, individual fish measurements were resampled with replacement. All stratum-specific information was carried with each record. For the length-age data, a separate but similar two-stage bootstrap process was done. Once samples of lengths and ages were obtained, age-length keys were constructed and applied to the catch-weighted length frequencies to compute age composition estimates. This process was repeated 100 times, and the results stored to obtain a distribution of both length and age composition.

Length frequency data on chum salmon from NMFS observer database was used to estimate the overall length and age composition of the bycatch (Figure 3-1). The first step in conducting this analysis was to estimate the catch by area and period within the season because there is a clear within-season pattern in length frequency (Figure 3-2). Initially a simple 2-area and 2-period approach was considered for a total of 4 strata. However, in some historical years the bycatch and data for the "early" period of the B-season (June and July) had very low sampling levels and bycatch, particularly for the region west of 170°W (Table 3-1 and Table 3-2). Consequently, the strata were re-considered as being EBS-wide for the early period and geographically stratified from the later period (Aug-October). This provided a compromise of samples and bycatch over the entire time series from which ages, lengths, and catch (Table 3-3) could be applied. Note that the stratification used here is independent from that used for the genetic stock composition estimation presented in the next section. The age data were used to construct annual stratified age-length keys when sample sizes were appropriate and stratified combined-year age-length keys for years where age samples were limited. To the extent possible, sex-specific age-length keys within each stratum were created and where cells were missing, a "global" sex-specific age-length key was used. The global key was computed over all strata within the same season. For years other than 2005-2009, a combined-year age-length key was used (based on data spanning all years).

Applying the available length frequencies with stratified catch and age data result in age composition estimates in the bycatch that are predominately age 4 (Table 3-4). Generally, it is inappropriate to use the same age-length key over multiple years because the proportions at age for given lengths can be influenced by variability in relative year-class strengths. Combining age data over all the years averages the year-class effects to some degree but may mask the actual variability in age compositions in individual years. To evaluate the sensitivity of our estimates to this problem we compared results by using the combined-year age-length key with results when annual keys were available. Results suggested that the differences associated with using the combined-year age-length key were relatively minor (Figure 3-3). For the purposes of this analysis, i.e., to provide improved estimates of the impact of bycatch on salmon returns, having age-specific bycatch estimates from these data is preferred. The estimates of uncertainty in the age composition due to sampling (via two-stage bootstrap application) were relatively minor (Figure 3-4).

The body size of chum salmon in the bycatch is generally larger during June and July than for the rest of the summer-fall season (Stram and Ianelli 2009). This pattern is also reflected by age as well with the average age of the bycatch older in the first stratum (June-July) compared to the other strata (Figure 3-5). Also apparent in these data are the differences in size frequency by sex with males consistently bigger than females (Stram and Ianelli 2009).

Table 3-1. Number of chum salmon length samples by area and season strata used for converting length frequency data to age composition data. Columns with labels E and W represent geographic strata for east and west of 170°W, respectively. *Source: NMFS Alaska Fisheries Science Center observer data.*

| | | | June-July | | | Aug-Oct | | | Other months | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | E | W | Total | E | W | Total | E | W | Total | |
| 1991 | 646 | 128 | 774 | 1,622 | 375 | 1,997 | 40 | 3 | 43 | 2,814 |
| 1992 | 1,339 | 565 | 1,904 | 6,921 | 2 | 6,923 | 163 | 1 | 164 | 8,991 |
| 1993 | 870 | 7 | 877 | 23,508 | 599 | 24,107 | 68 | 3 | 71 | 25,055 |
| 1994 | 773 | 36 | 809 | 12,552 | 1,734 | 14,286 | 81 | 3 | 84 | 15,179 |
| 1995 | 7 | 1 | 8 | 5,517 | 65 | 5,582 | 37 | 1 | 38 | 5,628 |
| 1996 | 407 | | 407 | 14,593 | 2,735 | 17,328 | 45 | 1 | 46 | 17,781 |
| 1997 | 1 | | 1 | 10,923 | 5,821 | 16,744 | 745 | 12 | 757 | 17,502 |
| 1998 | 59 | | 59 | 8,684 | 404 | 9,088 | 453 | 20 | 473 | 9,620 |
| 1999 | 12 | 1 | 13 | 13,269 | 387 | 13,656 | 39 | 3 | 42 | 13,711 |
| 2000 | 1,872 | 46 | 1,918 | 14,391 | 1,199 | 15,590 | 108 | 4 | 112 | 17,620 |
| 2001 | 1,302 | 714 | 2,016 | 12,774 | 2,675 | 15,449 | 914 | 81 | 995 | 18,460 |
| 2002 | 1,556 | 591 | 2,147 | 23,597 | 954 | 24,551 | 169 | 6 | 175 | 26,873 |
| 2003 | 6,909 | 828 | 7,737 | 47,147 | 7,673 | 54,820 | 1,391 | 84 | 1,475 | 64,032 |
| 2004 | 10,117 | 8,369 | 18,486 | 31,925 | 13,926 | 45,851 | 250 | 97 | 347 | 64,684 |
| 2005 | 19,905 | 2,871 | 22,776 | 20,871 | 30,284 | 51,155 | 153 | 137 | 290 | 74,221 |
| 2006 | 19,175 | 2,228 | 21,403 | 18,119 | 7,714 | 25,833 | 628 | 22 | 650 | 47,886 |
| 2007 | 2,147 | 2,154 | 4,301 | 15,444 | 10,615 | 26,059 | 3,771 | 43 | 3,814 | 34,174 |
| 2008 | 85 | 2,659 | 2,744 | 79 | 5,524 | 5,603 | 84 | 58 | 142 | 8,489 |
| 2009 | 289 | 9,846 | 10,135 | 108 | 8,690 | 8,798 | | 27 | 27 | 18,960 |
| 2010 | 82 | 3,736 | 3,818 | 49 | 2,734 | 2,783 | 2 | 22 | 24 | 6,625 |
| Total | 67,553 | 34,780 | 102,333 | 282,093 | 104,110 | 386,203 | 9,141 | 628 | 9,769 | 498,305 |

Table 3-2. Numbers of chum salmon age samples by area and season strata used for converting length frequency data to age composition data. Columns with labels E and W represent geographic strata for east and west of 170°W, respectively.

| | June-July | | | Aug-Oct | | | Total |
|---|---|---|---|---|---|---|---|
| | E | W | Total | E | W | Total | |
| 1988 | 0 | 0 | 0 | 204 | 0 | 204 | 204 |
| 1989 | 0 | 0 | 0 | 94 | 59 | 153 | 153 |
| 1990 | 103 | 0 | 103 | 281 | 41 | 322 | 425 |
| 1997 | 0 | 0 | 0 | 163 | 53 | 216 | 216 |
| 1998 | 0 | 0 | 0 | 92 | 69 | 161 | 161 |
| 1999 | 0 | 0 | 0 | 115 | 0 | 115 | 115 |
| 2000 | 0 | 0 | 0 | 122 | 0 | 122 | 122 |
| 2001 | 89 | 0 | 89 | 135 | 0 | 135 | 224 |
| 2002 | 67 | 0 | 67 | 144 | 0 | 144 | 211 |
| 2003 | 125 | 0 | 125 | 0 | 0 | 0 | 125 |
| 2004 | 224 | 0 | 224 | 103 | 62 | 165 | 389 |
| 2005 | 591 | 55 | 646 | 265 | 763 | 1,028 | 1,674 |
| 2006 | 202 | 65 | 267 | 280 | 483 | 763 | 1,030 |
| 2007 | 34 | 138 | 172 | 274 | 569 | 843 | 1,015 |
| 2008 | 106 | 41 | 147 | 151 | 213 | 364 | 511 |
| 2009 | 304 | 128 | 432 | 216 | 375 | 591 | 1,023 |
| Total | 1,845 | 427 | 2,272 | 2,639 | 2,687 | 5,326 | 7,598 |

Table 3-3. Numbers and percentages of chum salmon caught by area and season strata (top section) used for converting length frequency data to age composition data. Also shown are estimates of pollock catch (bottom section). Note that these totals differ slightly from NMFS official values due to minor spatio-temporal mapping discrepancies.

| Year | June-July | E Aug-Oct | W Aug-Oct | Total | June-July | E Aug-Oct | W Aug-Oct |
|---|---|---|---|---|---|---|---|
| | | | | **Chum (numbers)** | | | |
| 1991 | 4,817 | 19,801 | 2,796 | 27,414 | 18% | 72% | 10% |
| 1992 | 8,781 | 30,330 | 34 | 39,145 | 22% | 77% | 0% |
| 1993 | 4,550 | 229,180 | 7,142 | 240,872 | 2% | 95% | 3% |
| 1994 | 5,971 | 75,239 | 7,930 | 89,140 | 7% | 84% | 9% |
| 1995 | 122 | 18,329 | 418 | 18,870 | 1% | 97% | 2% |
| 1996 | 893 | 45,707 | 31,058 | 77,659 | 1% | 59% | 40% |
| 1997 | 319 | 31,503 | 32,452 | 64,274 | 0% | 49% | 50% |
| 1998 | 102 | 44,895 | 2,217 | 47,214 | 0% | 95% | 5% |
| 1999 | 470 | 44,438 | 874 | 45,783 | 1% | 97% | 2% |
| 2000 | 10,229 | 44,502 | 2,286 | 57,017 | 18% | 78% | 4% |
| 2001 | 6,371 | 36,578 | 10,105 | 53,055 | 12% | 69% | 19% |
| 2002 | 3,712 | 71,096 | 2,067 | 76,875 | 5% | 92% | 3% |
| 2003 | 14,843 | 142,319 | 18,986 | 176,147 | 8% | 81% | 11% |
| 2004 | 48,540 | 345,507 | 44,780 | 438,827 | 11% | 79% | 10% |
| 2005 | 238,338 | 304,078 | 128,740 | 671,156 | 36% | 45% | 19% |
| 2006 | 177,663 | 90,507 | 34,898 | 303,068 | 59% | 30% | 12% |
| 2007 | 13,352 | 31,901 | 39,841 | 85,094 | 16% | 37% | 47% |
| 2008 | 5,544 | 6,513 | 2,514 | 14,571 | 38% | 45% | 17% |
| 2009 | 23,890 | 16,879 | 4,576 | 45,346 | 53% | 37% | 10% |
| 2010 | 8,284 | 2,869 | 1,946 | 13,099 | 63% | 22% | 15% |
| | | | | **Pollock (t)** | | | |
| 1991 | 480,617 | 146,566 | 258,332 | 885,515 | 54% | 17% | 29% |
| 1992 | 481,266 | 225,503 | 23,639 | 730,407 | 66% | 31% | 3% |
| 1993 | 16,780 | 583,778 | 111,519 | 712,077 | 2% | 82% | 16% |
| 1994 | 33,303 | 516,557 | 154,842 | 704,703 | 5% | 73% | 22% |
| 1995 | 9,359 | 558,420 | 87,949 | 655,728 | 1% | 85% | 13% |
| 1996 | 12,139 | 513,922 | 103,967 | 630,028 | 2% | 82% | 17% |
| 1997 | 2,736 | 257,394 | 301,282 | 561,412 | 0% | 46% | 54% |
| 1998 | 1,748 | 441,128 | 133,283 | 576,159 | 0% | 77% | 23% |
| 1999 | 15,518 | 359,934 | 190,750 | 566,203 | 3% | 64% | 34% |
| 2000 | 68,868 | 351,649 | 244,314 | 664,831 | 10% | 53% | 37% |
| 2001 | 184,100 | 439,385 | 203,622 | 827,107 | 22% | 53% | 25% |
| 2002 | 268,146 | 478,689 | 132,809 | 879,644 | 30% | 54% | 15% |
| 2003 | 349,518 | 313,814 | 208,151 | 871,483 | 40% | 36% | 24% |
| 2004 | 360,000 | 245,770 | 249,329 | 855,099 | 42% | 29% | 29% |
| 2005 | 372,508 | 133,659 | 354,905 | 861,072 | 43% | 16% | 41% |
| 2006 | 347,953 | 105,202 | 409,078 | 862,234 | 40% | 12% | 47% |
| 2007 | 327,698 | 136,438 | 309,729 | 773,865 | 42% | 18% | 40% |
| 2008 | 277,689 | 48,327 | 245,132 | 571,147 | 49% | 8% | 43% |
| 2009 | 279,731 | 28,013 | 158,797 | 466,540 | 60% | 6% | 34% |
| 2010 | 298,925 | 39,816 | 133,066 | 471,808 | 63% | 8% | 28% |

Table 3-4. Estimated number of chum salmon by age based on stratified, catch-corrected application of bycatch length frequencies, 1991-2010. Due to the limited availability of samples, a combined age-length key was used (italicized values) for all years except 2005-2009. Note that these totals differ slightly from NMFS official values due to minor spatio-temporal mapping discrepancies.

| | Age | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Year** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **Total** |
| 1991 | *63* | *564* | *7,552* | *15,641* | *3,315* | *204* | *24* | 27,363 |
| 1992 | *64* | *136* | *11,409* | *22,869* | *4,372* | *224* | *48* | 39,122 |
| 1993 | *201* | *912* | *70,305* | *141,809* | *25,939* | *1,258* | *302* | 240,726 |
| 1994 | *200* | *69* | *17,133* | *58,652* | *12,214* | *680* | *164* | 89,112 |
| 1995 | *15* | *66* | *3,430* | *12,311* | *2,809* | *172* | *53* | 18,856 |
| 1996 | *585* | *1,443* | *20,195* | *43,908* | *10,651* | *620* | *138* | 77,540 |
| 1997 | *600* | *953* | *17,683* | *34,726* | *9,374* | *681* | *107* | 64,124 |
| 1998 | *65* | *55* | *6,244* | *31,672* | *7,877* | *530* | *109* | 46,552 |
| 1999 | *37* | *153* | *7,952* | *30,313* | *6,792* | *374* | *102* | 45,723 |
| 2000 | *140* | *82* | *9,243* | *37,670* | *9,260* | *511* | *70* | 56,976 |
| 2001 | *252* | *425* | *9,771* | *33,582* | *8,490* | *455* | *58* | 53,033 |
| 2002 | *86* | *291* | *13,554* | *50,440* | *11,658* | *630* | *185* | 76,844 |
| 2003 | *454* | *1,943* | *37,379* | *109,221* | *25,249* | *1,520* | *311* | 176,077 |
| 2004 | *1,260* | *1,408* | *103,576* | *266,650* | *61,006* | *3,380* | *661* | 437,941 |
| 2005 | 12,849 | 2,273 | 132,119 | 439,843 | 77,139 | 3,742 | 78 | 668,043 |
| 2006 | 0 | 0 | 47,852 | 155,360 | 93,930 | 3,997 | 70 | 301,209 |
| 2007 | 0 | 506 | 17,287 | 48,913 | 15,323 | 2,110 | 128 | 84,267 |
| 2008 | 4 | 7 | 1,848 | 9,471 | 3,022 | 141 | 23 | 14,516 |
| 2009 | 9 | 335 | 10,916 | 26,834 | 6,384 | 236 | 77 | 44,791 |
| 2010 | *81* | *68* | *2,121* | *7,991* | *2,654* | *156* | *21* | 13,093 |

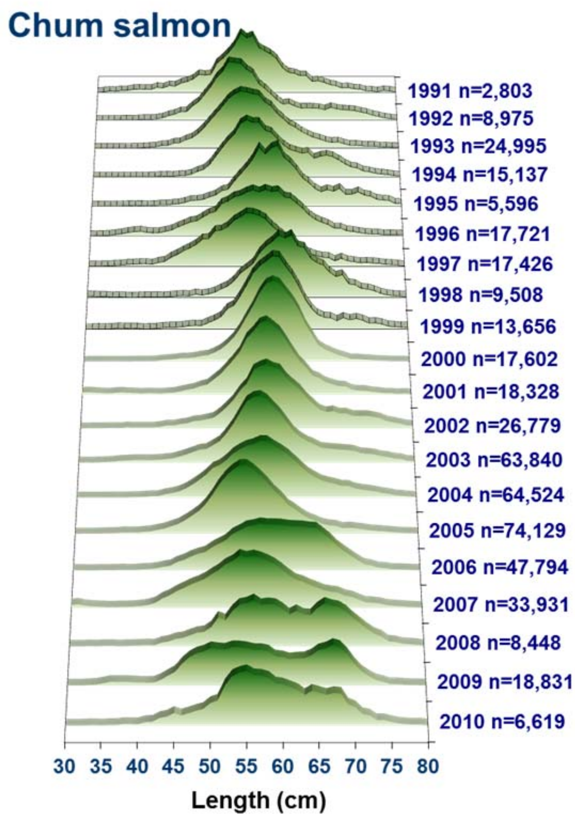



Figure 3-1. Chum salmon length frequency from the eastern Bering Sea pollock fishery, 1991-2010.

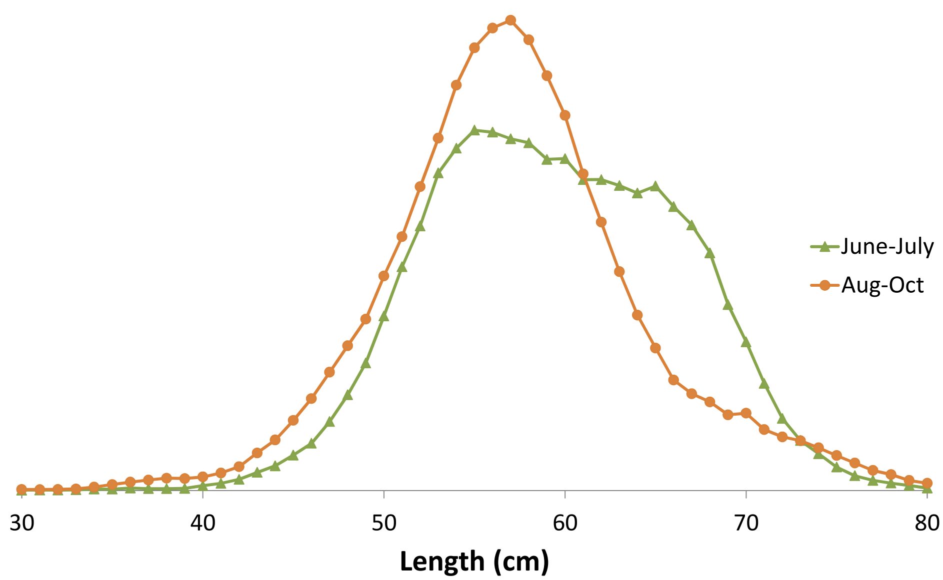



Figure 3-2. Aggregated chum length frequency from the eastern Bering Sea pollock fishery by period within the B-season, 1991-2010.

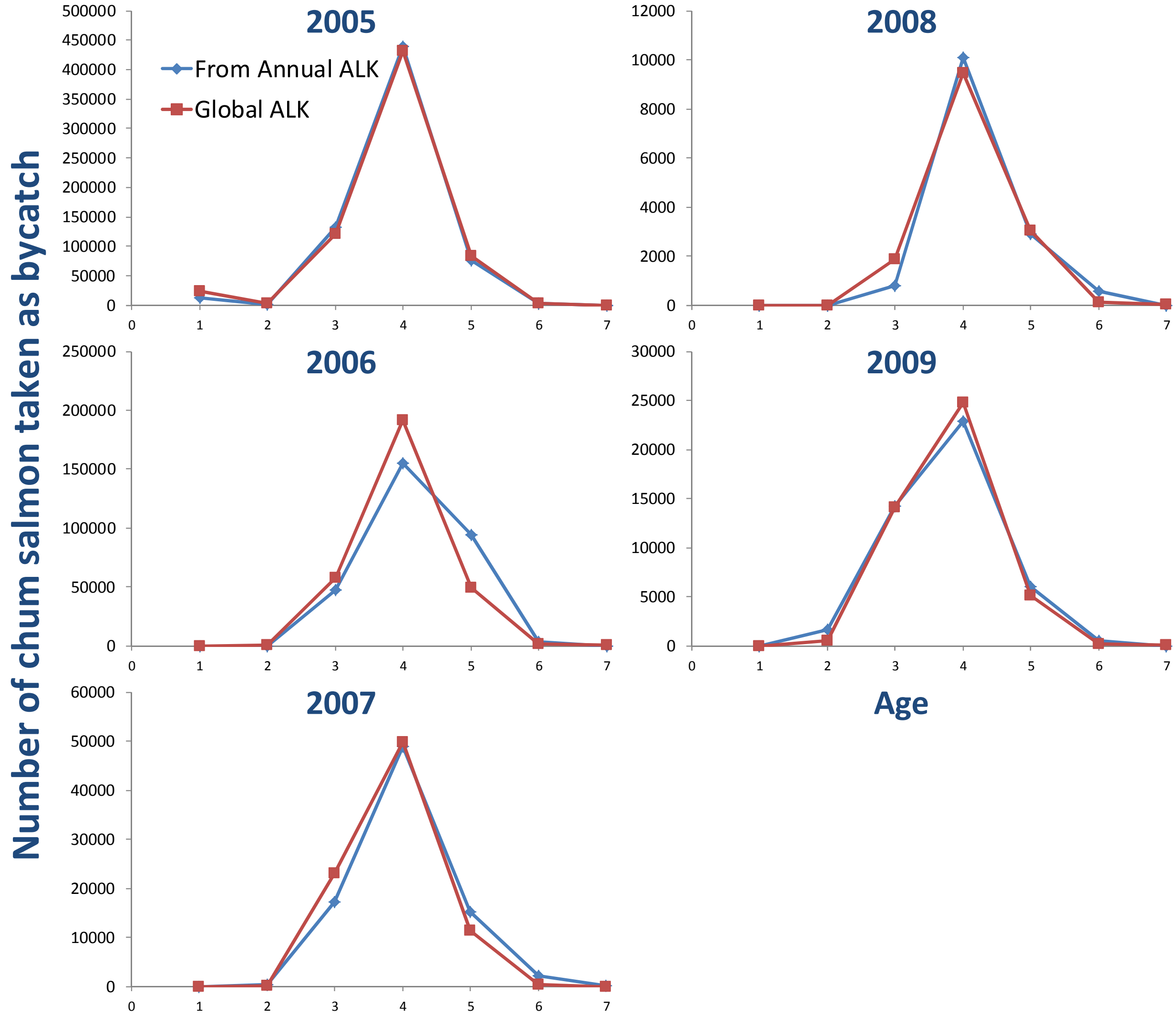



Figure 3-3. Estimated chum bycatch at age as estimated by using the combined-year stratified age-length key compared to estimates from annually varying stratified age-length keys, 2005-2009.

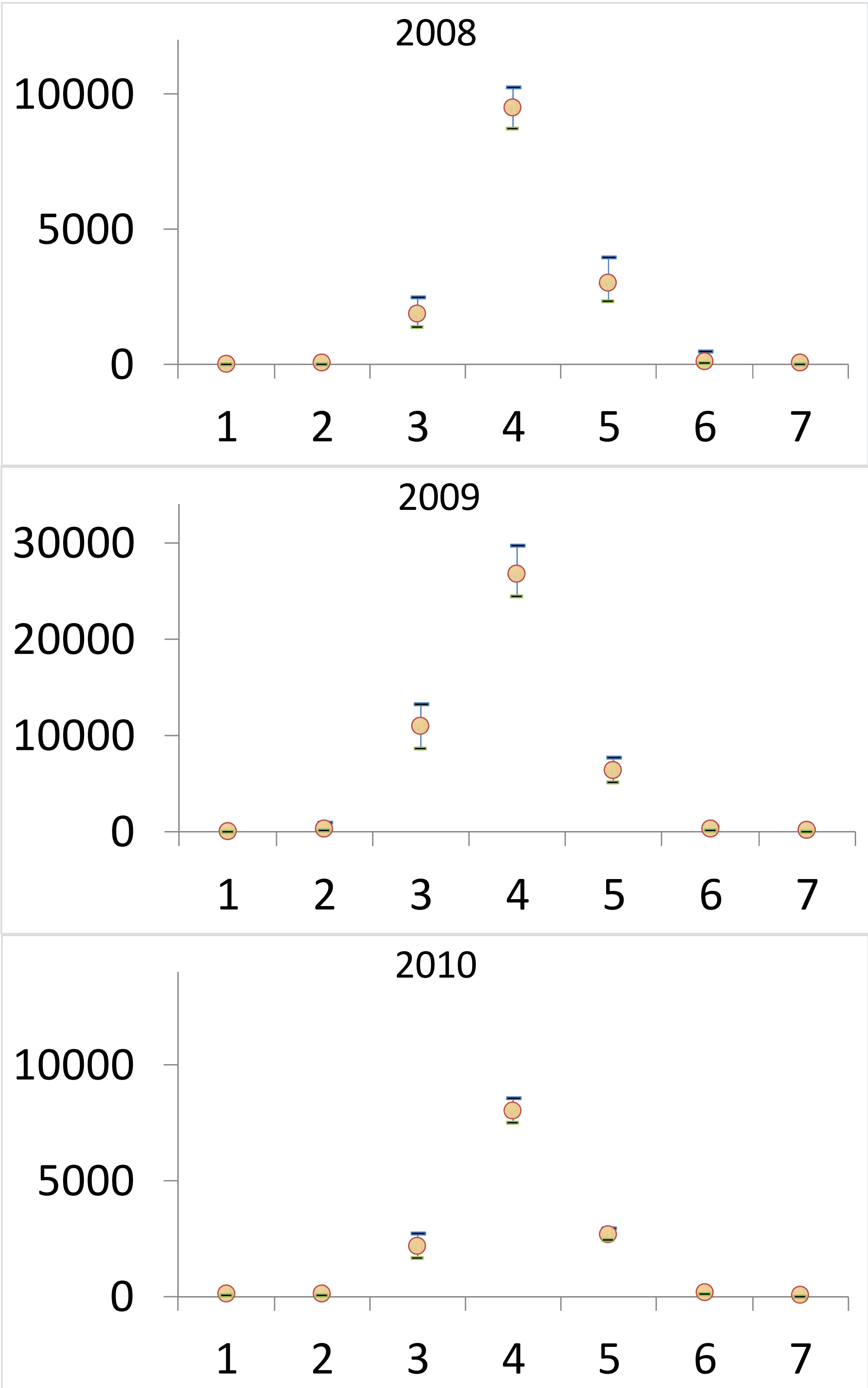



Figure 3-4. Examples of estimated chum bycatch at age and bootstrap quantiles (0.05 and 0.95) by using stratified age-length keys, 2008-2010.

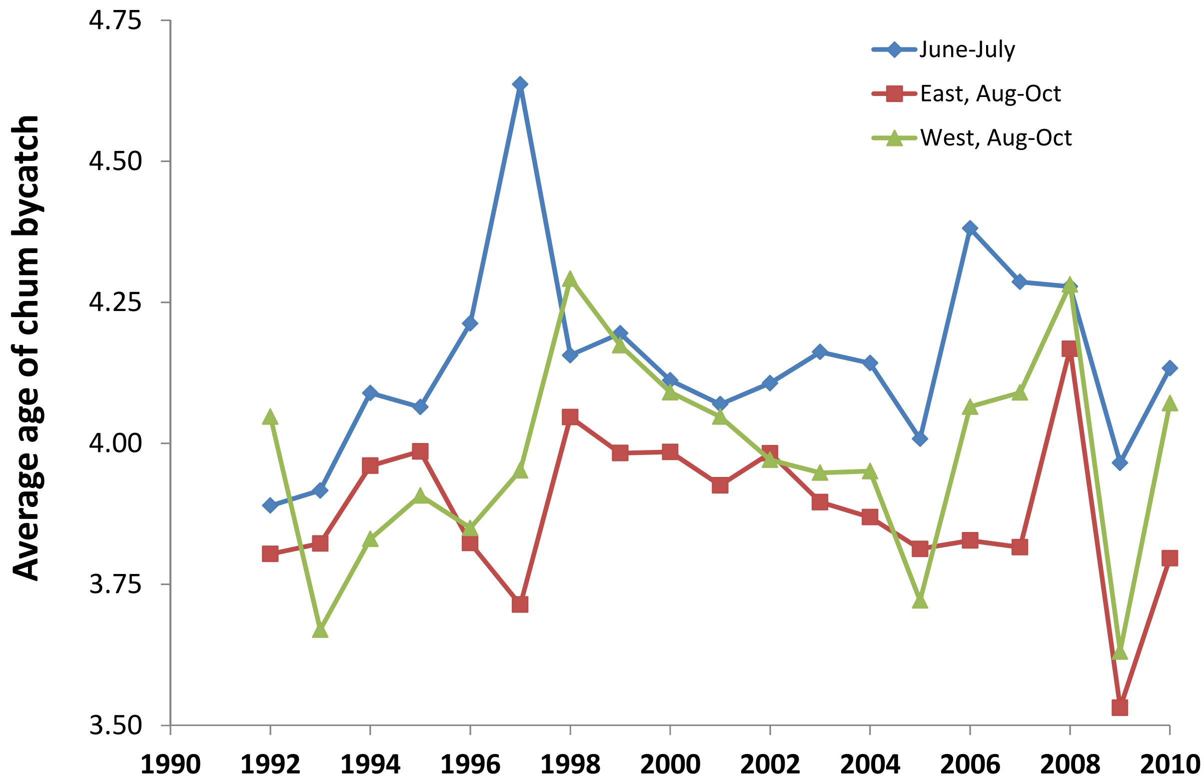



Figure 3-5. Stratified estimates of average age (years) of chum bycatch based on catch-at-age estimates from NMFS observer collected length frequencies and age determinations, 1991-2010.

### 3.2.1.2 Adult equivalence model

A simplified version of implementing Adult equivalence (AEQ) analysis to chum was possible because most of the bycatch occurred during the summer-fall fishery (only samples from this period are used for analysis). As with the Chinook model, given the age specific bycatch estimates by strata, oceanic natural mortality, and age composition of chum returning to spawn (for the AYK region), it is possible to estimate the AEQ for chum salmon. Alternative oceanic mortality rates can also evaluated because these are poorly known.

The impact of bycatch on salmon runs measures the historical bycatch levels relative to the subsequent returning salmon run *k* in year *t* as:

$$u_{t,k} = \frac{AEQ_{t,k}}{AEQ_{t,k} + S_{t,k}} \qquad (1)$$

where $AEQ_{t,k}$ and $S_{t,k}$ are the adult-equivalent bycatch and stock size (actual run size that returned) estimates of the salmon species in question, respectively. The calculation of $AEQ_{t,k}$ includes the bycatch of salmon returning to spawn in year *t* and the bycatch from previous years for the same brood year (i.e., at younger, immature ages). This latter component needs to be decremented by ocean survival rates and maturity schedules. The impact of current year and previous years bycatch on salmon returning (as adult equivalents in year *t*) can be expressed in expanded form (without stock specificity) as:

$$
\begin{aligned}
AEQ_t = \sum_{a=3}^{7} c_{t,a}\gamma_a &+ \\
&\gamma_4(1-\gamma_3)s_3c_{t-1,3} + \\
&\gamma_5(1-\gamma_4)(1-\gamma_3)s_3s_4c_{t-2,3} + \\
&\gamma_6(1-\gamma_5)(1-\gamma_4)(1-\gamma_3)s_3s_4s_5c_{t-3,3} + \\
&\gamma_7(1-\gamma_6)(1-\gamma_5)(1-\gamma_4)(1-\gamma_3)s_3s_4s_5s_6c_{t-4,3} + \\
\\
&\gamma_5(1-\gamma_4)s_4c_{t-1,4} + \\
&\gamma_6(1-\gamma_5)(1-\gamma_4)s_4s_5c_{t-2,4} + \\
&\gamma_7(1-\gamma_6)(1-\gamma_5)(1-\gamma_4)s_4s_5s_6c_{t-3,4} + \\
\\
&\gamma_6(1-\gamma_5)s_5c_{t-1,5} + \\
&\gamma_7(1-\gamma_6)(1-\gamma_5)s_5s_6c_{t-2,5} + \\
\\
&\gamma_7(1-\gamma_6)s_6c_{t-1,6}
\end{aligned} \tag{2}
$$

where $c_{t,a}$ is the bycatch of age *a* salmon in year *t*, $s_a$ is the proportion of salmon surviving from age *a* to *a+1,* and $\gamma_a$ is the proportion of salmon at sea that will return to spawn at age *a.* Since this model is central to the calculation of *AEQ* values, an explanatory schematic is given in Figure 3-6. Maturation rates vary over time and among stocks detailed information on this is available from a wide variety of sources. For the purpose of this study, an average over putative stocks was developed based on a variety of studies (Table 3-5). Note that there is a distinction between the distribution of mature age salmon found in rivers (Table 3-5) and the expected age-specific maturation rate of oceanic salmon ($\gamma_{a,k}$) used in this model (Table 3-6). However, given ocean survival rates the values for $\gamma_{a,k}$ can be solved which satisfy the age-specific maturation averaged over different stocks (2nd from bottom row of Table 3-5).

To carry out the computations in a straightforward manner, the numbers of salmon that remain in the ocean (i.e., they put off spawning for at least another year) are tracked through time until age 7 where for this model, all chum salmon in the ocean at that age are considered mature and will spawn in that year.

Stochastic versions of the adult equivalence calculations acknowledge both run-size inter-annual variability and run size estimation error, as well as uncertainty in maturation rates, the natural mortality rates (oceanic), river-of-origin estimates, and age assignments. The variability in run size can be written as (with $\dot{S}_{t,k}$ representing the stochastic version of $S_{t,k}$):

$$
\dot{S}_{t,k} = \overline{S}_k e^{\varepsilon_t+\delta_t} \quad \varepsilon_t \sim N\left(0,\sigma_1^2\right), \quad \delta_t \sim N\left(0,\sigma_2^2\right) \tag{3}
$$

where $\sigma_1^2, \sigma_2^2$ are specified levels of variability in inter-annual run sizes and run-size estimation variances, respectively. Note that for the purposes of this EA, estimates of run sizes were unavailable for some stocks hence this method is described here for conceptual purposes only.

The stochastic survival rates were simulated as:

$$\dot{s}_a = 1 - \exp\left(-M_a + \delta\right), \qquad \delta \sim N\left(0, 0.1^2\right) \tag{4}$$

whereas the maturity in a given year and age was drawn from beta-distributions:

$$\dot{\gamma}_a \sim B\left(\alpha_a, \beta_a\right) \tag{5}$$

with parameters $\alpha_a, \beta_a$ specified to satisfy the expected value of age at maturation (Table 3-5) and a pre-specified coefficient of variation term (provided as model input).

Similarly, the parameter responsible for assigning bycatch to river-system of origin was modeled by using a combination of years and "parametric bootstrap" approach, also with the beta distribution:

$$\dot{p}_k \sim B(\alpha_k, \beta_k) \tag{6}$$

again with $\alpha_k, \beta_k$ specified to satisfy the expected value of the estimates and variances shown from proportions based on the genetic analysis of the bycatch samples. For the purposes of this study, the estimation uncertainty is considered as part of the inter-annual variability in this parameter. The steps (implemented in a spreadsheet) for the AEQ analysis can be outlined as follows:

1. Select a bootstrap sample of salmon bycatch-at-age ($c_{t,a}$) for each year from the catch-age procedure described above;
2. Sum the bycatch-at-age for each year and proceed to account for year-of-return factors (e.g., stochastic maturation rates and ocean survival (Eqs. 2-5);
3. Partition the bycatch estimates to stock proportions (by year and area) drawn randomly from each parametric bootstrap;
4. Store stratum-specific AEQ values for each year;
5. Repeat 1-4 200 times;
6. Based on updated genetics results, assign to river of origin components ($\dot{p}_k$, Eq. 6).
7. Compile results over all years and compute frequencies from which relative probabilities can be estimated;

Sensitivity analyses on maturation rates by brood year were conducted and contrasted with alternative assumptions about natural mortality ($M_a$) schedules during their oceanic phase interacts with the corresponding age-specific probabilities that a salmon would return to spawn (Table 3-6; given the in-river mature population proportions shown in Table 3-5).Table 3-5).

The pattern of bycatch relative to AEQ is variable and relatively insensitive to mortality assumptions (Figure 3-7). For simplicity in presenting the analysis, subsequent values are based on the intermediate age-specific natural mortality (Scenario 2) which when evaluated with the stochastic components, revealed a fair amount of uncertainty in the AEQ estimates (Figure 3-8).

Notice that in some years, the bycatch records may be below the actual AEQ due to the lagged impact of previous years' catches (e.g., in 1994 and 2006; Table 3-7). A similar result would be predicted for AEQ model results in 2010 regardless of actual bycatch levels in this year due to the cumulative effect of bycatch prior to 2010.

Overall, the estimate of AEQ chum salmon mortality from 1994-2010 ranged from about 16,000 fish to just over 540,000 (Table 3-7). The application of these results to the genetic stock identification derived from sampling is presented in the next section.

The approach for evaluating alternative management measures (detailed in subsequent sections) generally involves superimposing measures on observed data from 2003-2011. These data are collapsed to ADFG statistical area, pollock fleet sector, year, and week. Consequently, results are presented in terms of how much the actual bycatch tally (in a given year) would be reduced given a particular management measure. To easily map this into AEQ that can subsequently be applied to stock identification, we conducted a multiple regression from the results presented in which simply used the current year's bycatch and the bycatch the year before to predict this year's AEQ. Results indicated a highly significant (the intercept was found to be not significantly different than zero) fit:

| | Regression Statistics |
|---|---|
| Multiple R | 0.999818 |
| R Square | 0.999635 |
| Adjusted R Square | 0.94079 |
| Standard Error | 3929.607 |
| Observations | 19 |

ANOVA

| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 2 | 7.2E+11 | 3.6E+11 | 23297.96 | 1.93E-28 |
| Residual | 17 | 2.63E+08 | 15441813 | | |
| Total | 19 | 7.2E+11 | | | |

with coefficients:

| | Coefficients | Standard Error |
|---|---|---|
| $b_1$ | 0.599723 | 0.006381 |
| $b_2$ | 0.328816 | 0.006378 |

This produces an estimate of AEQ given last year's and the current year's bycatch which can be readily used for converting bycatch reductions to AEQ reductions. The formula is thus:

$$AEQ_t = C_t b_1 + C_{t-1} b_2 \quad (3)$$

where $C_t, C_{t-1}$ is the total bycatch of chum the current year and the previous year, respectively.

Table 3-5. In-river maturity-at-age distribution of chum salmon by region. Note that the column "relative weight" was used for computing a weighted mean maturity rate for chum salmon arising from relative run sizes presented in section 5.0. *Source: Dani Eveson, ADFG pers. comm. 2010.*

| | | Age-specific in-river maturity | | | | |
|---|---|---|---|---|---|---|
| **Region** | Relative weight | 3 | 4 | 5 | 6 | 7 |
| Norton Sound | 0.14 | 4.8% | 50.4% | 40.7% | 4.0% | 0.1% |
| Yukon River summer | 0.17 | 1.4% | 52.9% | 42.7% | 3.1% | 0.0% |
| Yukon River fall | 0.17 | 3.8% | 67.8% | 27.5% | 0.9% | 0.0% |
| Nushagak | 0.16 | 2.0% | 64.0% | 32.0% | 1.0% | 0.0% |
| Kuskokwim | 0.35 | 1.9% | 63.8% | 33.3% | 1.1% | 0.0% |
| Weighted mean | | 2.6% | 60.8% | 34.7% | 1.8% | 0.0% |

Table 3-6 Estimated maturity-at-age for chum salmon bycatch based on the weighted in-river maturity observations (Table 3-5) and different assumptions of ocean annual survival rates (as mapped through natural mortality, *M*).

| | Age 1 | Age 2 | Age 3 | Age 4 | Age 5 | Age 6 | Age 7 |
|---|---|---|---|---|---|---|---|
| **Scenario 1** | | | | | | | |
| Maturity($\gamma_a$) | 0.000 | 0.000 | 0.118 | 0.760 | 0.984 | 0.999 | 1.000 |
| $M$ | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **Scenario 2** | | | | | | | |
| Maturity($\gamma_a$) | 0.000 | 0.000 | 0.110 | 0.744 | 0.986 | 0.999 | 1.000 |
| $M$ | 0.400 | 0.300 | 0.200 | 0.150 | 0.100 | 0.050 | 0.000 |
| **Scenario 3** | | | | | | | |
| Maturity($\gamma_a$) | 0.000 | 0.000 | 0.114 | 0.748 | 0.985 | 0.999 | 1.000 |
| $M$ | 0.100 | 0.100 | 0.100 | 0.100 | 0.100 | 0.100 | 0.100 |

Table 3-7 Estimated chum bycatch by year, their age-equivalent removals to mature returning salmon (AEQ, with upper and lower confidence intervals from simulations) and removals by chum salmon brood year (last two columns) using natural mortality scenario 2. Italicised values represent predictions from Eq. 7).

| Bycatch year | Annual bycatch | Mean AEQ | AEQ 5th percentile | AEQ 95th percentile | Brood year | Estimated bycatch |
|---|---|---|---|---|---|---|
| 1991 | 28,951 | 16,884 | 14,791 | 18,754 | 1988 | 56,008 |
| 1992 | 40,274 | 31,539 | 27,733 | 38,968 | 1989 | 160,433 |
| 1993 | 242,191 | 154,290 | 138,556 | 172,756 | 1990 | 119,973 |
| 1994 | 92,672 | 132,571 | 100,609 | 186,132 | 1991 | 38,624 |
| 1995 | 19,264 | 47,948 | 36,212 | 75,265 | 1992 | 55,596 |
| 1996 | 77,236 | 53,984 | 47,699 | 61,907 | 1993 | 62,179 |
| 1997 | 65,988 | 60,301 | 51,509 | 80,216 | 1994 | 64,948 |
| 1998 | 64,042 | 66,699 | 59,521 | 78,004 | 1995 | 46,863 |
| 1999 | 45,172 | 48,279 | 41,618 | 61,929 | 1996 | 54,118 |
| 2000 | 58,571 | 52,581 | 45,178 | 61,074 | 1997 | 57,182 |
| 2001 | 57,007 | 52,743 | 46,109 | 65,963 | 1998 | 90,286 |
| 2002 | 80,782 | 69,344 | 61,280 | 82,058 | 1999 | 190,325 |
| 2003 | 189,185 | 141,869 | 125,711 | 171,351 | 2000 | 376,947 |
| 2004 | 440,468 | 325,945 | 292,873 | 377,794 | 2001 | 631,926 |
| 2005 | 704,552 | 567,893 | 501,585 | 671,478 | 2002 | 285,480 |
| 2006 | 309,630 | 419,542 | 335,831 | 591,359 | 2003 | 97,814 |
| 2007 | 93,783 | 150,434 | 116,769 | 214,919 | 2004 | 37,342 |
| 2008 | 15,267 | 45,958 | 34,578 | 70,315 | 2005 | 31,239 |
| 2009 | 46,127 | 36,435 | 31,402 | 43,711 | 2006 | 16,959 |
| 2010 | 13,222 | 21,765 | 15,983 | 32,509 | | |
| *2011* | 191,445 | *119,162* | | | | |
| *2012* | | *62,950* | | | | |

The sum over ages of catch in year *t* that would have returned in that year

$$AEQ_t = \sum_{a=3}^{7} c_{t,a}\gamma_a + \text{ Fish caught in earlier years that would have survived:}$$

The catch of age 3 salmon in previous years that survived and had not returned in earlier years

$$\begin{cases} \gamma_4\left(1-\gamma_3\right)s_3c_{t-1,3} + \\ \gamma_5\left(1-\gamma_4\right)\left(1-\gamma_3\right)s_3s_4c_{t-2,3} + \\ \gamma_6\left(1-\gamma_5\right)\left(1-\gamma_4\right)\left(1-\gamma_3\right)s_3s_4s_5c_{t-3,3} + \\ \gamma_7\left(1-\gamma_6\right)\left(1-\gamma_5\right)\left(1-\gamma_4\right)\left(1-\gamma_3\right)s_3s_4s_5s_6c_{t-4,3} + \end{cases}$$

The catch of age 4 salmon in previous years that survived and had not returned in earlier years

$$\begin{cases} \gamma_5\left(1-\gamma_4\right)s_4c_{t-1,4} + \\ \gamma_6\left(1-\gamma_5\right)\left(1-\gamma_4\right)s_4s_5c_{t-2,4} + \\ \gamma_7\left(1-\gamma_6\right)\left(1-\gamma_5\right)\left(1-\gamma_4\right)s_4s_5s_6c_{t-3,4} + \end{cases}$$

The catch of age 5 salmon…

$$\begin{cases} \gamma_6\left(1-\gamma_5\right)s_5c_{t-1,5} + \\ \gamma_7\left(1-\gamma_6\right)\left(1-\gamma_5\right)s_5s_6c_{t-2,5} + \end{cases}$$

$$\gamma_7\left(1-\gamma_6\right)s_6c_{t-1,6}$$

Figure 3-6. Explanatory schematic of main AEQ equation. Symbols are defined in text.

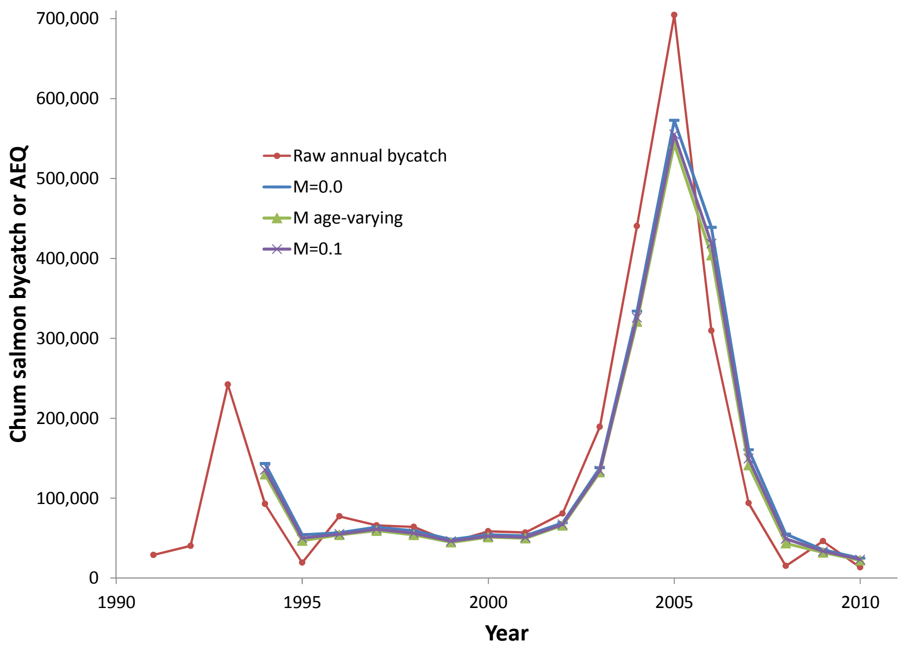



Figure 3-7. Estimated chum bycatch age-equivalent (AEQ) chum bycatch for three different assumptions about oceanic natural mortality rates compared to the annual tally.

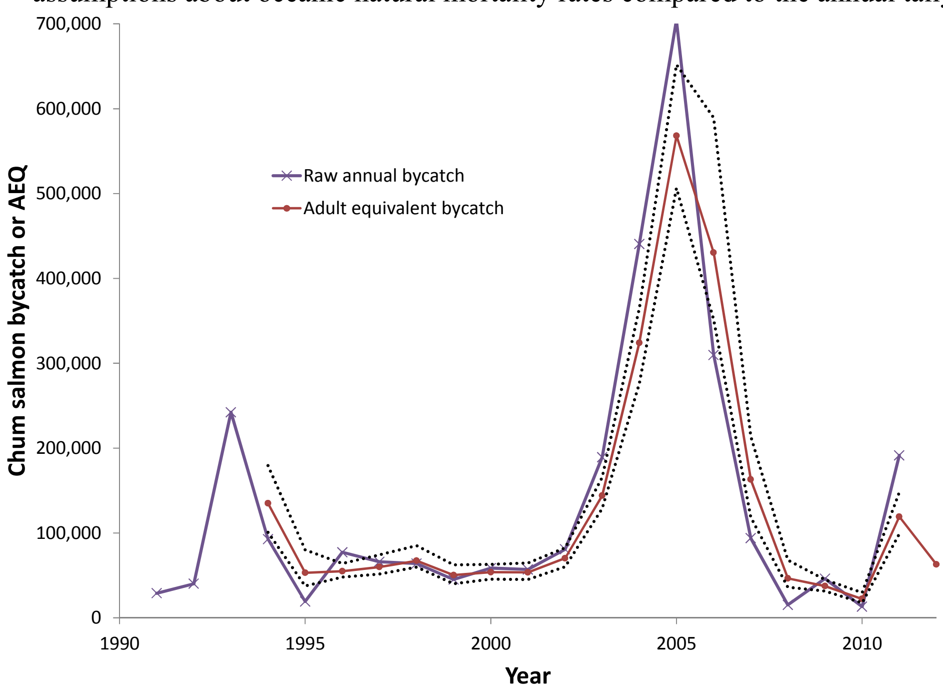



Figure 3-8. Estimated chum bycatch age-equivalent (AEQ) chum bycatch with stochastic (CV=0.4) age-specific oceanic natural mortality scenario 2 and rates compared to the annual tally. Dashed lines represent $5^{th}$ and $95^{th}$ percentiles based on 100 simulations. Note that values from 2011 and 2012 are based on predictions from equation 7.

### 3.2.2 Estimating the stock composition of chum salmon bycatch

This section provides an overview the available information used to determine the region or river of origin of the chum salmon caught as bycatch in the Bering Sea pollock fishery.

To determine the stock composition mixtures of the chum salmon bycatch samples collected from the Bering Sea pollock fishery, a number of genetics analyses have been completed and presented to the Council (i.e., Guyon et al. 2010, Marvin et al. 2010, Gray et al. 2010, and McCraney et al. 2010). The details of this work are provided in these reports and build from earlier studies (e.g., Wilmot et al. 1998, Seeb et al. 2004). These studies represent a large body of work on processing and analyzing the available genetic data and include comparisons of stock composition (of the bycatch samples) between the early period of the B-season and later as summarized in Gray et al. (2010). Based on the available datasets, they found a consistent pattern that later in the B-season the potential impact on Alaska stocks declines with bycatch samples dropping from about 28% Alaska origin down to about 13% after July 18th. The proportions of bycatch from the SE Alaska-BC-Washington region also decreased later in the season while proportions from Russia and Japan increased later in the B-season. Given the available data, chum salmon bycatch origins appear to be affected by the relative amounts of bycatch that occur during the early and late periods within the B-season. The genetic analysis used here extends from the approaches reported earlier (e.g., Gray et al. 2010, Guyon et al. 2009) and spans the period 2005-2009. The main difference from these previous studies is that samples were temporally stratified to be from the period June-July or from August-October.

For this impact analysis, it is desirable to provide some estimates of AEQ specific to individual western Alaska river systems. On a gross scale, one approach would be to apply baseline average run-sizes for each system and apply these proportions to the “Western Alaska” group identified in the genetic analysis. An alternative approach might be to include the time series of run-size estimates so that a dynamic proportion for these sub-groups could be estimated. Neither approach is without problems but may help to provide some indication of the potential for specific in-river impacts due to bycatch. Because run size estimates are less reliable at fine regional scales results are presented at the level consistent with the genetics results (i.e., 6-regional breakouts; Figure 3-9). Individual populations from each region are identified in Table 3-8. To the extent possible assumptions of run sizes and maturity were used to provide qualitative results to individual western Alaskan river systems (See section 5.0).

Because mixing genetic samples with total bycatch levels and estimating bycatch proportions from stocks of interest (e.g., Western Alaska) requires careful consideration of variances, a model was developed from which a number of parameters of interest could easily be computed. It also provides a basis for more thorough evaluations on the significance of differences over years and areas. An integrated model approach provides a way to easily use existing genetics samples applied to stratified bycatch levels to appropriately weight annual estimates of total bycatch (and provide variance estimates). Namely

$$\hat{y}_{i,j,k} = N_{i,j}\hat{p}_{i,j,k} \qquad (4)$$

where $\hat{y}_{i,j,k}$ is the predicted bycatch in year *i*, stratum *j*, from regional “stock” *k*, $N_{i,j}$ is the number of adult-equivalent chum salmon taken as bycatch, and $\hat{p}_{i,j,k}$ is the predicted stratum-specific proportion of bycatch estimated to arise from stock *k* based on the genetic samples. Note that “data”, $p_{i,j,k}$, from the genetics analysis include an estimated covariance matrix for each sample ($\Sigma_{i,j}$) which can be used to obtain the appropriate inverse-weights to estimate the mean proportions for each year (summed over strata: $y_{i,\bullet,k}$). Given this, the model fitting procedure via maximum likelihood is constructed to follow the multinomial or multivariate normal likelihood formulation (dropping subscripts for year and strata):

$$L = \frac{N!}{y_1! \cdots y_K!} p_1^{y_1} \cdots p_K^{y_K} \qquad (5)$$

$$L = (2\pi)^{-\frac{K}{2}} |\boldsymbol{\Sigma}|^{-\frac{1}{2}} e^{-\frac{1}{2}(\mathbf{p}-\hat{\mathbf{p}})' \boldsymbol{\Sigma}^{-1} (\mathbf{p}-\hat{\mathbf{p}})} \qquad (6)$$

where and $N$ is the sample size from that stratum. This model requires as data (for each pre-defined stratum) the estimated proportion to stock of origin and covariance matrix of these estimates, the AEQ due to bycatch, and the sample size (for optionally ignoring the covariance matrix and assuming a multinomial distribution). The parameter estimates done within the integrated model and are consistent with the general form for computing variances of weighted sums of random variables (where *a* and *b* might represent the bycatch levels from different strata) for arbitrary random variables *X* and *Y*:

$$\mathrm{var}(aX + bY) = a^2\,\mathrm{var}(X) + b^2\,\mathrm{var}(Y) + 2ab\,\mathrm{cov}(X,Y)$$

The goal of this approach is to provide variance estimates for AEQ mortality to specific regions in different years. Analytical methods could be developed for these but would add complexity. The integrated model allows simple specification of variables such as year and strata factors that can be estimated simultaneously. Of particular interest for these data are whether seasonal differences in stock composition are significant and the degree to which stock composition estimates vary over years. Also, it may be possible to characterize the between year variability for the period that data are available and apply that variability to reconstruct historical bycatch patterns.

To test and illustrate the properties of the model, some simple example scenarios were developed. Specifically, a situation with three strata from a single year was used to contrast different levels of bycatch and sampling within each stratum (Table 3-9). For all scenarios the “true” proportion attributed to the stock of interest for each stratum was fixed. For each of these the MLE based on the multinomial was used (Eq. 5).

Results show that sample size affects the precision of estimates for a particular stock of interest within a stratum (Figure 3-10). When input sample size is crossed with different levels of bycatch by strata, the results for the final proportion attributed to a stock of interest is primarily a function of bycatch but the relative precision also plays a role (Figure 3-11).

Genetics results were compiled based on sampling schemes that were sub-optimal for minimizing variance (Table 3-10). I.e., Guyon et al. (2010) demonstrate that the sample collections were typically out of proportion with the bycatch (in time and areas) and were collected for a variety of projects with different objectives. Consequently, the ability to apply these data to determine overall annual stock-of-origin estimates of the bycatch requires careful consideration of how the sampling occurred. While this approach accounts for factors that are known and can be controlled (e.g., that stratum-level sampling for genetics is disproportionate to bycatch), there remains a general concern that the spatio-temporal resolution for the strata selected is too coarse which could result in biases due to sampling. With this in mind, an approach that tends to be conservative (reflecting a higher degree of uncertainty) was taken as described below.

The SPAM software (ADFG 2003) uses an algorithm to produce stock composition estimates and can account for missing alleles in the baseline (Pella and Masuda, 2001). SPAM stock composition estimates based on data from all 11 loci were derived for the six regional groupings (Table 3-11). This method accounts for two sources of error: that due to the resolution of the genetic information to ascertain stock of origin and that due to the sample size. Kalinowski (2006) describes this as the expected squared error (ESE) of stock composition estimates.

$$ESE_k = E\left(p_k - \hat{p}_k\right)^2$$

$$ESE_k = ESE_{k,fishery} + ESE_{k,genetic} \quad (7)$$

where $p_k$, $\hat{p}_k$ are the observed and estimated proportions for stock *k* in a given stratum, respectively. Note that the $ESE_{k,fishery}$ is typically taken as being drawn randomly and follows a multinomial sampling process. From the point estimates and covariance matrices provided from the SPAM analysis, it is relatively simple to estimate the contribution of uncertainty due to the genetics by comparing the implied sample size ($\tilde{N}$):

$$N^2 \operatorname{var}\left(\hat{p}_k\right) = N\hat{p}_k\left(1-\hat{p}_k\right)$$

$$\tilde{N} = \hat{p}_k\left(1-\hat{p}_k\right)\operatorname{var}\left(\hat{p}_k\right)^{-1} \quad (8)$$

For each strata and year from which samples were available, the implied sample size represented about 69% of the actual sample size based on an evaluation of all the estimates of $\hat{p}_k$ and variances from the genetic analysis (Figure 3-12). This suggests that the uncertainty due to the genetic analysis component lowers the implied sample size by about 30%. One way to clarify what this means (as proposed by Kalinowski 2006) is to contrast results as if there were no errors due to stock identification (i.e., each fish was perfectly “marked”). In that type of scenario, the implied sample size would equal the actual sample size.

In most fisheries sampling situations, rarely are data collected in a manner that can be considered as purely random with respect to the population of interest (in this case, the stock of origin of the bycatch). Composition data in general, be it stomach contents, lengths, or ages, are commonly afflicted with a situation where the actual number of fish sampled is much higher than the “effective” sample size (e.g., Pennington and Volstad 1994, Chih 2010). For length or age composition data, it is routine to apply an adjustment to the actual sample size in fitting stock assessment models because of the relatively low within-haul variability. While the practice of using these adjustment factors vary in technique, they are widely acknowledged as being an important consideration in stock assessment modeling (see Fournier and Archibald (1982) for early consideration of using the multinomial likelihood for fitting composition data). One conservative approach (which will likely lead to a positive bias in variance) would be to substitute the number of fish sampled with the number of hauls from which samples were collected. There are a number of hauls from which many chum salmon were used for genetics sampling (Figure 3-13). Also, there were differences in relative terms between the number hauls and the number of fish used for genetics over time (Figure 3-14).

Thus, we evaluated the effect of treating the genetics output to the actual PSC estimates a number of ways:

1) Using multinomial likelihood method assuming each fish was selected randomly with respect to bycatch (this implies negligible classification errors due to the genotypes);
2) Based on the covariance estimates arising from genetic analysis. Note that this is the same as in 1) but includes errors in stock composition estimation, Table 3-11); and

3) Based on adjustments that account for the fact that the effective sample size is less than the actual number of fish used for bycatch stock identification (conservatively set to the number of hauls from which samples were collected).

4) As in 3) but adjusted further to account for errors in the genetic information that leads to stock identification

Results for evaluating these alternative approaches shows that in most cases the 4th procedure provides higher levels of uncertainty (as expected) in the amount of bycatch that can be attributed to coastal western Alaska systems (Table 3-12). In general, the estimates of uncertainty are likely to be more robust using option 4) because there were sample design issues with these data. Assuming a more conservative (i.e., greater variance) estimate of uncertainty seems prudent and the inflation of the variance is actually relatively modest (Figure 3-15). Under this scenario, the average proportions of PSC chum salmon bycatch by six regions varies considerably by season with more from Japan and Russian during the latter part of the B season (Figure 3-16).

The SSC requested that year-effects on stock composition be tested to the extent possible. This was accomplished by estimating the mean June-July and August-October sub-season effect and computing the annual variability relative to these effects. The marginal distribution of the within-season effect indicates that western Alaska stocks comprise nearly 13% more in the June-July period compared to later in the season (Figure 3-17). However, there were some significant levels of between-year variability with lower proportions of western Alaska chum salmon evident in 2008 and 2009 samples during the June-July period (Figure 3-18). This indicates that year-effects are significant and would add to the uncertainty in extrapolating these results to an historical period. On the advice of the SSC, the stock composition estimates are focus on the period 2005-2009. However, for the earlier periods, the mean stratified stock composition estimates from this period could be used but with an added component of uncertainty equal to the estimated year-effect variability. This was accomplished by contrasting the within season mean estimates (and the variability associated with those) and adding the random-effects variance over different years. This is illustrated by comparing the proportion of stock composition that can be attributed to western Alaska stocks (coastal western AK plus Upper Yukon chum salmon) during the June-July period relative to the Aug-October period (Figure 3-19). Note that the variance due to the year effect is inflated and thus has the desired property of estimation “outside of sampled” years.

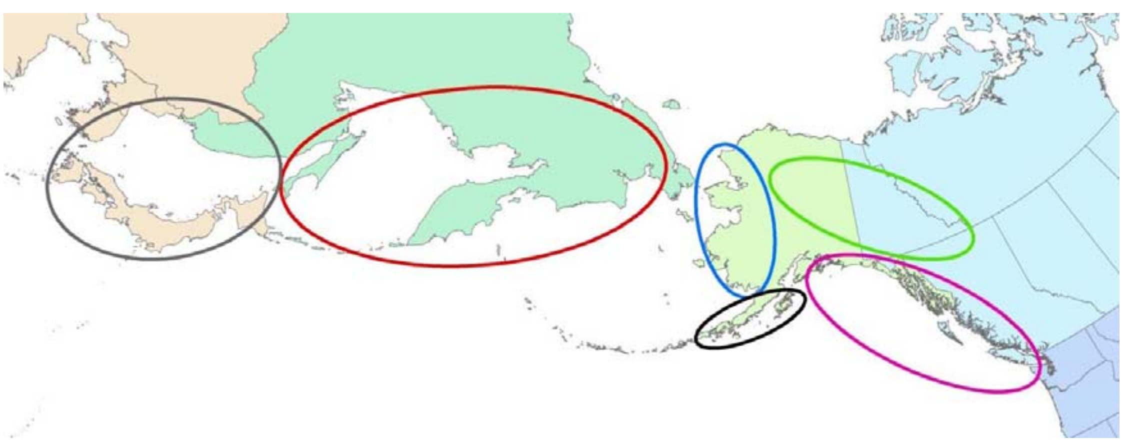


Figure 3-9. Six regional groupings of chum salmon populations used in the analysis including east Asia (grey), north Asia (red), coastal western Alaska (blue), upper/middle Yukon (green), southwest Alaska (black), and the Pacific Northwest (magenta). From Gray et al. 2010.

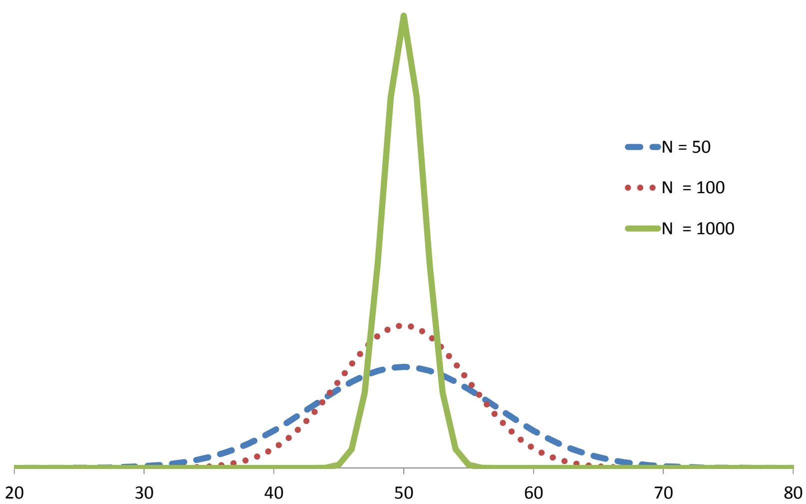



Figure 3-10. Example distributions for different effective sample sizes where the proportion for this example stock composition estimate is 0.5 applied to 100 chum salmon in the bycatch. *Note: this is an illustrative example to evaluate model behavior.*

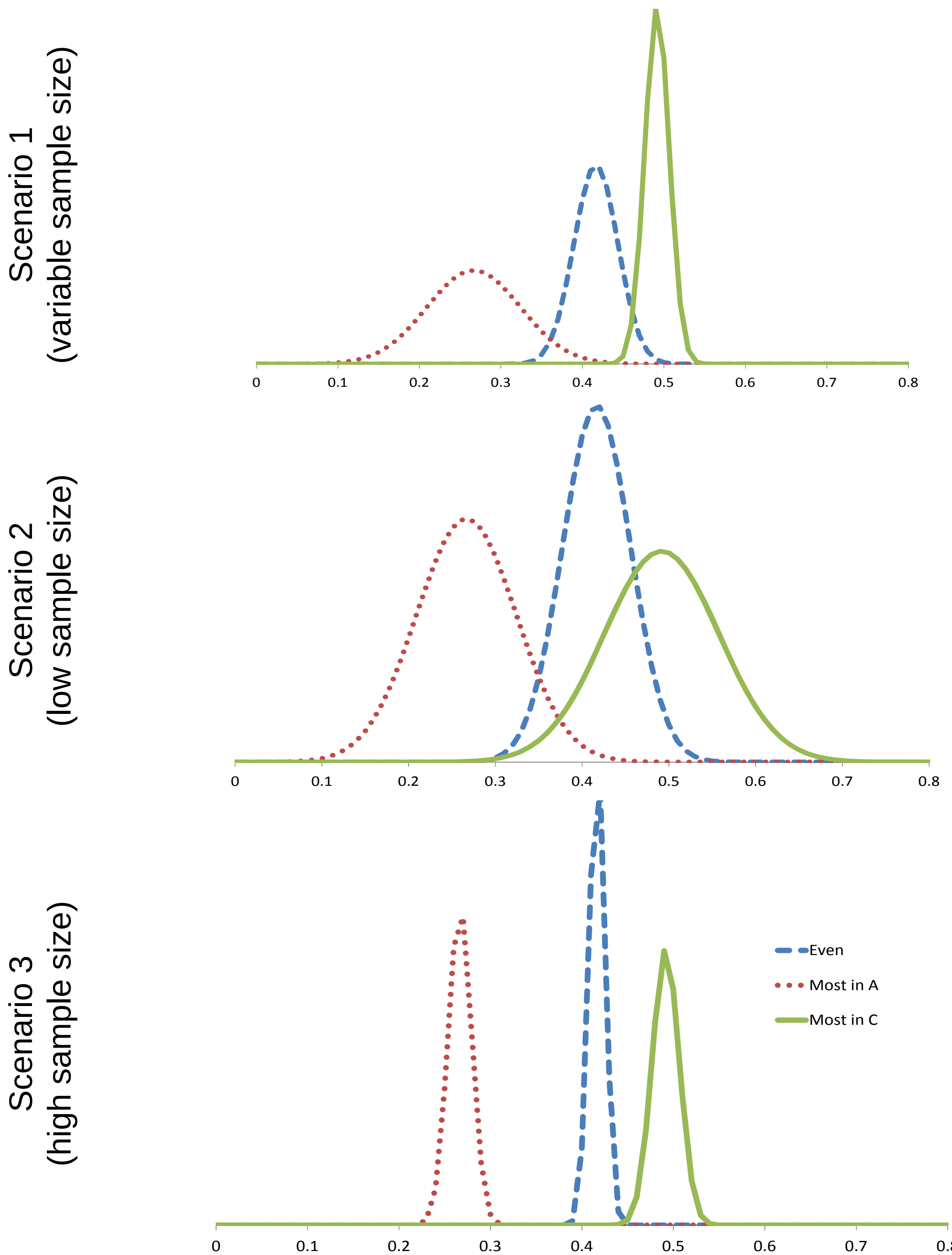



Figure 3-11. Example results of bycatch proportions assuming different bycatch levels within strata (dotted, dashed and solid lines) and different sample size configurations (scenarios 1-3). Each distribution is the integrated (variance weighted) estimate over all strata. *Note: this is an illustrative example to evaluate model behavior.*

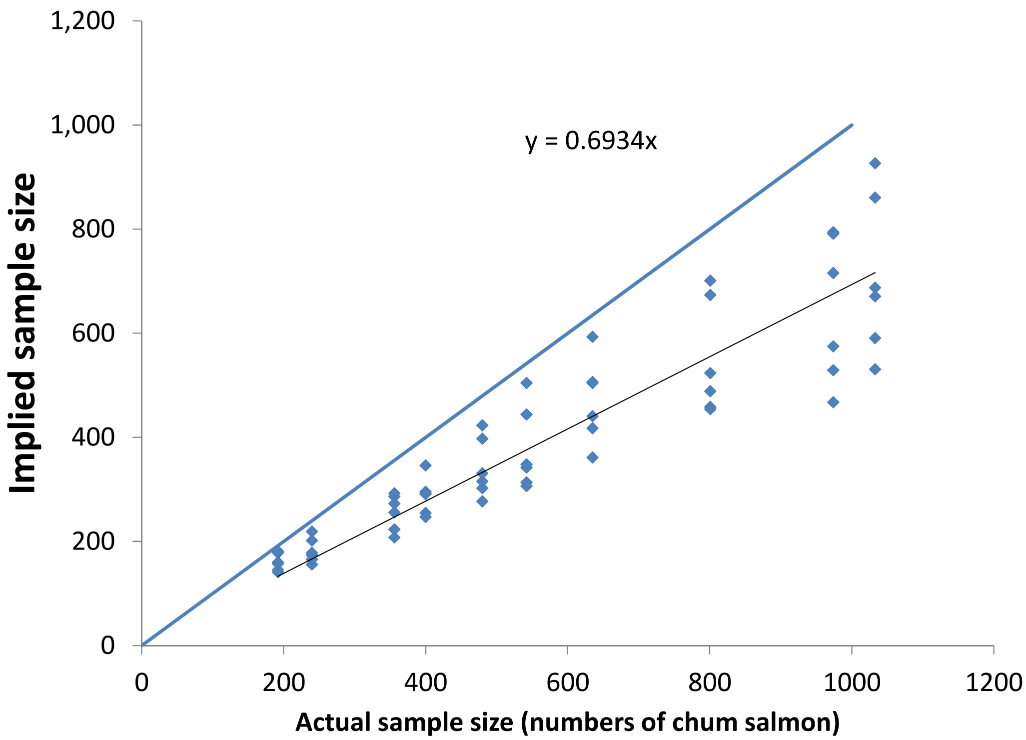



Figure 3-12. Comparison of the implied sample size (as derived from the estimated proportions and variances from the genetic samples) to the actual sample size, 2005-2009 data. Thick diagonal line represents the 1 to 1 line and the thin line represents the fit to the points.

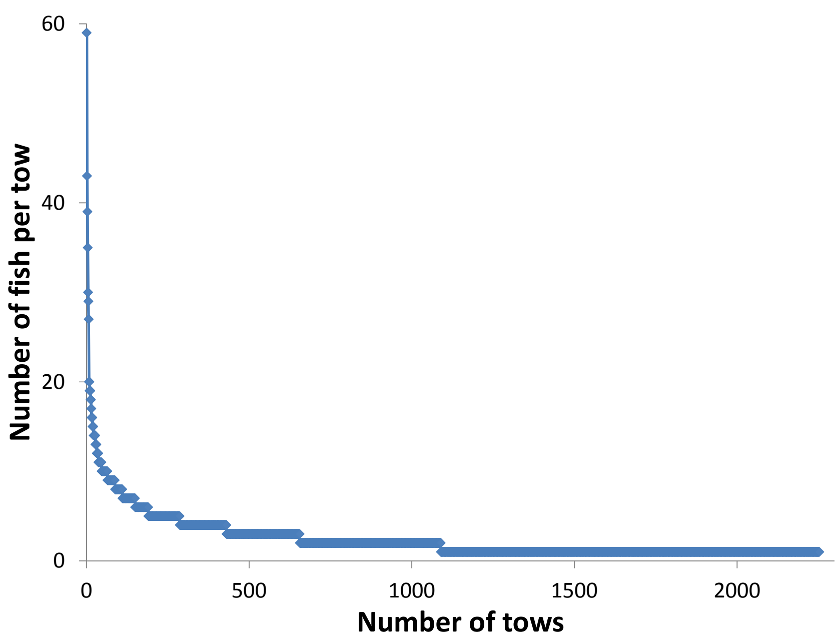



Figure 3-13. Number of B-season chum salmon per tow (trawl fishing operation) from which samples were obtained for genetic analysis compared to the number of tows, 2005-2009.

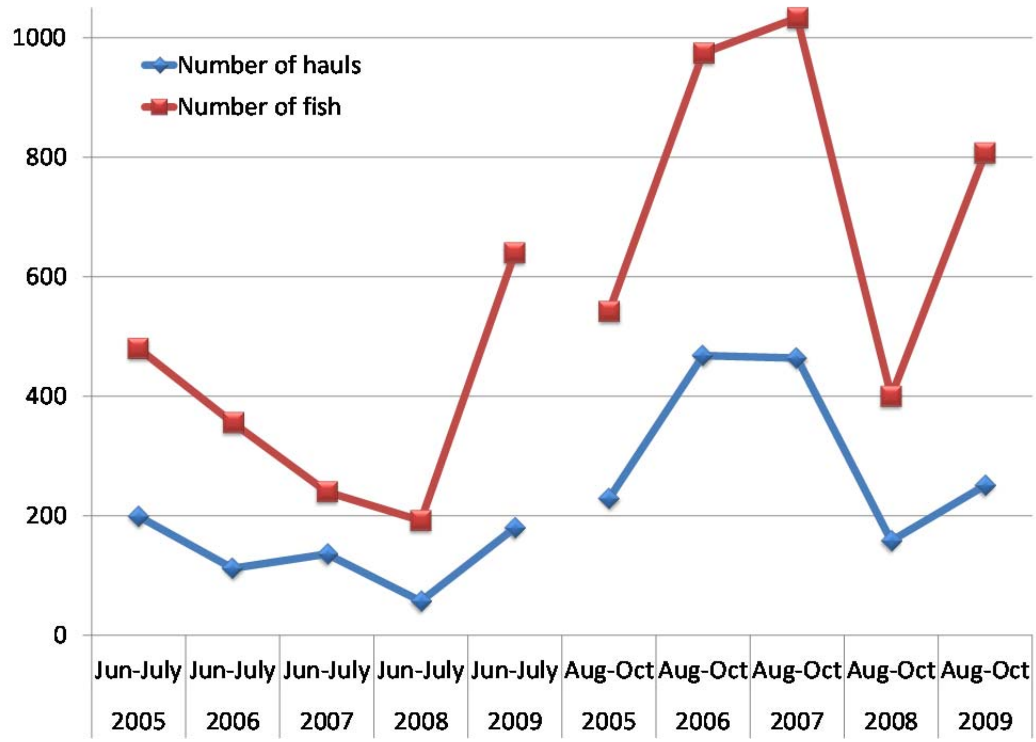



Figure 3-14. Number of fish and number of hauls from which samples were obtained for genetic analysis by early and late B-season strata, 2005-2009.

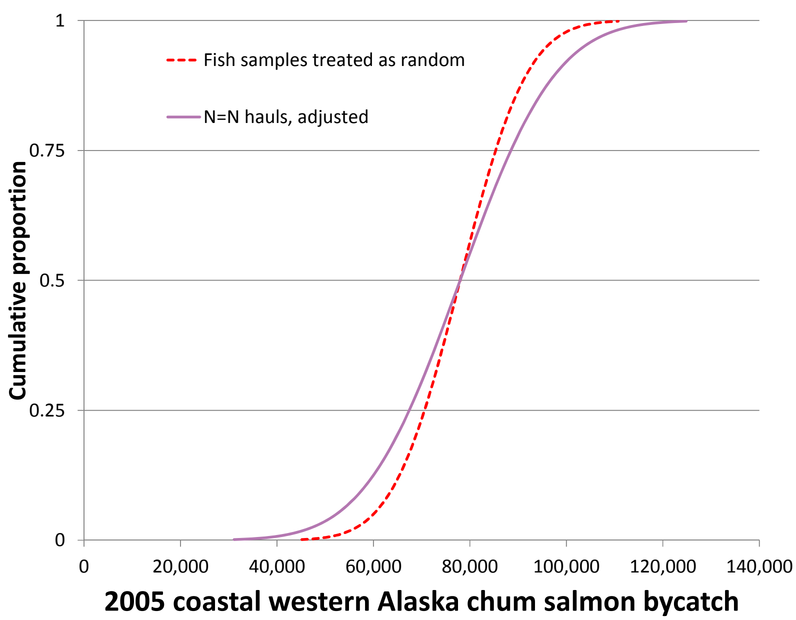



Figure 3-15. Cumulative probability of using the default estimate of uncertainty from the genetic results for chum salmon bycatch (dashed line) compared with that where an adjustment to reflect variable sampling schemes is included (solid line).

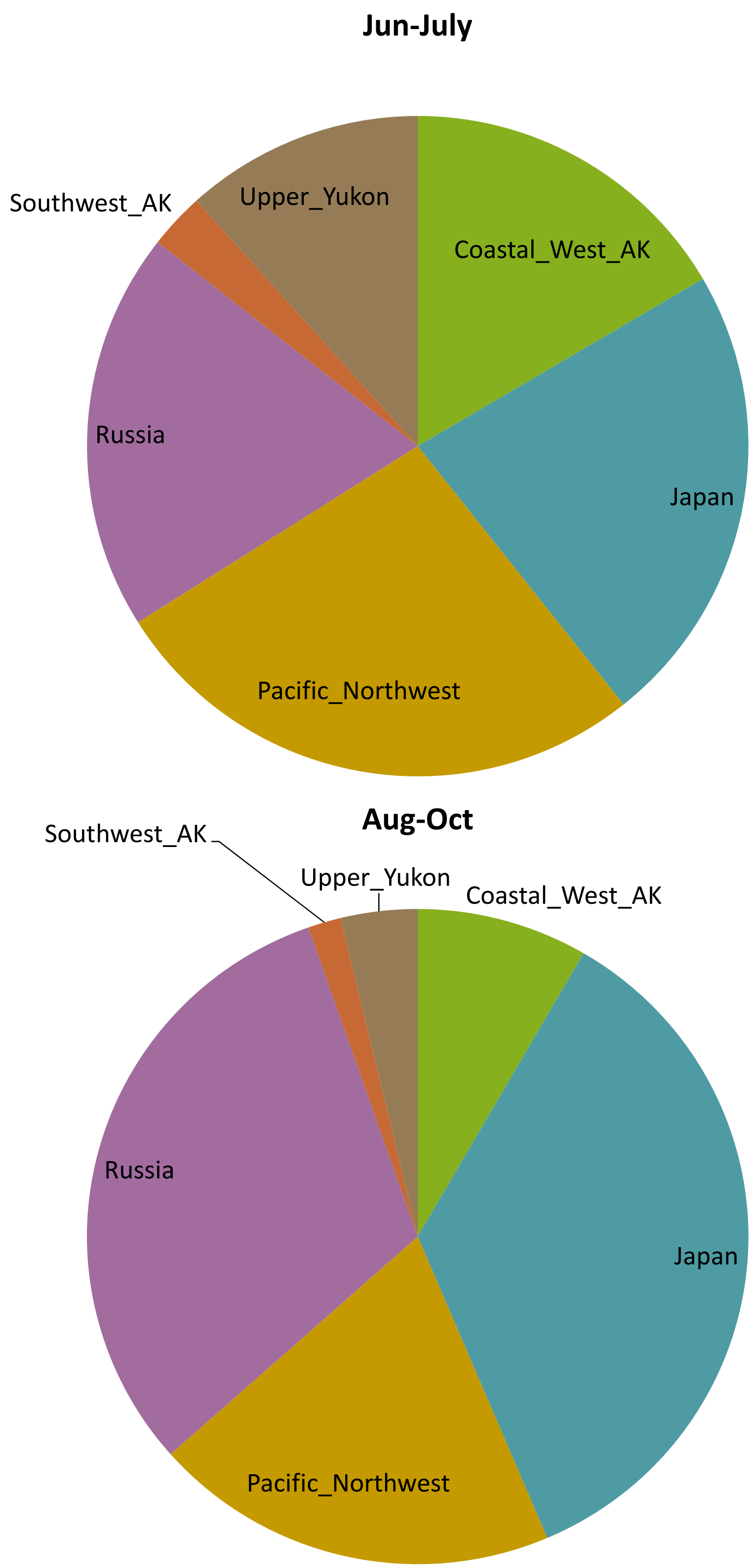



Figure 3-16. Average breakout of bycatch based on genetic analysis by early and late B-season strata, 2005-2009.

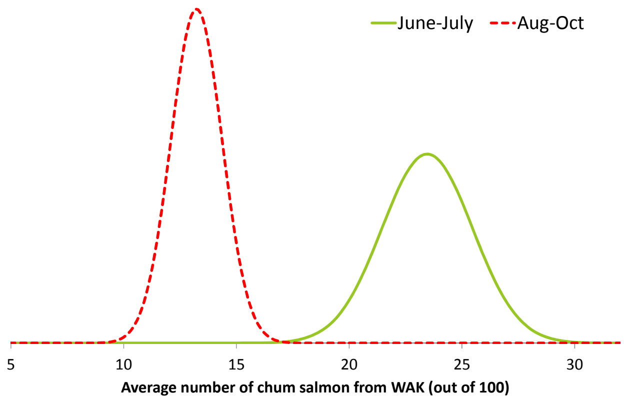



Figure 3-17. Genetic results showing the distribution of the mean WAK (coastal western Alaska and Upper Yukon combined) chum salmon in the bycatch for the early (June-July) compared to the late (Aug-Oct) B-season based on genetic data from 2005-2009.

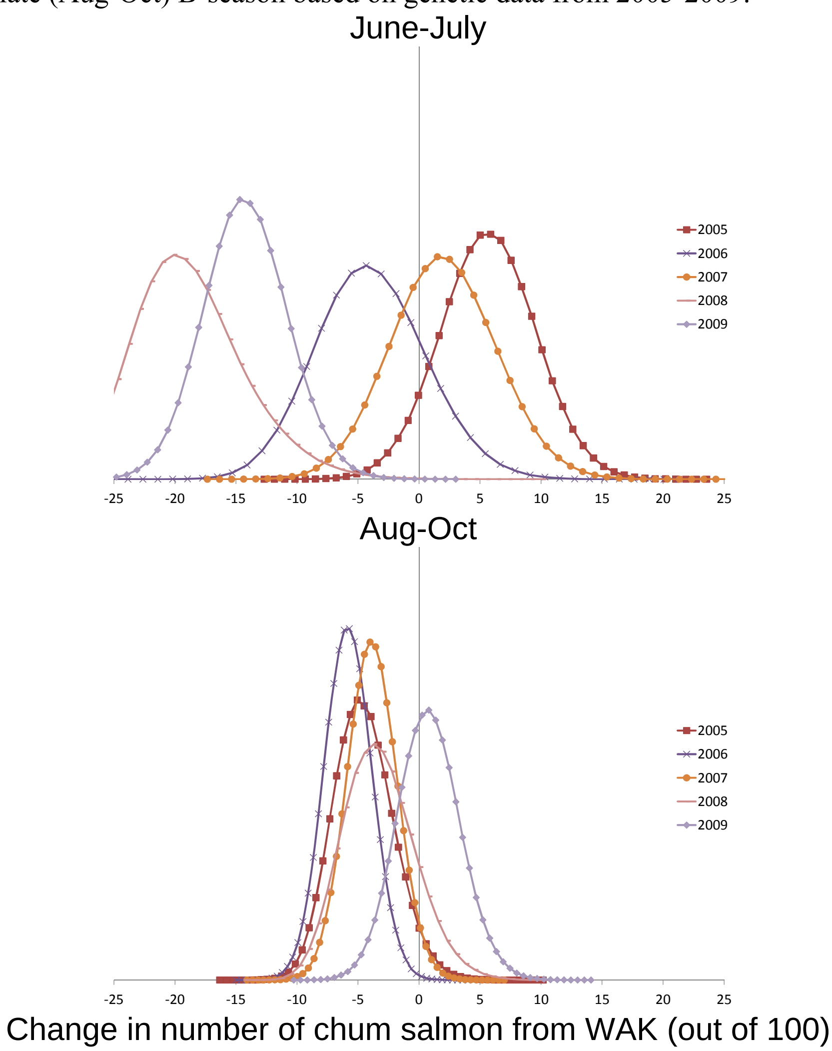



Figure 3-18. Genetics results showing the distribution of the mean WAK (coastal western Alaska and Upper Yukon combined) chum salmon in the bycatch for the early (June-July) compared to the late (Aug-Oct) B-season based on genetics data from 2005-2009.

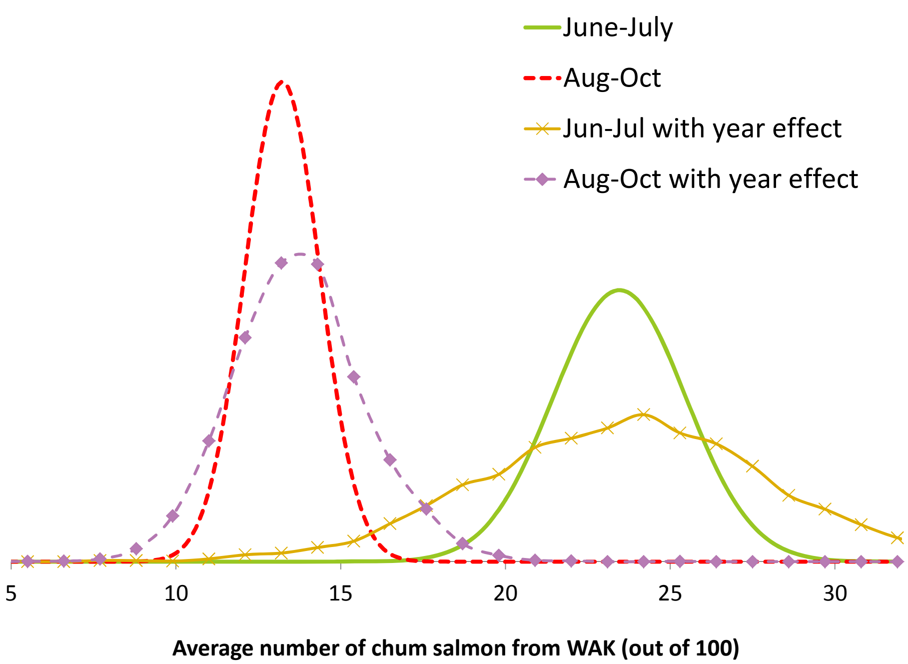



Figure 3-19. Comparison of the mean proportion of chum salmon bycatch originating from WAK (including upper Yukon) during early and late B-season and with the additional uncertainty due to year-effect variability.

Table 3-8. Chum salmon populations in the DFO microsatellite baseline with the regional designations used Gray et al, 2010.

| DFO | Population | No. | DFO | Population | No. | DFO | Population | No. | DFO | Population | No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 41 | Abashiri | 1 | 230 | Udarnitsa | 2 | 439 | Porcupine | 4 | 107 | Clatse_Creek | 6 |
| 215 | Avakumovka | 1 | 290 | Utka_River | 2 | 83 | Salcha | 4 | 118 | Clyak | 6 |
| 40 | Chitose | 1 | 208 | Vorovskaya | 2 | 4 | Sheenjek | 4 | 62 | Cold_Creek | 6 |
| 315 | Gakko_River | 1 | 387 | Zhypanova | 2 | 1 | Tatchun | 4 | 77 | Colonial | 6 |
| 292 | Hayatsuki | 1 | 348 | Agiapuk | 3 | 9 | Teslin | 4 | 353 | Constantine | 6 |
| 44 | Horonai | 1 | 376 | Alagnak | 3 | 84 | Toklat | 4 | 168 | Cooper_Inlet | 6 |
| 252 | Kawabukuro | 1 | 3 | Andreafsky | 3 | 360 | Alagoshak | 5 | 197 | County_Line | 6 |
| 313 | Koizumi_River | 1 | 357 | Aniak | 3 | 333 | American_River | 5 | 12 | Cowichan | 6 |
| 300 | Kushiro | 1 | 301 | Anvik | 3 | 366 | Big_River | 5 | 414 | Crag_Cr | 6 |
| 37 | Miomote | 1 | 80 | Chulinak | 3 | 354 | Coleman_Creek | 5 | 161 | Dak_ | 6 |
| 391 | Namdae_R | 1 | 347 | Eldorado | 3 | 355 | Delta_Creek | 5 | 259 | Dana_Creek | 6 |
| 231 | Narva | 1 | 358 | George | 3 | 359 | Egegik | 5 | 123 | Date_Creek | 6 |
| 298 | Nishibetsu | 1 | 307 | Gisasa | 3 | 332 | Frosty_Creek | 5 | 250 | Dawson_Inlet | 6 |
| 293 | Ohkawa | 1 | 371 | Goodnews | 3 | 365 | Gertrude_Creek | 5 | 91 | Dean_River | 6 |
| 297 | Orikasa | 1 | 288 | Henshaw_Creek | 3 | 370 | Joshua_Green | 5 | 261 | Deena | 6 |
| 214 | Ryazanovka | 1 | 339 | Imnachuk | 3 | 364 | Meshik | 5 | 170 | Deer_Pass | 6 |
| 312 | Sakari_River | 1 | 361 | Kanektok | 3 | 283 | Moller_Bay | 5 | 46 | Demamiel | 6 |
| 311 | Shari_River | 1 | 362 | Kasigluk | 3 | 369 | Pumice_Creek | 5 | 210 | Dipac_Hatchery | 6 |
| 36 | Shibetsu | 1 | 328 | Kelly_Lake | 3 | 367 | Stepovak_Bay | 5 | 319 | Disappearance | 6 |
| 299 | Shikiu | 1 | 340 | Kobuk | 3 | 335 | Sturgeon | 5 | 269 | Dog-tag | 6 |
| 253 | Shiriuchi | 1 | 343 | Koyuk | 3 | 350 | Uganik | 5 | 177 | Draney | 6 |
| 310 | Shizunai | 1 | 363 | Kwethluk | 3 | 334 | Volcano_Bay | 5 | 114 | Duthie_Creek | 6 |
| 217 | Suifen | 1 | 336 | Kwiniuk_River | 3 | 356 | Westward_Creek | 5 | 427 | East_Arm | 6 |
| 35 | Teshio | 1 | 303 | Melozitna | 3 | 239 | Ahnuhati | 6 | 266 | Ecstall_River | 6 |
| 39 | Tokachi | 1 | 373 | Mulchatna | 3 | 69 | Ahta______ | 6 | 94 | Elcho_Creek | 6 |
| 38 | Tokoro | 1 | 372 | Naknek | 3 | 155 | Ain_ | 6 | 193 | Ellsworth_Cr | 6 |
| 314 | Tokushibetsu | 1 | 330 | Niukluk | 3 | 183 | Algard | 6 | 203 | Elwha | 6 |
| 291 | Toshibetsu | 1 | 329 | Noatak | 3 | 58 | Alouette | 6 | 276 | Ensheshese | 6 |
| 296 | Tsugaruishi | 1 | 345 | Nome | 3 | 325 | Alouette_North | 6 | 263 | Fairfax_Inlet | 6 |
| 316 | Uono_River | 1 | 302 | Nulato | 3 | 270 | Andesite_Cr | 6 | 32 | Fish_Creek | 6 |
| 309 | Yurappu | 1 | 374 | Nunsatuk | 3 | 428 | Arnoup_Cr | 6 | 429 | Flux_Cr | 6 |
| 218 | Amur | 2 | 13 | Peel_River | 3 | 153 | Ashlulm | 6 | 102 | Foch_Creek | 6 |
| 207 | Anadyr | 2 | 322 | Pikmiktalik | 3 | 156 | Awun | 6 | 179 | Frenchman | 6 |
| 384 | Apuka_River | 2 | 331 | Pilgrim_River | 3 | 133 | Bag_Harbour | 6 | 227 | Gambier | 6 |
| 382 | Bolshaya | 2 | 346 | Shaktoolik | 3 | 164 | Barnard | 6 | 96 | Gill_Creek | 6 |
| 380 | Dranka | 2 | 341 | Snake | 3 | 16 | Bella_Bell | 6 | 166 | Gilttoyee | 6 |
| 223 | Hairusova | 2 | 368 | Stuyahok_River | 3 | 79 | Bella_Coola | 6 | 145 | Glendale | 6 |
| 378 | Ivashka | 2 | 375 | Togiak | 3 | 49 | Big_Qual | 6 | 135 | Gold_Harbour | 6 |
| 213 | Kalininka | 2 | 154 | Tozitna | 3 | 201 | Big_Quilcene | 6 | 11 | Goldstream | 6 |
| 225 | Kamchatka | 2 | 342 | Unalakleet | 3 | 281 | Bish_Cr | 6 | 66 | Goodspeed_River | 6 |
| 219 | Kanchalan | 2 | 344 | Ungalik | 3 | 198 | Bitter_Creek | 6 | 136 | Government | 6 |
| 379 | Karaga | 2 | 8 | Big_Creek | 4 | 103 | Blackrock_Creek | 6 | 205 | Grant_Creek | 6 |
| 294 | Kikchik | 2 | 89 | Big_Salt | 4 | 390 | Blaney_Creek | 6 | 100 | Green_River | 6 |
| 209 | Kol_ | 2 | 86 | Black_River | 4 | 138 | Botany_Creek | 6 | 450 | GreenRrHatchery | 6 |
| 233 | Magadan | 2 | 87 | Chandalar | 4 | 264 | Buck_Channel | 6 | 237 | Greens | 6 |
| 211 | Naiba | 2 | 28 | Chandindu | 4 | 169 | Bullock_Chann | 6 | 141 | Harrison | 6 |
| 295 | Nerpichi | 2 | 82 | Cheena | 4 | 61 | Campbell_River | 6 | 438 | Harrison_late | 6 |
| 381 | Okhota | 2 | 81 | Delta | 4 | 323 | Carroll | 6 | 64 | Hathaway_Creek | 6 |
| 212 | Oklan | 2 | 7 | Donjek | 4 | 78 | Cascade | 6 | 234 | Herman_Creek | 6 |
| 222 | Ola_ | 2 | 5 | Fishing_Br | 4 | 76 | Cayeghle | 6 | 17 | Heydon_Cre | 6 |
| 386 | Olutorsky_Bay | 2 | 88 | Jim_River | 4 | 42 | Cheakamus | 6 | 407 | Hicks_Cr | 6 |
| 228 | Ossora | 2 | 85 | Kantishna | 4 | 398 | Cheenis_Lake | 6 | 400 | Homathko | 6 |
| 224 | Penzhina | 2 | 2 | Kluane | 4 | 51 | Chehalis | 6 | 411 | Honna | 6 |
| 385 | Plotnikova_R | 2 | 59 | Kluane_Lake | 4 | 19 | Chemainus | 6 | 204 | Hoodsport | 6 |
| 221 | Pymta | 2 | 181 | Koyukuk_late | 4 | 47 | Chilliwack | 6 | 185 | Hooknose | 6 |
| 220 | Tauy | 2 | 90 | Koyukuk_south | 4 | 392 | Chilqua_Creek | 6 | 406 | Hopedale_Cr | 6 |
| 383 | Tugur_River | 2 | 10 | Minto | 4 | 117 | Chuckwalla | 6 | 412 | Hutton_Head | 6 |

Table 3-8. (continued) Chum salmon populations in the DFO microsatellite baseline (code) with the regional designations used in the analyses (column titled "No.";Gray et al. 2010).

| DFO | Population | No. | DFO | Population | No. | DFO | Population | No. |
|---|---|---|---|---|---|---|---|---|
| | | | 254 | Mountain_Cr | 6 | 265 | Stanley | 6 |
| | | | 111 | Mussel_River | 6 | 52 | Stave | 6 |
| 226 | Tym_ | 2 | 157 | Naden | 6 | 396 | Stawamus | 6 |
| 6 | Pelly | 4 | 337 | Nahmint_River | 6 | 409 | Steel_Cr | 6 |
| 152 | Inch_Creek | 6 | 444 | Nakut_Su | 6 | 424 | Stewart_Cr | 6 |
| 146 | Indian_River | 6 | 14 | Nanaimo | 6 | 416 | Stumaun_Cr | 6 |
| 92 | Jenny_Bay | 6 | 122 | Nangeese | 6 | 327 | Sugsaw | 6 |
| 115 | Kainet_River | 6 | 422 | Nass_River | 6 | 324 | Surprise | 6 |
| 144 | Kakweiken | 6 | 399 | Necleetsconnay | 6 | 75 | Taaltz | 6 |
| 268 | Kalum | 6 | 113 | Neekas_Creek | 6 | 30 | Taku | 6 |
| 395 | Kanaka_Cr | 6 | 321 | Neets_Bay_early | 6 | 18 | Takwahoni | 6 |
| 402 | Kano_Inlet_Cr | 6 | 320 | Neets_Bay_late | 6 | 251 | Tarundl_Creek | 6 |
| 162 | Kateen | 6 | 173 | Nekite | 6 | 149 | Theodosia | 6 |
| 389 | Kawkawa | 6 | 104 | Nias_Creek | 6 | 22 | Thorsen | 6 |
| 95 | Kemano | 6 | 143 | Nimpkish | 6 | 129 | Toon | 6 |
| 192 | Kennedy_Creek | 6 | 53 | Nitinat | 6 | 279 | Tseax | 6 |
| 238 | Kennell | 6 | 191 | Nooksack | 6 | 202 | Tulalip | 6 |
| 351 | Keta_Creek | 6 | 186 | Nooseseck | 6 | 97 | Turn_Creek | 6 |
| 101 | Khutze_River | 6 | 318 | NorrishWorth | 6 | 430 | Turtle_Cr | 6 |
| 126 | Khutzeymateen | 6 | 159 | North_Arm | 6 | 247 | Tuskwa | 6 |
| 282 | Kiltuish | 6 | 377 | Olsen_Creek | 6 | 165 | Tyler | 6 |
| 93 | Kimsquit | 6 | 184 | Orford | 6 | 33 | Tzoonie | 6 |
| 187 | Kimsquit_Bay | 6 | 287 | Pa-aat_River | 6 | 124 | Upper_Kitsumkal | 6 |
| 419 | Kincolith | 6 | 260 | Pacofi | 6 | 140 | Vedder | 6 |
| 273 | Kispiox | 6 | 56 | Pallant | 6 | 70 | Viner_Sound | 6 |
| 106 | Kitasoo | 6 | 65 | Pegattum_Creek | 6 | 45 | Wahleach | 6 |
| 99 | Kitimat_River | 6 | 48 | Puntledge | 6 | 172 | Walkum | 6 |
| 275 | Kitsault_Riv | 6 | 98 | Quaal_River | 6 | 73 | Waump | 6 |
| 163 | Kitwanga | 6 | 147 | Quap | 6 | 232 | Wells_Bridge | 6 |
| 271 | Kleanza_Cr | 6 | 108 | Quartcha_Creek | 6 | 352 | Wells_River | 6 |
| 437 | Klewnuggit_Cr | 6 | 199 | Quinault | 6 | 105 | West_Arm_Creek | 6 |
| 21 | Klinaklini | 6 | 110 | Roscoe_Creek | 6 | 267 | Whitebottom_Cr | 6 |
| 418 | Ksedin | 6 | 397 | Salmon_Bay | 6 | 326 | Widgeon_Slough | 6 |
| 125 | Kshwan | 6 | 195 | Salmon_Cr | 6 | 277 | Wilauks_Cr | 6 |
| 423 | Kumealon | 6 | 134 | Salmon_River | 6 | 120 | Wilson_Creek | 6 |
| 112 | Kwakusdis_River | 6 | 200 | Satsop | 6 | 401 | Worth_Creek | 6 |
| 436 | Kxngeal_Cr | 6 | 236 | Sawmill | 6 | 60 | Wortley_Creek | 6 |
| 127 | Lachmach | 6 | 410 | Seal_Inlet_Cr | 6 | 248 | Yellow_Bluff | 6 |
| 262 | Lagins | 6 | 158 | Security | 6 | 434 | Zymagotitz | 6 |
| 131 | Lagoon_Inlet | 6 | 130 | Sedgewick | 6 | 139 | Clapp_Basin | 6 |
| 448 | LagoonCr | 6 | 393 | Serpentine_R | 6 | | | |
| 167 | Lard | 6 | 317 | Shovelnose_Cr | 6 | | | |
| 160 | Little_Goose | 6 | 249 | Shustnini | 6 | | | |
| 50 | Little_Qua | 6 | 206 | Siberia_Creek | 6 | | | |
| 413 | Lizard_Cr | 6 | 25 | Silverdale | 6 | | | |
| 119 | Lockhart-Gordon | 6 | 196 | Skagit | 6 | | | |
| 176 | Lower_Lillooet | 6 | 274 | Skeena | 6 | | | |
| 137 | Mace_Creek | 6 | 171 | Skowquiltz | 6 | | | |
| 242 | Mackenzie_Sound | 6 | 447 | SkykomishRiv | 6 | | | |
| 116 | MacNair_Creek | 6 | 132 | Slatechuck_Cre | 6 | | | |
| 55 | Mamquam | 6 | 43 | Sliammon | 6 | | | |
| 121 | Markle_Inlet_Cr | 6 | 15 | Smith_Cree | 6 | | | |
| 27 | Martin_Riv | 6 | 54 | Snootli | 6 | | | |
| 338 | Mashiter_Creek | 6 | 180 | Southgate | 6 | | | |
| 109 | McLoughin_Creek | 6 | 26 | Squakum | 6 | | | |
| 178 | Milton | 6 | 142 | Squamish | 6 | | | |
| 194 | Minter_Cr | 6 | 128 | Stagoo | 6 | | | |

Table 3-9. Scenario evaluations (sample sizes) for different example situations for bycatch within a year attributed to a single "stock". I.e., in stratum "A" the bycatch proportion attributed to the stock of interest is 25% whereas for the other strata it is 50%. *Note: this is intended as an illustrative example only.*

| Strata | A | B | C |
|---|---|---|---|
| Stock of interest proportion w/in strata | 0.25 | 0.5 | 0.5 |
| **Bycatch even among strata** | **100** | **100** | **100** |
| Variable sample sizes | 50 | 100 | 1000 |
| Low sample sizes | 50 | 50 | 50 |
| High sample sizes | 1000 | 1000 | 1000 |
| **Bycatch mostly in stratum A** | **280** | **10** | **10** |
| Variable sample sizes | 50 | 100 | 1000 |
| Low sample sizes | 50 | 50 | 50 |
| High sample sizes | 1000 | 1000 | 1000 |
| **Bycatch mostly in stratum C** | **10** | **10** | **280** |
| Variable sample sizes | 50 | 100 | 1000 |
| Low sample sizes | 50 | 50 | 50 |
| High sample sizes | 1000 | 1000 | 1000 |

Table 3-10. Sample sizes (numbers of B-season chum salmon) available for genetic stock-composition estimates (by sub-season stratified samples) compared to the number of hauls and the actual bycatch levels, 2005-2009. Note that bycatch totals may differ slightly from official totals due to minor differences encountered when matching spatially disaggregated data.

| Year | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|
| Number of chum used in genetics sampling | | | | | |
| Jun-Jul | 480 | 356 | 240 | 192 | 635 |
| Aug-Oct | 542 | 974 | 1033 | 400 | 801 |
| Total | 1,022 | 1,330 | 1,273 | 592 | 1,436 |
| Number of hauls from which samples were collected | | | | | |
| Jun-Jul | 199 | 136 | 180 | 468 | 158 |
| Aug-Oct | 112 | 57 | 229 | 464 | 251 |
| Total | 311 | 193 | 409 | 932 | 409 |
| Bycatch of non-Chinook salmon | | | | | |
| Jun-Jul | 238,338 | 177,663 | 13,352 | 5,544 | 23,890 |
| Aug-Oct | 432,818 | 125,405 | 71,742 | 9,027 | 21,455 |
| Total | 671,156 | 303,068 | 85,094 | 14,571 | 45,346 |

Table 3-11. Summary results from genetic stock-composition estimates ( $p_{i,k}$ for year *i* and sub-season stratum *k*) from the BAYES analysis. These data were used in conjunction with actual bycatch levels within sub-season strata. CV = coefficient of variation for $p_{i,k}$ .

| | | | | | | | Correlation | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Strata** | $p_{i,k}$ | **CV** | **Region** | Japan | Russia | WAK | UppYuk | SW_AK | AKBCWA |
| 2005 | Jun-Jul | 0.190 | 10% | Japan | | -0.2493 | -0.2588 | -0.1796 | -0.1020 | -0.2535 |
| 2005 | Jun-Jul | 0.210 | 11% | Russia | | | -0.2751 | -0.1909 | -0.1085 | -0.2694 |
| 2005 | Jun-Jul | 0.222 | 11% | WAK | | | | -0.1982 | -0.1126 | -0.2796 |
| 2005 | Jun-Jul | 0.121 | 15% | UppYuk | | | | | -0.0781 | -0.1941 |
| 2005 | Jun-Jul | 0.043 | 26% | SW_AK | | | | | | -0.1103 |
| 2005 | Jun-Jul | 0.215 | 10% | AKBCWA | | | | | | |
| 2005 | Aug-Oct | 0.366 | 6% | Japan | | -0.5038 | -0.2374 | -0.1374 | -0.0928 | -0.3629 |
| 2005 | Aug-Oct | 0.306 | 8% | Russia | | | -0.2074 | -0.1200 | -0.0810 | -0.3170 |
| 2005 | Aug-Oct | 0.089 | 18% | WAK | | | | -0.0566 | -0.0382 | -0.1494 |
| 2005 | Aug-Oct | 0.032 | 30% | UppYuk | | | | | -0.0221 | -0.0865 |
| 2005 | Aug-Oct | 0.015 | 47% | SW_AK | | | | | | -0.0584 |
| 2005 | Aug-Oct | 0.186 | 10% | AKBCWA | | | | | | |
| 2006 | Jun-Jul | 0.256 | 10% | Japan | | -0.2810 | -0.2339 | -0.2108 | -0.0676 | -0.3773 |
| 2006 | Jun-Jul | 0.187 | 14% | Russia | | | -0.1910 | -0.1721 | -0.0552 | -0.3081 |
| 2006 | Jun-Jul | 0.137 | 17% | WAK | | | | -0.1433 | -0.0459 | -0.2565 |
| 2006 | Jun-Jul | 0.114 | 16% | UppYuk | | | | | -0.0414 | -0.2312 |
| 2006 | Jun-Jul | 0.013 | 54% | SW_AK | | | | | | -0.0741 |
| 2006 | Jun-Jul | 0.293 | 9% | AKBCWA | | | | | | |
| 2006 | Aug-Oct | 0.301 | 5% | Japan | | -0.4304 | -0.1687 | -0.1444 | -0.1000 | -0.3952 |
| 2006 | Aug-Oct | 0.301 | 6% | Russia | | | -0.1686 | -0.1444 | -0.1000 | -0.3951 |
| 2006 | Aug-Oct | 0.062 | 17% | WAK | | | | -0.0566 | -0.0392 | -0.1548 |
| 2006 | Aug-Oct | 0.046 | 16% | UppYuk | | | | | -0.0335 | -0.1326 |
| 2006 | Aug-Oct | 0.023 | 30% | SW_AK | | | | | | -0.0918 |
| 2006 | Aug-Oct | 0.266 | 6% | AKBCWA | | | | | | |
| 2007 | Jun-Jul | 0.234 | 12% | Japan | | -0.3074 | -0.1873 | -0.2774 | -0.0667 | -0.2816 |
| 2007 | Jun-Jul | 0.237 | 14% | Russia | | | -0.1890 | -0.2799 | -0.0673 | -0.2842 |
| 2007 | Jun-Jul | 0.103 | 24% | WAK | | | | -0.1706 | -0.0410 | -0.1732 |
| 2007 | Jun-Jul | 0.202 | 15% | UppYuk | | | | | -0.0608 | -0.2565 |
| 2007 | Jun-Jul | 0.014 | 64% | SW_AK | | | | | | -0.0617 |
| 2007 | Jun-Jul | 0.207 | 14% | AKBCWA | | | | | | |
| 2007 | Aug-Oct | 0.351 | 4% | Japan | | -0.5292 | -0.2292 | -0.1478 | -0.0736 | -0.3267 |
| 2007 | Aug-Oct | 0.341 | 5% | Russia | | | -0.2242 | -0.1446 | -0.0719 | -0.3196 |
| 2007 | Aug-Oct | 0.089 | 14% | WAK | | | | -0.0626 | -0.0312 | -0.1384 |
| 2007 | Aug-Oct | 0.039 | 19% | UppYuk | | | | | -0.0201 | -0.0892 |
| 2007 | Aug-Oct | 0.010 | 41% | SW_AK | | | | | | -0.0444 |
| 2007 | Aug-Oct | 0.165 | 8% | AKBCWA | | | | | | |
| 2008 | Jun-Jul | 0.223 | 14% | Japan | | -0.1942 | -0.1207 | -0.1487 | -0.1124 | -0.5353 |
| 2008 | Jun-Jul | 0.116 | 23% | Russia | | | -0.0815 | -0.1004 | -0.0759 | -0.3613 |
| 2008 | Jun-Jul | 0.048 | 37% | WAK | | | | -0.0624 | -0.0472 | -0.2246 |
| 2008 | Jun-Jul | 0.071 | 29% | UppYuk | | | | | -0.0581 | -0.2767 |
| 2008 | Jun-Jul | 0.042 | 38% | SW_AK | | | | | | -0.2092 |
| 2008 | Jun-Jul | 0.499 | 7% | AKBCWA | | | | | | |
| 2008 | Aug-Oct | 0.421 | 6% | Japan | | -0.5371 | -0.2504 | -0.1992 | -0.0971 | -0.3564 |
| 2008 | Aug-Oct | 0.284 | 9% | Russia | | | -0.1848 | -0.1470 | -0.0717 | -0.2631 |
| 2008 | Aug-Oct | 0.079 | 21% | WAK | | | | -0.0685 | -0.0334 | -0.1226 |
| 2008 | Aug-Oct | 0.052 | 25% | UppYuk | | | | | -0.0266 | -0.0975 |
| 2008 | Aug-Oct | 0.013 | 56% | SW_AK | | | | | | -0.0476 |
| 2008 | Aug-Oct | 0.149 | 14% | AKBCWA | | | | | | |
| 2009 | Jun-Jul | 0.252 | 7% | Japan | | -0.2742 | -0.2094 | -0.1136 | -0.1394 | -0.4301 |
| 2009 | Jun-Jul | 0.182 | 11% | Russia | | | -0.1703 | -0.0925 | -0.1134 | -0.3499 |
| 2009 | Jun-Jul | 0.115 | 14% | WAK | | | | -0.0706 | -0.0866 | -0.2672 |
| 2009 | Jun-Jul | 0.037 | 23% | UppYuk | | | | | -0.0470 | -0.1450 |
| 2009 | Jun-Jul | 0.055 | 20% | SW_AK | | | | | | -0.1778 |
| 2009 | Jun-Jul | 0.354 | 6% | AKBCWA | | | | | | |
| 2009 | Aug-Oct | 0.392 | 5% | Japan | | -0.5557 | -0.3244 | -0.1413 | -0.1415 | -0.2248 |
| 2009 | Aug-Oct | 0.324 | 7% | Russia | | | -0.2793 | -0.1216 | -0.1218 | -0.1935 |
| 2009 | Aug-Oct | 0.140 | 12% | WAK | | | | -0.0710 | -0.0711 | -0.1130 |
| 2009 | Aug-Oct | 0.030 | 27% | UppYuk | | | | | -0.0310 | -0.0492 |
| 2009 | Aug-Oct | 0.030 | 25% | SW_AK | | | | | | -0.0493 |
| 2009 | Aug-Oct | 0.073 | 14% | AKBCWA | | | | | | |

Table 3-12. Results showing from genetic stock-composition estimates relative precision (by stratified samples) as applied to the bycatch totals for **coastal western Alaska** (excludes mid-upper Yukon River chum salmon). CV=coefficients of variation for stratum-specific estimates of chum salmon from coastal western Alaska. Because of consequences having several fish from the same tow, the estimates of uncertainty were based on adjusted sample sizes (bottom panel in bold).

| Coastal West Alaska | | Aug-Oct |
|---|---|---|
| Multinomial, N= fish | CV | |
| 2005 | 9% | 14% |
| 2006 | 13% | 13% |
| 2007 | 19% | 10% |
| 2008 | 32% | 17% |
| 2009 | 11% | 9% |
| Multivariate normal, Covariance | | |
| 2005 | 11% | 18% |
| 2006 | 17% | 17% |
| 2007 | 23% | 14% |
| 2008 | 37% | 21% |
| 2009 | 14% | 12% |
| Multinomial, N=hauls | | |
| 2005 | 13% | 30% |
| 2006 | 22% | 52% |
| 2007 | 22% | 21% |
| 2008 | 21% | 16% |
| 2009 | 22% | 16% |
| **Multinomial, N=hauls adjusted** | | |
| **2005** | **16%** | **36%** |
| **2006** | **26%** | **62%** |
| **2007** | **26%** | **26%** |
| **2008** | **25%** | **19%** |
| **2009** | **27%** | **19%** |

Table 3-13. Time series of genetic stock-composition estimates of AEQ (percentages in top panel, total numbers in lower panel) based on B-season stratified samples. *Note—for 1994-2004 and 2010, mean stratified genetics data were applied to the bycatch levels.* ***All estimates include the lag-effect which accounts for the proportion of AEQ being caught in different calendar years.***

| | AEQ | Coastal West AK | Japan | AKBCWA | Russia | SWAK | UppYukon |
|---|---|---|---|---|---|---|---|
| 1994 | 132,571 | 9.4% | 36.2% | 17.5% | 30.7% | 1.9% | 4.3% |
| 1995 | 47,948 | 9.4% | 36.3% | 17.4% | 30.8% | 1.9% | 4.3% |
| 1996 | 53,984 | 9.3% | 36.7% | 17.0% | 31.1% | 1.8% | 4.1% |
| 1997 | 60,301 | 9.3% | 36.7% | 16.9% | 31.2% | 1.8% | 4.0% |
| 1998 | 66,699 | 9.3% | 36.8% | 16.9% | 31.2% | 1.8% | 4.0% |
| 1999 | 48,279 | 9.3% | 36.8% | 17.0% | 31.2% | 1.8% | 4.0% |
| 2000 | 52,581 | 9.7% | 34.9% | 18.9% | 29.5% | 2.0% | 4.9% |
| 2001 | 52,743 | 9.7% | 35.0% | 18.8% | 29.6% | 2.0% | 4.9% |
| 2002 | 69,344 | 9.5% | 35.9% | 17.8% | 30.4% | 1.9% | 4.4% |
| 2003 | 141,869 | 9.5% | 35.7% | 18.0% | 30.3% | 1.9% | 4.5% |
| 2004 | 325,945 | 9.6% | 35.4% | 18.4% | 29.9% | 2.0% | 4.7% |
| 2005 | 567,893 | 12.8% | 31.6% | 19.4% | 27.9% | 2.4% | 6.0% |
| 2006 | 419,542 | 11.9% | 29.1% | 24.2% | 25.3% | 2.0% | 7.5% |
| 2007 | 150,434 | 10.5% | 30.5% | 22.2% | 27.9% | 1.6% | 7.3% |
| 2008 | 45,958 | 9.6% | 33.0% | 22.4% | 28.6% | 1.7% | 6.8% |
| 2009 | 36,435 | 11.5% | 31.5% | 21.7% | 24.8% | 3.7% | 3.8% |
| 2010 | 21,765 | 12.1% | 30.5% | 23.9% | 24.4% | 3.6% | 5.5% |
| 2011 | 4,979 | 11.9% | 29.8% | 24.5% | 24.0% | 3.4% | 6.4% |
| 2012 | 464 | 11.5% | 28.7% | 25.5% | 23.5% | 3.0% | 7.7% |
| 1994 | 132,571 | 12,444 | 48,038 | 23,176 | 40,730 | 2,496 | 5,693 |
| 1995 | 47,948 | 4,492 | 17,407 | 8,346 | 14,761 | 899 | 2,042 |
| 1996 | 53,984 | 5,015 | 19,786 | 9,204 | 16,792 | 992 | 2,207 |
| 1997 | 60,301 | 5,587 | 22,153 | 10,218 | 18,805 | 1,102 | 2,435 |
| 1998 | 66,699 | 6,170 | 24,534 | 11,262 | 20,828 | 1,214 | 2,675 |
| 1999 | 48,279 | 4,478 | 17,753 | 8,190 | 15,070 | 883 | 1,952 |
| 2000 | 52,581 | 5,098 | 18,376 | 9,912 | 15,531 | 1,065 | 2,601 |
| 2001 | 52,743 | 5,100 | 18,458 | 9,891 | 15,603 | 1,063 | 2,586 |
| 2002 | 69,344 | 6,557 | 24,921 | 12,338 | 21,115 | 1,328 | 3,081 |
| 2003 | 141,869 | 13,484 | 50,713 | 25,540 | 42,947 | 2,749 | 6,444 |
| 2004 | 325,945 | 31,262 | 115,333 | 59,930 | 97,582 | 6,446 | 15,402 |
| 2005 | 567,893 | 72,605 | 179,225 | 110,351 | 158,205 | 13,400 | 34,093 |
| 2006 | 419,542 | 49,768 | 122,118 | 101,412 | 106,288 | 8,562 | 31,428 |
| 2007 | 150,434 | 15,814 | 45,875 | 33,427 | 41,974 | 2,366 | 11,039 |
| 2008 | 45,958 | 4,390 | 15,179 | 10,313 | 13,124 | 772 | 3,148 |
| 2009 | 36,435 | 4,203 | 11,481 | 7,890 | 9,046 | 1,353 | 1,392 |
| 2010 | 21,765 | 2,628 | 6,641 | 5,201 | 5,301 | 791 | 1,204 |
| 2011 | 4,979 | 593 | 1,482 | 1,221 | 1,197 | 169 | 317 |
| 2012 | 464 | 54 | 133 | 118 | 109 | 14 | 36 |

### 3.2.3 Combining genetic information with AEQ results

The AEQ model uses genetic estimates of chum salmon taken as bycatch in the Bering Sea pollock fishery to determine where the AEQ chum salmon would have returned. In order to align the AEQ estimates with the available genetics information the AEQ results need to split out by the years when the bycatch mortality occurred. For example, the AEQ bycatch mortality in 2008 (i.e., the impact on returning chum salmon in calendar year 2008) is a result of bycatch that occurred in earlier years in addition to the mature (returning) fish that were taken in 2008. This step is needed to apportion the AEQ results to stock of origin based on genetic samples which consist of mature and immature fish.. By splitting the AEQ estimates to relative contributions of bycatch from previous years, and applying GSI data from those years, they can then be realigned and renormalized to get proportions from systems by year (Table 3-13). The impact of the correction due to the lag is illustrated in Figure 3-20. Since data from 1991-2004 and

2010 were unavailable for this analysis, mean GSI (with year-effect variability added to the estimates of uncertainty) were used.

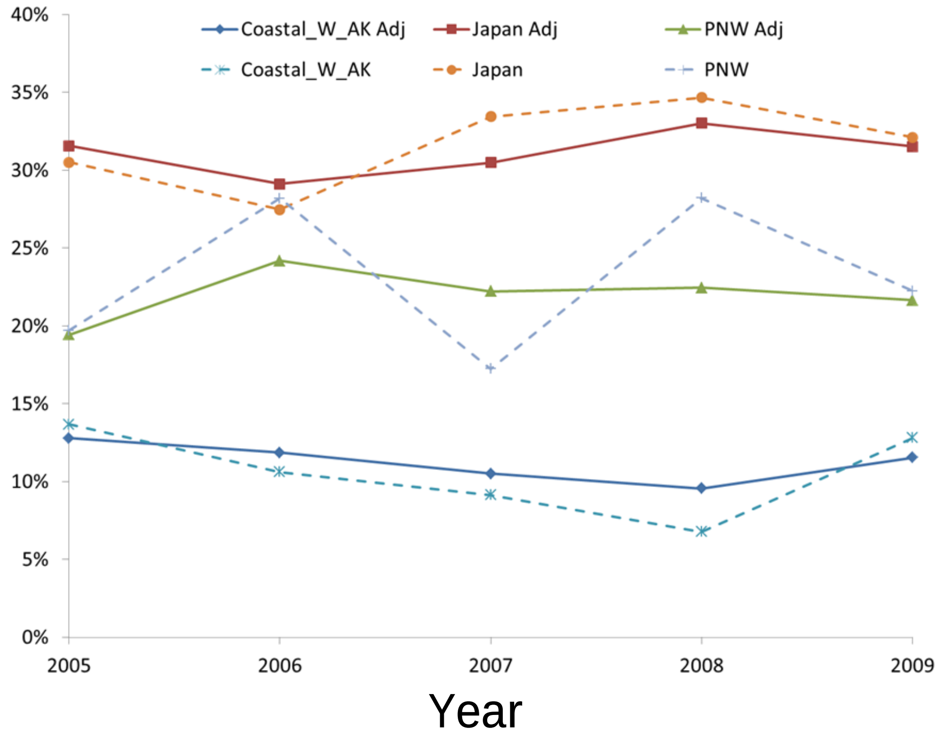



Figure 3-20. Comparison of the annual proportion of B-season chum salmon bycatch originating from different regions by year using the annual genetics results compared with the lag-corrected values (Adj).

## 3.3 Approach to evaluate Status Quo/RHS program

A separate analysis was completed estimating the efficacy of the RHS program salmon bycatch reduction compared to what salmon bycatch would have been in the absence of that program. Both the methodology for this analysis as well as the impact analysis are contained in Chapter 5, Section 5.4.1.1 The methodological portions of that analysis will be moved to this section for the public review draft.

## 3.4 Approach to evaluate Alternative 2, hard caps

Hard caps were evaluated similar to the methods for determining closures in the next section except that for each sector allocation and cap combination, rather than diverting effort to other areas, they were treated as if their season was over. At that point, the amount of salmon was compared with the total actual non-Chinook salmon bycatch to evaluate potential salmon savings that might have occurred had the hard cap been in place (ignoring the fact that the fleet would likely have taken measures to avoid reaching the cap). Likewise, their pollock catch at the point the cap was reached was compared with actual values for that year (within sectors). The cap levels evaluated for analysis were 50,000, 200,000, and 353,000 non-Chinook salmon with three selected sector-allocation schemes as outlined in section 2.

## 3.5 Evaluating Alternative 3, trigger-cap scenarios

As noted in section 2.3.1, the 50% area scenarios were selected to evaluate the range of caps apportioned by sector and month. The historical data from 2003-2010 was used for each cap scenario. As a monthly trigger limit was reached, the areas designated for that month are closed to that sector and re-opened in the subsequent month (unless the cumulative total was exceeded for that month—if that is the case, then that month begins with the “optimal” closures for that month). When areas become closed, the remaining pollock observed for that sector is assumed to be taken *outside of the closed areas* at the mean bycatch rate / t of pollock observed outside the closed areas.

This process requires accounting to track open and closed area rates simply for each of the 4 options for triggering (options 1a, 1b, 2a, and 2b under component 2). The analysis focused on the historical period from 2003-2011 and evaluated three cap scenarios, each with three alternative sector-specific allocation schemes, for the four trigger closure methods. Presenting the results of this analysis by sector and year is challenging since there are nearly 3,000 values to display.

The historical NMFS observer data as described earlier allows flexibility in evaluating input specifications (i.e., different spatial closures, cap/sector allocations). To the extent possible, evaluations of alternative chum salmon trigger caps were thus based on re-casting historical catch levels as if a cap proposal had been implemented. Since the alternatives all have specific values by season and sector, the effect on bycatch levels can vary for each alternative and over different years. This is caused by the distribution of the fleet relative to the resource and the variability of bycatch rates by season and years.

The annual proportion of week-area chum bycatch was computed for each year and a gridded dataset with 10 alternative chum bycatch levels was constructed (with totals spanning 50,000, 100,000, … , 500,000 for each of the 9 years). This dataset was then used to evaluate the relative benefits of different trigger closure options. The point of this was to capture some of the spatio-temporal variability between years. One disadvantage of this approach is that it assumes that bycatch in years where levels were low would have a similar spatio-temporal patterns in high bycatch years (and vice versa).

Area closures (chum savings areas in 2003-2005 and VRHS in 2001-2010) affect the available data for evaluating optimal closure areas and regions. Additionally, a fishing patterns have shifted through this period (due to the relative abundance of pollock) with varying proportions of pollock taken west of the Pribilof Islands.

Within-season patterns are also illustrated by cap, sector split, and suboption. This is to show whether particular trigger cap options affect chum salmon bycatch earlier in the year when generally a proportion of western Alaska stocks in the bycatch would be expected to be lower (since the stock composition appears to vary between early and later in the season).

# 4 Walleye pollock

## 4.1 Overview of pollock biology and distribution

Overview information in this section is extracted from Ianelli et al. (2010). Other information on pollock may be found at the NMFS website, www.afsc.noaa.gov/refm.

Walleye pollock, *Theragra chalcogramma***,** are a member of the order Gadiformes and family Gadidae. They are a semidemersal, schooling species that are generally found at depths from 30 to 300 meters but have been recorded at depths as low as 950 meters (Mecklenburg *et al.* 2002). Pollock are usually concentrated on the outer shelf and slope of coastal waters but may utilize a wide variety of habitats as nearshore seagrass beds (Sogard and Olla 1993). Their distribution extends from the waters of the North Pacific Ocean off Carmel, California throughout the Gulf of Alaska in the eastern Pacific Ocean, across the North Pacific Ocean including the Bering Sea, Chukchi Sea, and Aleutian Islands, and in the western Pacific Ocean from the Sea of Japan north to the Sea of Okhotsk in the western Pacific Ocean (Mecklenburg *et al.* 2002, Hart 1973).

Adult pollock are visual, opportunistic feeders that diet on euphausiids, copepods, and fish, with a majority of their diet from juvenile pollock (National Research Council 1996). In the eastern Bering Sea, cannibalism is the greatest source of mortality for juvenile pollock (Livingston 1989), but cannibalism is not prevalent in the Gulf of Alaska (GOA) (Bailey *et al.* 1999). Juvenile pollock reach sexual maturity and recruit to the fishery at about age four at lengths of 40 to 45 centimeters (Wespestad 1993). Most pollock populations spawn at consistent times and consistent locations each year, most often in sea valleys, canyons, deep water, or the outer margins of the continental shelf during late winter and early spring (Bailey *et al*. 1999). In the eastern Bering Sea, spawning occurs over the southeastern slope and shelf from March through June and over the northwest slope and shelf from June through August (Hinckley 1987). The main spawning location is on the southeastern shelf while the main rearing ground location is on the northeastern shelf (Ianelli 2010).

For management purposes, pollock in the U.S. waters of the Bering Sea are divided into three stocks: the eastern Bering Sea stock, the Aleutian Islands stock, and the Central Bering Sea-Bogoslof Island stock (Ianelli *et al.* 2007). The extent to which pollock migrate across the boundaries of these three areas, across the boundaries of the Bering Sea U.S. EEZ and the Russian EZZ, and seasonally within the eastern Bering Sea is unclear. General migratory movements of adult pollock on and off the eastern Bering Sea shelf tend to follow a pattern of movement to the outer shelf edge and deep water in the winter months, to spawning areas in the springtime, and to the outer and central shelf during the summer months to feed (Smith 1981).

Japanese mark-recapture studies during the summer/autumn feeding seasons have revealed that pollock migrate across the Bering Sea (Dawson 1989) suggesting the interchange of pollock between Russian and U.S. waters. There are concerns that Russian fisheries may be harvesting U.S. managed pollock stocks resulting in a higher fishing mortality. Although the few tagging studies in the Bering Sea have not provided information on spawning migrations, homing to specific spawning sites, and the characteristic of migrating populations as schools or individuals, tagging studies around Japan have been more informative. Mark-recapture studies in which pollock were tagged during the spawning season (April) in Japanese waters revealed migrations for spawning site fidelity, but diffuse mixing during the summer feeding season (Tsuji 1989).

### 4.1.1 Food habits/ecological role

In North American waters, pollock are most prevalent in the eastern Bering Sea. Because of their large biomass, pollock provide an important food source for other fishes, marine mammals as Steller sea lions (*Eumetopias jubatus*), northern fur seals (*Callorhinus ursinus*), and fin whales (*Balaenoptera physalus*), and marine birds as the northern fulmars (*Fulmarus glacialis*), kittiwakes (*Rissa tridactyla, Rissa brevirostris*), murres (*Uria aalge, Uria lomvia*), and puffins (*Fratercula corniculata, Lunda cirrhata*) (Kajimura and Fowler 1984). These predator-prey relationships between pollock and other organisms are an integral part of the balance that makes the eastern Bering Sea one of the most highly productive environments in the world.

In comparisons of the Western Bering Sea (WBS) with the Eastern Bering Sea using mass-balance food-web models based on 1980-85 summer diet data, Aydin et al. (2002) found that the production in these two systems is quite different. On a per-unit-area measure, the western Bering Sea has higher productivity than the EBS. Also, the pathways of this productivity are different with much of the energy flowing through epifaunal species (e.g., sea urchins and brittlestars) in the WBS whereas for the EBS, crab and flatfish species play a similar role. In both regions, the keystone species in 1980-85 were pollock and Pacific cod. This study showed that the food web estimated for the EBS ecosystem appears to be relatively mature due to the large number of interconnections among species. In a more recent study based on 1990-93 diet data (see Boldt et al. 2007 for methods), pollock remain in a central role in the ecosystem. The diet of pollock is similar between adults and juveniles with the exception that adults become more piscivorous (with consumption of pollock by adult pollock representing their third largest prey item). In terms of magnitude, pollock cannibalism may account for 2.5 million t to nearly 5 million t of pollock consumed (based on uncertainties in diet percentage and total consumption rate).

Regarding specific small-scale ecosystems of the EBS, Ciannelli et al. (2004) presented an application of an ecosystem model scaled to data available around the Pribilof Islands region. They applied bioenergetics and foraging theory to characterize the spatial extent of this ecosystem. They compared energy balance, from a food web model relevant to the foraging range of northern fur seals and found that a range of 100 nautical mile radius encloses the area of highest energy balance representing about 50% of the observed foraging range for lactating fur seals. This suggests that fur seals depend on areas outside the energetic balance region. This study develops a method for evaluating the shape and extent of a key ecosystem in the EBS (i.e., the Pribilof Islands). Subsequent studies have examined spatial and temporal patterns of age zero pollock in this region and showed that densities are highly variable (Winter et al. 2005, Swartzman et al. 2005).

The impact of predation by species other than pollock may have shifted in recent years. In particular, the increasing population of arrowtooth flounder in the Bering Sea is a concern, especially considering the large predation caused by these flatfish in the Gulf of Alaska. Overall, the total non-cannibal groundfish predator biomass has gone down in the Bering Sea according to current stock assessments, with the drop of Pacific cod in the 1980s exceeding the rise of arrowtooth in terms of biomass (e.g., Fig. 4 in Boldt 2007). This also represents a shift in the age of predation, with arrowtooth flounder consuming primarily age-2 pollock, while Pacific cod primarily consume larger pollock. However, the dynamics of this predation interaction may be quite different than in the Gulf of Alaska. A comparison of 1990-94 natural mortality by predator for arrowtooth flounder in the Bering Sea and the Gulf of Alaska shows that they are truly a top predator in the Gulf of Alaska. In the Bering Sea, pollock, skates, and sharks all prey on arrowtooth flounder, giving the species a relatively high predation mortality.

The predation on small arrowtooth flounder by large pollock gives rise to a specific concern for the Bering pollock stock. Walters and Kitchell (2001) describe a predator/prey system called “cultivation/depensation” whereby a species such as pollock “cultivates” its young by preying on species that would eat its young (for example, arrowtooth flounder). If these interactions are strong, the removal of the large pollock may lead to an accelerated decline, as the control it exerts on predators of its recruits is removed—this has been cited as a cause for a decline of cod in the Baltic Sea in the presence of herring feeding on cod young (Walters and Kitchell 2001). In situations like this, it is possible that predator culling (e.g., removing arrowtooth) may not have a strong effect towards controlling predation compared to applying additional caution to pollock harvest and thus preserving this natural control. At the moment, this concern for Bering Sea pollock is qualitative; work on extending a detailed, age-structured, multispecies statistical model (e.g., MSM; Jurado-Molina et al. 2005) to more completely model this complex interaction for pollock and arrowtooth flounder is continuing.

### 4.1.2 Groundfish Fisheries

Pollock continues to represent over 40% of the global whitefish production with the market disposition split fairly evenly between fillets, whole (head and gutted), and surimi. An important component of the commercial production is the sale of roe from pre-spawning pollock. Pollock are considered a relatively fast growing and short-lived species and currently represents a major biological component of the Bering Sea ecosystem.

In the U.S. portion of the Bering Sea three stocks of pollock are identified for management purposes. These are: Eastern Bering Sea which consists of pollock occurring on the Eastern Bering Sea shelf from Unimak Pass to the U.S.-Russia Convention line; the Aleutian Islands Region encompassing the Aleutian Islands shelf region from 170°W to the U.S.-Russia Convention line; and the Central Bering Sea—Bogoslof Island pollock. These three management stocks undoubtedly have some degree of exchange. The Bogoslof stock forms a distinct spawning aggregation that has some connection with the deep water region of the Aleutian Basin. In the Russian EEZ, pollock are considered to form two stocks, a western Bering Sea stock centered in the Gulf of Olyutorski, and a northern stock located along the Navarin shelf from 171°E to the U.S.- Russia Convention line. There is some indication (based on contiguous surveys) that the fishery in the northern region may be a mixture of Eastern and western Bering Sea pollock with the former predominant. Bailey et al. (1999) present a thorough review of population structure of pollock throughout the north Pacific region. Genetic differentiation using microsatellite methods suggest that populations from across the North Pacific Ocean and Bering Sea were similar. However, weak differences were significant on large geographical scales and conform to an isolation-by-distance pattern (O'Reilly and Canino, 2004; Canino et al. 2005).

From 1954 to 1963, pollock were harvested at low levels in the Eastern Bering Sea and directed foreign fisheries began in 1964. Catches increased rapidly during the late 1960s and reached a peak in 1970-75 when they ranged from 1.3 to 1.9 million t annually. Following a peak catch of 1.9 million t in 1972, catches were reduced through bilateral agreements with Japan and the USSR.

Since the advent of the U.S. EEZ in 1977 the annual average Eastern Bering Sea pollock catch has been 1.2 million t and has ranged from 0.9 million t in 1987 to nearly 1.5 million t in recent years. Stock biomass has apparently ranged from a low of 4-5 million t to highs of 10-12 million t (Figure 4-1). United States vessels began fishing for pollock in 1980 and by 1987 they were able to take 99% of the quota. Since 1988, only U.S. vessels have been operating in this fishery. By 1991, the current NMFS observer program for north Pacific groundfish-fisheries was in place. In recent years, the proportion of catch taken west of 170°W has grown. The spatial distribution of the fishery is depicted in Figure 4-2.

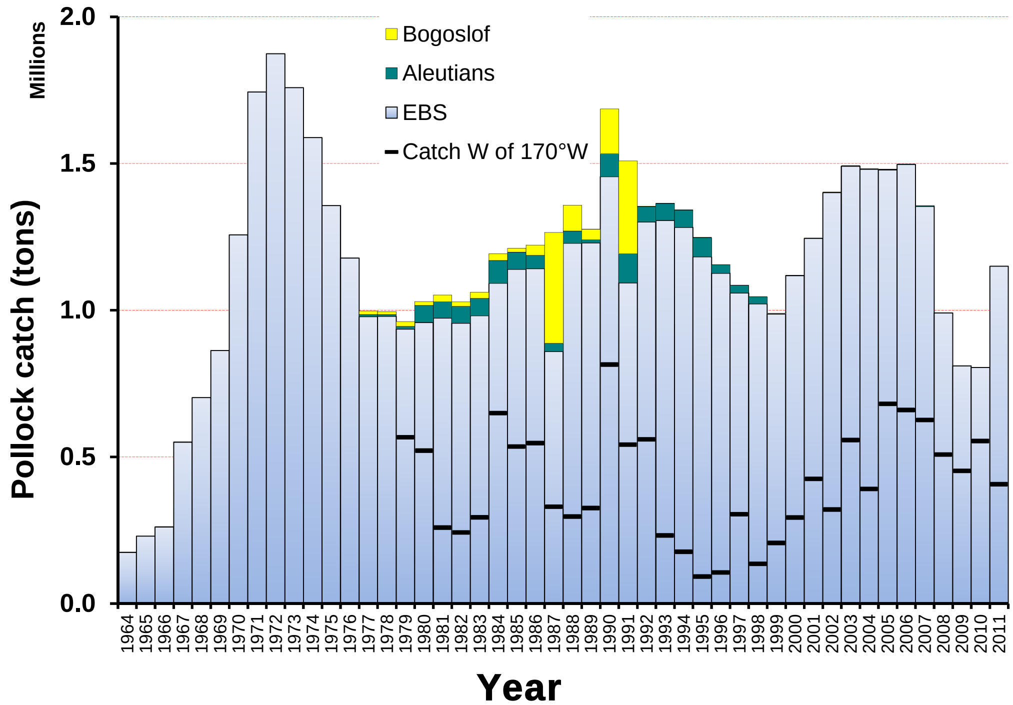



Figure 4-1. Alaska pollock catch estimates from the Eastern Bering Sea, Aleutian Islands, and Bogoslof Island regions, 1964-2011.

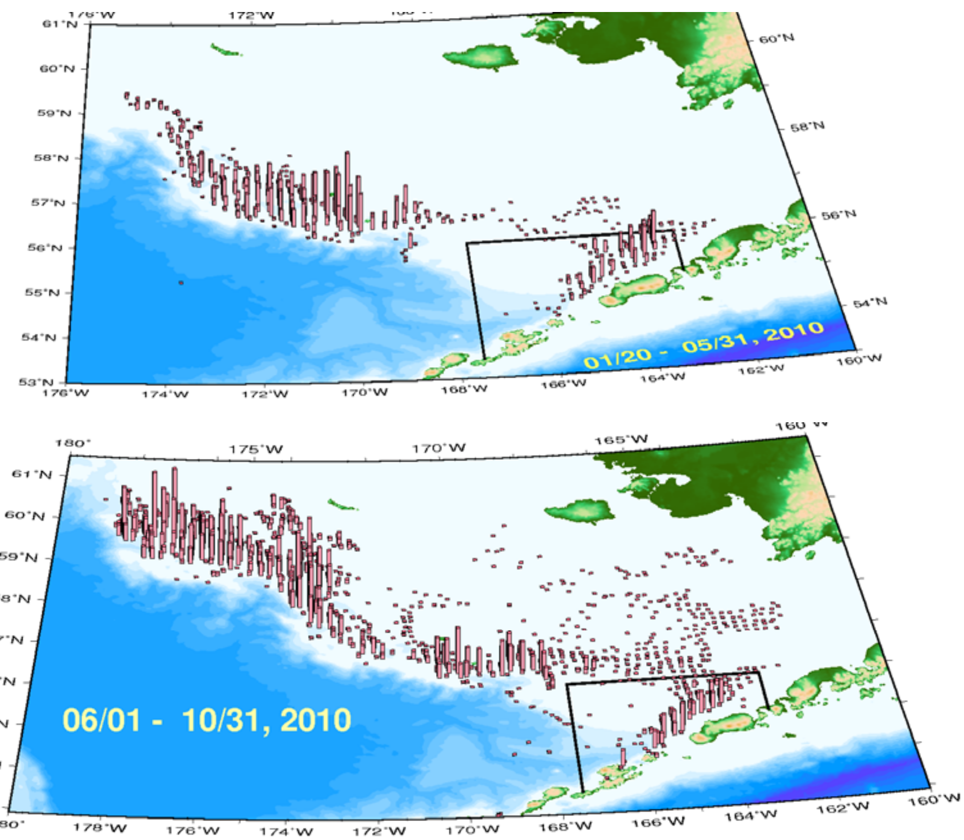



Figure 4-2. Alaska pollock 2011 catch distribution during the winter (top) and summer-fall (bottom).

### 4.1.3 NMFS surveys and stock assessment

The NMFS conducts bottom trawl surveys annually and echo-integration trawl surveys every other year. Both occur during summer months and provide a synoptic overview of relative densities of adult and pre-recruit pollock (Figure 4-3).

Extensive observer sampling is conducted and a complete assessment is done each year for evaluating stock status and to form the basis of catch recommendations. The most recent assessment shows a declining biomass since 2003 due to a period of below-average recruitment which has subsequently improved since 2008 and is estimated to be above the target spawning level in 2011 (Ianelli et al. 2010). Due to the decline, catch was restricted to about 800 thousand tons in 2009 and 2010 whereas catch averaged 1.463 million tons from 2002-2005. The effect of these catches is closely monitored by resource assessment surveys and an extensive fishery observer program.

The assessment reporting process involves reviews done by the Council through the Groundfish Plan Team (which meet on assessment issues twice per year). The Plan Team prepares a summary report of the assessment as the introduction to the Stock Assessment and Fishery Evaluation (SAFE) report which contains separate chapters for each stock or stock complex. These are posted on the internet and can be obtained at http://www.afsc.noaa.gov/REFM/stocks/assessments.htm. Preliminary drafts are presented to the Council in early December where the SSC reviews the documents and makes final ABC recommendations. As part of the review process, the SSC formally provides feedback on aspects of research and improvements on assessments for the coming year. The SSC ABC recommendation is forwarded to the Council where the value represents an upper limit of where the TAC may be set. A summary of biomass and recruitment is shown in Figure 4-4.

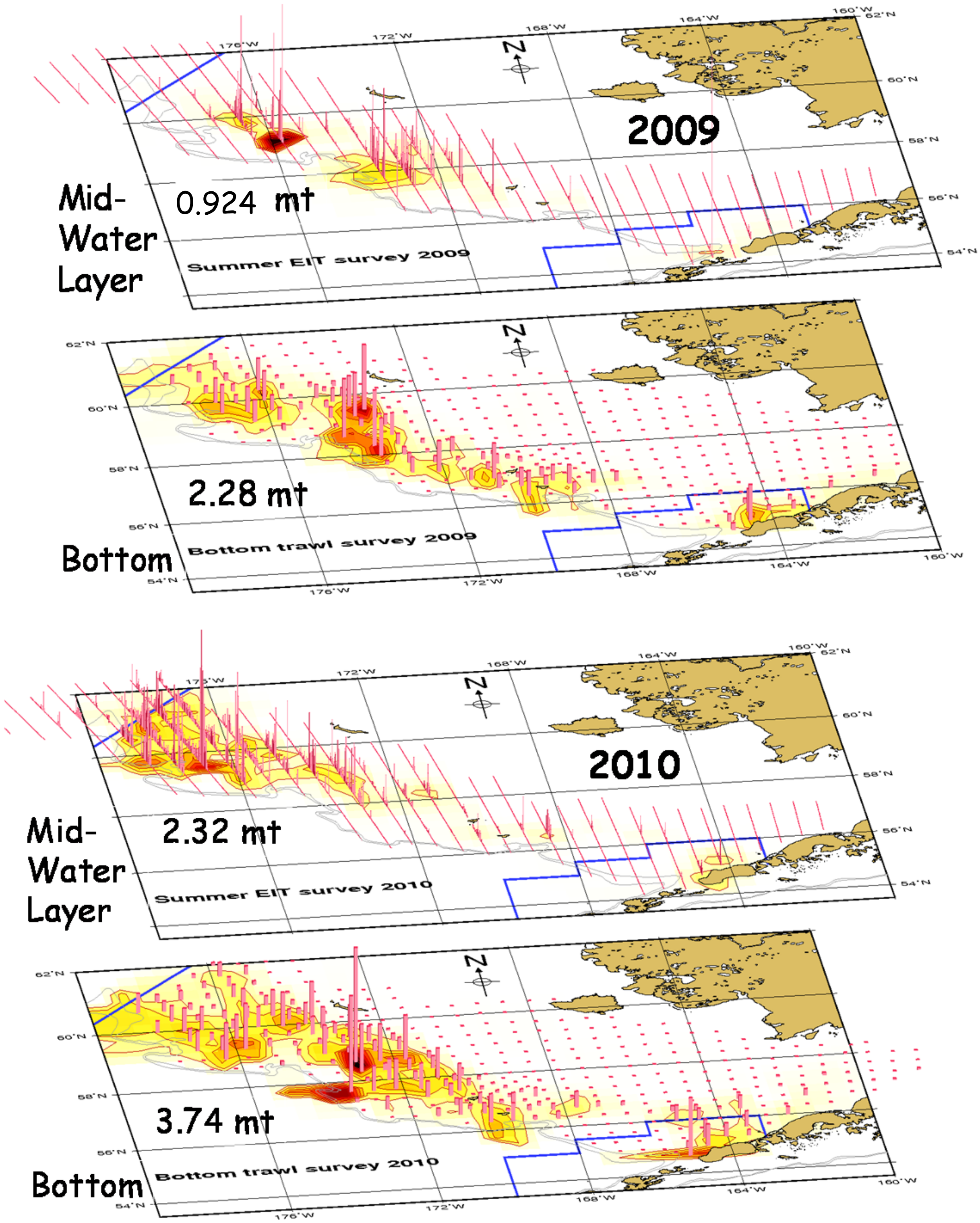



Figure 4-3. Echo-integration trawl and bottom trawl survey results for 2009 and 2010. Vertical lines represent biomass of pollock as observed in the different surveys.

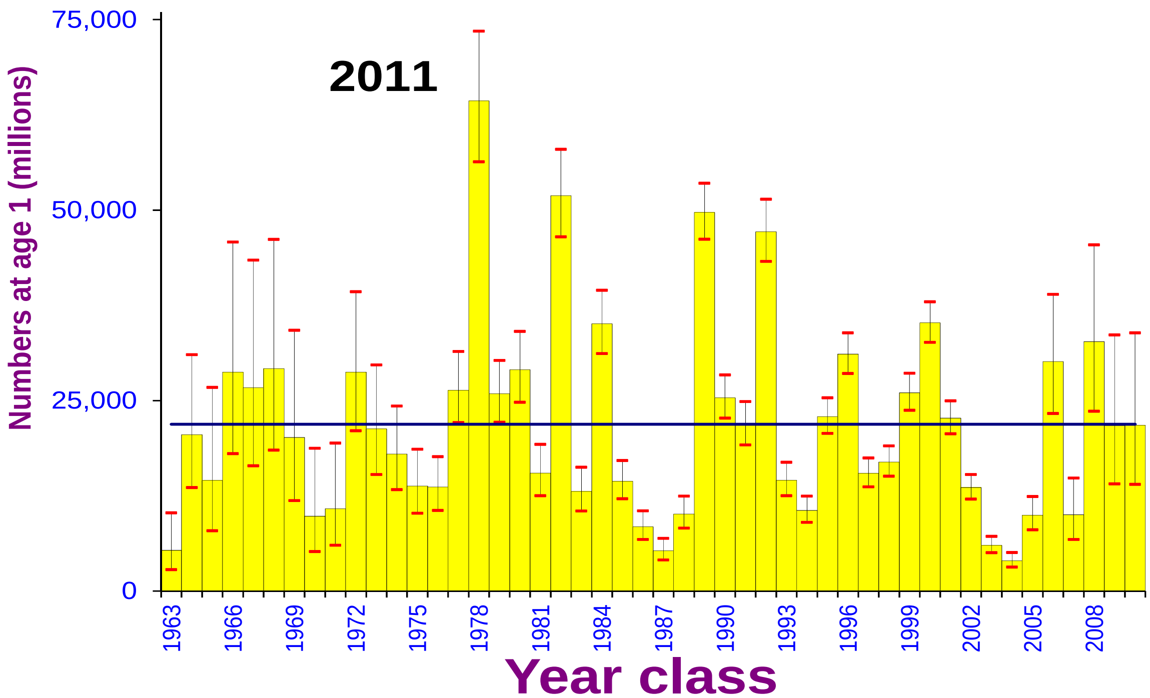




Figure 4-4. Estimated age female spawning EBS mid-year pollock biomass, 1978-2014 (top; with previous year's estimates) and age-1 year-class strengths (bottom panel). Approximate upper and lower 95% confidence limits are shown by shadings and error bars.

## 4.2 Impact of alternatives on the fishery

The significance of the impacts of the alternative management measures on pollock stocks based on criteria adopted from HAPC EA 2006. Criteria used to determine significance of effects on target groundfish stocks are as follows:

| Effect | Criteria | | | |
|---|---|---|---|---|
| | Significantly Negative | Insignificant | Significantly Positive | Unknown |
| Fishing mortality | Reasonably expected to jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis. | Reasonably expected not to jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis. | Action allows the stock to return to its unfished biomass. | Magnitude and/or direction of effects are unknown |
| Spatial or temporal distribution | Reasonably expected to adversely affect the distribution of harvested stocks either spatially or temporally such that it jeopardizes the ability of the stock to sustain itself. | Unlikely to affect the distribution of harvested stocks either spatially or temporally such that it has an effect on the ability of the stock to sustain itself. | Reasonably expected to positively affect the harvested stocks through spatial or temporal increases in abundance such that it enhances the ability of the stock to sustain itself. | Magnitude and/or direction of effects are unknown |
| Change in prey availability | Evidence that the action may lead to changed prey availability such that it jeopardizes the ability of the stock to sustain itself. | Evidence that the action will not lead to a change in prey availability such that it jeopardizes the ability of the stock to sustain itself. | Evidence that the action may result in a change in prey availability such that it enhances the ability of the stock to sustain itself. | Magnitude and/or direction of effects are unknown |

#### 4.2.1.1 Significance of Alternative 1 (status quo) on the pollock resource

The significance criteria for Alternative 1 (status quo) is insignificant for fishing mortality, spatial distribution, and changes in prey availability. Presently the stock is managed based on science covering a wide variety of facets including the capacity of the stock to yield sustainable biomass on a continuing basis. Spatial and temporal distribution changes in potential impacts are closely monitored by scientificly trained at-sea observers. Regular diet compositions and applications to multispecies ecosystem models are conducted to evaluate changes in predator-prey dynamics. In general, variability in environmental conditions seems to affect stock productivity. However, the present bycatch management system in place has an insignificant effect on the ability to sustainably manage the pollock resource because it is not reasonably expected not to jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis.

### 4.2.2 Alternative 2, hard caps

The amount of pollock catch that would have been forgone was compared with the total actual pollock to evaluate the impact of different sector-split hard caps. **This method ignores the fact that the fleet would likely have taken measures to avoid reaching a cap in any given year.** Nonetheless, all hard caps show that all sectors would have forgone high levels of pollock catch at most cap levels (Table 4-1 and Table 4-2). The sector most affected is the shore-based catcher vessels (CVs), particularly for the 50,000 chum salmon hard cap and the third sector allocation scheme evaluated (Table 4-1 and Table 4-2). For the first sector allocation scheme the impact on the at-sea catcher processors was highest, particularly in 2004. Since the impacts for hard caps are quite high (based on historical data in terms of tonnages of pollock), the effort required to avoid chum in such years would additionally increase the costs of fishing (Table 4-3). Summing hypothetical forgone pollock over sectors, the amount varies considerably between years ranging from no pollock forgone to over 79% for the low cap option in 2005 (Table 4-4). Also, the estimated week of closure in some years was quite early (Table 4-5 for options 1a and Table 4-6 for 1b).

Table 4-1. Alternative 2 option 1a) estimated forgone pollock (in metric tons) by sector and year under 3 different allocation schemes and hard caps for 2003-2011 for the B season.

**2ii (sector allocation 1)**

| Cap: | **50,000** | | | | **200,000** | | | | **353,000** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CDQ | CP | M | CV | CDQ | CP | M | CV | CDQ | CP | M | CV |
| 2003 | 50,723 | 67,075 | 44,326 | 194,988 | 12,679 | | 12,127 | | | | | |
| 2004 | 73,686 | 304,419 | 63,213 | 199,799 | 27,506 | 222,427 | 9,237 | 89,611 | | 132,913 | | 36,316 |
| 2005 | 25,671 | 283,430 | 73,940 | 298,886 | 9,934 | 105,591 | 26,121 | 255,189 | | 80,113 | 7,350 | 200,721 |
| 2006 | | 224,581 | | 360,034 | | | | 240,309 | | | | |
| 2007 | 18,314 | 119,498 | 30,463 | 80,763 | | | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | | | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 20,817 | 204,538 | 62,788 | 188,426 | | 92,896 | 51,116 | | | 10,732 | 21,005 | |

**4ii (sector allocation 2)**

| Cap: | **50,000** | | | | **200,000** | | | | **353,000** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CDQ | CP | M | CV | CDQ | CP | M | CV | CDQ | CP | M | CV |
| 2003 | 33,787 | 32,926 | 28,469 | 220,230 | | | | 28,381 | | | | |
| 2004 | 51,765 | 289,711 | 50,902 | 204,602 | | 132,913 | 458 | 95,021 | | | | 67,238 |
| 2005 | 22,469 | 127,176 | 68,474 | 303,437 | | 65,017 | 12,128 | 264,732 | | | | 238,356 |
| 2006 | | 93,943 | | 360,034 | | | | 290,957 | | | | 201,854 |
| 2007 | 15,434 | 82,889 | 22,808 | 103,343 | | | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | | 13,558 | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 2,323 | 151,590 | 60,464 | 215,455 | | | 27,827 | | | | 7,574 | |

**6 (sector allocation 3)**

| Cap: | **50,000** | | | | **200,000** | | | | **353,000** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CDQ | CP | M | CV | CDQ | CP | M | CV | CDQ | CP | M | CV |
| 2003 | 12,679 | 6,391 | 19,764 | 248,565 | | | | 69,425 | | | | |
| 2004 | 32,838 | 264,515 | 37,113 | 226,240 | | 18,792 | | 152,617 | | | | 89,611 |
| 2005 | 19,944 | 112,588 | 65,867 | 320,886 | | | | 291,630 | | | | 255,590 |
| 2006 | | | | 373,630 | | | | 328,416 | | | | 243,714 |
| 2007 | 6,477 | 61,779 | 13,400 | 119,714 | | | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | | 64,654 | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | | 130,289 | 60,464 | 242,594 | | | 17,266 | 61,332 | | | | |

Table 4-2. Alternative 2 **option 1b)** estimated forgone pollock (in metric tons) by sector and year under 3 different allocation schemes and hard caps for 2003-2011 for the B season).

2ii (sector allocation 1)

| Cap: | 50,000 | | | | 200,000 | | | | 353,000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CDQ | CP | M | CV | CDQ | CP | M | CV | CDQ | CP | M | CV |
| 2003 | | 38,970 | 14,101 | 23,616 | | | | | | | | |
| 2004 | 10,985 | 175,156 | 19,184 | | | 159,428 | 3,320 | | | 153,109 | | |
| 2005 | | 114,083 | 37,724 | 118,425 | | 33,803 | 36,050 | 83,610 | | | 27,978 | 77,373 |
| 2006 | | 87,257 | 6,156 | 149,916 | | 11,069 | | 115,273 | | | | 104,702 |
| 2007 | | 47,456 | 14,500 | | | | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | 12,821 | 18,631 | 3,750 | | | | | | | | |
| 2010 | | | 5,835 | | | | | | | | | |
| 2011 | 20,154 | 85,724 | 30,319 | 138,096 | | 51,090 | 28,619 | 40,953 | | 5,487 | 26,296 | |

4ii (sector allocation 2)

| Cap: | 50,000 | | | | 200,000 | | | | 353,000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CDQ | CP | M | CV | CDQ | CP | M | CV | CDQ | CP | M | CV |
| 2003 | | | 5,644 | 23,616 | | | | | | | | |
| 2004 | | 171,506 | 16,823 | 5,654 | | 139,833 | | | | 49,196 | | |
| 2005 | | 105,322 | 37,724 | 133,393 | | | 30,585 | 84,629 | | | | 77,373 |
| 2006 | | 44,052 | | 149,916 | | | | 136,320 | | | | 104,702 |
| 2007 | | | 8,598 | 7,554 | | | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | 9,211 | 22,572 | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 3,199 | 77,231 | 29,710 | 144,503 | | 5,487 | 26,296 | 59,519 | | | 16,948 | |

6 (sector allocation 3)

| Cap: | 50,000 | | | | 200,000 | | | | 353,000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CDQ | CP | M | CV | CDQ | CP | M | CV | CDQ | CP | M | CV |
| 2003 | | | 2,624 | 49,727 | | | | | | | | |
| 2004 | | 171,506 | 16,823 | 18,095 | | 89,514 | | | | | | |
| 2005 | | 101,626 | 37,724 | 143,802 | | | 20,414 | 96,580 | | | | 83,610 |
| 2006 | | 25,285 | | 149,916 | | | | 149,916 | | | | 115,273 |
| 2007 | | | 4,941 | 23,015 | | | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | | 56,031 | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | | 65,778 | 29,710 | 150,279 | | | 22,364 | 91,316 | | | 9,897 | 40,953 |

Table 4-3. Alternative 2, option 1a) Estimated forgone pollock (relative to estimated catches) by sector and year under 3 different allocation schemes and hard caps for 2003-2011 for the B season.

2ii (sector allocation 1)

| Cap: | 50,000 | | | | 200,000 | | | | 353,000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CDQ | CP | M | CV | CDQ | CP | M | CV | CDQ | CP | M | CV |
| 2003 | 34% | 13% | 34% | 30% | 9% | | 9% | | | | | |
| 2004 | 49% | 59% | 49% | 31% | 18% | 43% | 7% | 14% | | 26% | | 6% |
| 2005 | 17% | 55% | 57% | 46% | 7% | 20% | 20% | 39% | | 15% | 6% | 31% |
| 2006 | | 43% | | 56% | | | | 37% | | | | |
| 2007 | 13% | 24% | 25% | 14% | | | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | | | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 18% | 48% | 57% | 36% | | 22% | 47% | | | 3% | **19**% | |

4ii (sector allocation 2)

| Cap: | 50,000 | | | | 200,000 | | | | 353,000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CDQ | CP | M | CV | CDQ | CP | M | CV | CDQ | CP | M | CV |
| 2003 | 23% | 6% | 22% | 34% | | | | 4% | | | | |
| 2004 | 35% | 56% | 39% | 32% | | 26% | 0% | 15% | | | | 11% |
| 2005 | 15% | 25% | 52% | 47% | | 13% | 9% | 41% | | | | 37% |
| 2006 | | 18% | | 56% | | | | 45% | | | | 31% |
| 2007 | 11% | 17% | 19% | 18% | | | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | | 4% | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 2% | 36% | 55% | 42% | | | 25% | | | | 7% | |

6 (sector allocation 3)

| Cap: | 50,000 | | | | 200,000 | | | | 353,000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CDQ | CP | M | CV | CDQ | CP | M | CV | CDQ | CP | M | CV |
| 2003 | 9% | 1% | 15% | 38% | | | | 11% | | | | |
| 2004 | 22% | 51% | 29% | 35% | | 4% | | 24% | | | | 14% |
| 2005 | 13% | 22% | 50% | 50% | | | | 45% | | | | 39% |
| 2006 | | | | 58% | | | | 51% | | | | 38% |
| 2007 | 5% | 13% | 11% | 21% | | | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | | 18% | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | | 31% | 55% | 47% | | | 16% | 12% | | | | |

Table 4-4. Alternative 2 summary of forgone (or diverted for 1b) pollock totaled over sectors under 3 different allocation schemes and hard caps for 2003-2011 for the B season. Bottom panels show in relative percentages.

| Year | Actual pollock catch (t) | 50,000 2ii | 50,000 4ii | 50,000 6 | 200,000 2ii | 200,000 4ii | 200,000 6 | 353,000 2ii | 353,000 4ii | 353,000 6 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Option 1a)** | | | | | | | | |
| 2003 | 874,471 | 357,113 | 315,412 | 287,398 | 24,806 | 28,381 | 69,425 | | | |
| 2004 | 855,557 | 641,117 | 596,980 | 560,706 | 348,780 | 228,392 | 171,409 | 169,229 | 67,238 | 89,611 |
| 2005 | 861,226 | 681,927 | 521,555 | 519,285 | 396,835 | 341,878 | 291,630 | 288,184 | 238,356 | 255,590 |
| 2006 | 862,021 | 584,615 | 453,977 | 373,630 | 240,309 | 290,957 | 328,416 | | 201,854 | 243,714 |
| 2007 | 773,138 | 249,038 | 224,474 | 201,370 | | | | | | |
| 2008 | 572,010 | | | | | | | | | |
| 2009 | 464,654 | | 13,558 | 64,654 | | | | | | |
| 2010 | 470,405 | | | | | | | | | |
| 2011 | 676,342 | 476,569 | 429,832 | 433,347 | 144,013 | 27,827 | 78,598 | 31,737 | 7,574 | |
| Total | 6,409,825 | 2,990,379 | 2,555,789 | 2,440,389 | 1,154,743 | 917,434 | 939,478 | 489,151 | 515,021 | 588,916 |
| | | **Option 1b)** | | | | | | | | |
| 2003 | 874,471 | 76,687 | 29,260 | 52,351 | | | | | | |
| 2004 | 855,557 | 205,324 | 193,983 | 206,425 | 162,748 | 139,833 | 89,514 | 153,109 | 49,196 | |
| 2005 | 861,226 | 270,232 | 276,439 | 283,152 | 153,463 | 115,214 | 116,994 | 105,351 | 77,373 | 83,610 |
| 2006 | 862,021 | 243,329 | 193,968 | 175,201 | 126,342 | 136,320 | 149,916 | 104,702 | 104,702 | 115,273 |
| 2007 | 773,138 | 61,956 | 16,152 | 27,957 | | | | | | |
| 2008 | 572,010 | | | | | | | | | |
| 2009 | 464,654 | 35,202 | 31,783 | 56,031 | | | | | | |
| 2010 | 470,405 | 5,835 | | | | | | | | |
| 2011 | 676,342 | 274,294 | 254,642 | 245,766 | 120,662 | 91,302 | 113,681 | 31,783 | 16,948 | 50,850 |
| Total | 6,409,825 | 1,172,859 | 996,228 | 1,046,883 | 563,214 | 482,668 | 470,105 | 394,944 | 248,219 | 249,732 |
| | | **Option 1a)** | | | | | | | | |
| 2003 | 874,471 | 41% | 36% | 33% | 3% | 3% | 8% | | | |
| 2004 | 855,557 | 75% | 70% | 66% | 41% | 27% | 20% | 20% | 8% | 10% |
| 2005 | 861,226 | 79% | 61% | 60% | 46% | 40% | 34% | 33% | 28% | 30% |
| 2006 | 862,021 | 68% | 53% | 43% | 28% | 34% | 38% | | 23% | 28% |
| 2007 | 773,138 | 32% | 29% | 26% | | | | | | |
| 2008 | 572,010 | | | | | | | | | |
| 2009 | 464,654 | | 3% | 14% | | | | | | |
| 2010 | 470,405 | | | | | | | | | |
| 2011 | 676,342 | 70% | 64% | 64% | 21% | 4% | 12% | 5% | 1% | |
| Total | 6,409,825 | 47% | 40% | 38% | 18% | 14% | 15% | 8% | 8% | 9% |
| | | **Option 1b)** | | | | | | | | |
| 2003 | 874,471 | 9% | 3% | 6% | | | | | | |
| 2004 | 855,557 | 24% | 23% | 24% | 19% | 16% | 10% | 18% | 6% | |
| 2005 | 861,226 | 31% | 32% | 33% | 18% | 13% | 14% | 12% | 9% | 10% |
| 2006 | 862,021 | 28% | 23% | 20% | 15% | 16% | 17% | 12% | 12% | 13% |
| 2007 | 773,138 | 8% | 2% | 4% | | | | | | |
| 2008 | 572,010 | | | | | | | | | |
| 2009 | 464,654 | 8% | 7% | 12% | | | | | | |
| 2010 | 470,405 | 1% | | | | | | | | |
| 2011 | 676,342 | 41% | 38% | 36% | 18% | 13% | 17% | 5% | 3% | 8% |
| Total | 6,409,825 | 18% | 16% | 16% | 9% | 8% | 7% | 6% | 4% | 4% |

Table 4-5. Estimated week of sector-specific pollock fishery closures due to hypothetical Alternative 2 (option 1a) hard caps (column sections) for three different allocation schemes (row sections) for the B season (2003-2011). A blank cell indicates that the fishery would have remained open.

| 2ii (sector | 50,000 | | | | 200,000 | | | | 353,000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| allocation 1) | CDQ | CP | M | S | CDQ | CP | M | S | CDQ | CP | M | S |
| 2003 | 30-Aug | 9-Aug | 2-Aug | 9-Aug | 20-Sep | 4-Oct | 20-Sep | | | | | |
| 2004 | 15-Aug | 13-Jun | 11-Jul | 1-Aug | 12-Sep | 4-Jul | 26-Sep | 5-Sep | | 1-Aug | | 26-Sep |
| 2005 | 16-Aug | 21-Jun | 21-Jun | 5-Jul | 13-Sep | 23-Aug | 23-Aug | 19-Jul | | 30-Aug | 27-Sep | 2-Aug |
| 2006 | | 19-Jul | | 14-Jun | | | | 26-Jul | | | | |
| 2007 | 9-Aug | 28-Jun | 9-Aug | 6-Sep | 11-Oct | 6-Sep | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | | | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 16-Aug | 28-Jun | 21-Jun | 12-Jul | | 23-Aug | 12-Jul | | | 18-Oct | 30-Aug | |
| 4ii (sector | 50,000 | | | | 200,000 | | | | 353,000 | | | |
| allocation 2) | CDQ | CP | M | S | CDQ | CP | M | S | CDQ | CP | M | S |
| 2003 | 6-Sep | 23-Aug | 30-Aug | 9-Aug | | | | 27-Sep | | | | |
| 2004 | 5-Sep | 13-Jun | 1-Aug | 1-Aug | | 1-Aug | 31-Oct | 5-Sep | | | | 12-Sep |
| 2005 | 16-Aug | 16-Aug | 28-Jun | 5-Jul | | 30-Aug | 20-Sep | 19-Jul | | | | 26-Jul |
| 2006 | | 16-Aug | | 14-Jun | | | | 5-Jul | | | | 2-Aug |
| 2007 | 23-Aug | 16-Aug | 23-Aug | 30-Aug | | | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | | 30-Aug | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 18-Oct | 26-Jul | 21-Jun | 5-Jul | | | 16-Aug | | | | 11-Oct | |
| 6 (sector | 50,000 | | | | 200,000 | | | | 353,000 | | | |
| allocation 3) | CDQ | CP | M | S | CDQ | CP | M | S | CDQ | CP | M | S |
| 2003 | 20-Sep | 20-Sep | 6-Sep | 2-Aug | | | | 13-Sep | | | | |
| 2004 | 12-Sep | 20-Jun | 22-Aug | 1-Aug | | 5-Sep | | 22-Aug | | | | 5-Sep |
| 2005 | 23-Aug | 16-Aug | 28-Jun | 28-Jun | | | | 12-Jul | | | | 19-Jul |
| 2006 | | | | 7-Jun | | | | 21-Jun | | | | 26-Jul |
| 2007 | 30-Aug | 30-Aug | 20-Sep | 16-Aug | | | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | | 26-Jul | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | | 2-Aug | 21-Jun | 21-Jun | | | 13-Sep | 6-Sep | | | | |

Table 4-6. Estimated week of sector-specific pollock fishery closures due to hypothetical Alternative 2 (option 1b) hard caps (column sections) for three different allocation schemes (row sections) for the B season (2003-2011). A blank cell indicates that the fishery would have remained open.

| 2ii (sector | 50,000 (15,600) | | | | 200,000 (62,400) | | | | 353,000 (110,136) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| allocation 1) | CDQ | CP | M | S | CDQ | CP | M | S | CDQ | CP | M | S |
| 2003 | 19-Jul | 7-Jun | 19-Jul | 26-Jul | | | | | | | | |
| 2004 | 11-Jul | 6-Jun | 4-Jul | | | 13-Jun | 25-Jul | | | 20-Jun | | |
| 2005 | | 14-Jun | 21-Jun | 28-Jun | | 12-Jul | 21-Jun | 5-Jul | | | 28-Jun | 12-Jul |
| 2006 | | 14-Jun | 19-Jul | 7-Jun | | 19-Jul | | 14-Jun | | | | 21-Jun |
| 2007 | 7-Jun | 7-Jun | 12-Jul | 26-Jul | | 12-Jul | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | 26-Jul | 5-Jul | 26-Jul | | | | | | | | |
| 2010 | | | 19-Jul | | | | | | | | | |
| 2011 | 5-Jul | 21-Jun | 14-Jun | 14-Jun | | 5-Jul | 21-Jun | 19-Jul | | 26-Jul | 21-Jun | |
| 4ii (sector | 50,000 (15,600) | | | | 200,000 (62,400) | | | | 353,000 (110,136) | | | |
| allocation 2) | CDQ | CP | M | S | CDQ | CP | M | S | CDQ | CP | M | S |
| 2003 | | 19-Jul | 19-Jul | 19-Jul | | | | | | | | |
| 2004 | | 13-Jun | 4-Jul | 25-Jul | | 20-Jun | | | | 18-Jul | | |
| 2005 | | 21-Jun | 21-Jun | 21-Jun | | | 28-Jun | 5-Jul | | | | 12-Jul |
| 2006 | | 28-Jun | | 7-Jun | | | | 14-Jun | | | | 21-Jun |
| 2007 | 7-Jun | 7-Jun | 19-Jul | 26-Jul | | | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | 19-Jul | 19-Jul | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 26-Jul | 28-Jun | 14-Jun | 14-Jun | | 26-Jul | 21-Jun | 12-Jul | | | 12-Jul | |
| 6 (sector | 50,000 (15,600) | | | | 200,000 (62,400) | | | | 353,000 (110,136) | | | |
| allocation 3) | CDQ | CP | M | S | CDQ | CP | M | S | CDQ | CP | M | S |
| 2003 | | | 26-Jul | 12-Jul | | | | | | | | |
| 2004 | | 13-Jun | 4-Jul | 25-Jul | | 4-Jul | | | | | | |
| 2005 | | 21-Jun | 21-Jun | 21-Jun | | | 5-Jul | 5-Jul | | | | 5-Jul |
| 2006 | | 19-Jul | | 7-Jun | | | | 7-Jun | | | | 14-Jun |
| 2007 | | 28-Jun | 26-Jul | 5-Jul | | | | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | | 5-Jul | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | | 28-Jun | 14-Jun | 14-Jun | | | 28-Jun | 28-Jun | | | 19-Jul | 19-Jul |

#### 4.2.2.1 An evaluation of transferability of chum salmon among sectors

As noted in methods, the analysis assumes between cooperative transferability. Between sector transferability is evaluated here for Alternative 2, option 1a for illustrative purposes. This option assumes "perfect" transferability in that sectors would exchange allocated chum salmon PSC freely. By year, comparing with and without transferability shows that adding transferability generally increases the amount of forgone pollock and (as shown in chapter 5) reduces the effectiveness of saving chum salmon. (Table 5-80).

Actual transferability options would be initially from sector specific allocations (the analysis above was as if there were no sector allocations) and then in a given year, a "clean" sector could transfer their chum salmon PSC to a sector that requires more. Logically this poses challenges for analysis because the conditions for a transfer would have to be that the “clean” sector would know in advance that they have salmon to transfer to a sector needing more PSC salmon to extend their pollock fishing. Alternatively the clean sector could finish their pollock fishing earlier than the sector needing more PSC salmon and transfer at that time. Simulating either condition would require apriori knowledge about the interaction between sectors which are unknown. Additionally, such a system will add complexity to management and enforcement, and will obviously result in higher salmon bycatch (within a cap) and less foregone pollock.

To provide some evaluation of this option one scenario to for Alternative 2, option 1a) with a cap of 50,000 and sector allocation 6. In 2005 had this scenario been in place all sectors would have come up against their cap so there would be no transfers (with motherships and shorebased CV sectors hitting their cap on the 2$^{nd}$ and 4$^{th}$ of July, respectively). In 2006, shorebased boats would have hit their cap on June 14$^{th}$, and remarkably all other sectors stay below their cap. Assuming somehow that the other sectors would know how much salmon they would catch at the end of the year, then the difference between the remaining salmon and the sum of their caps is 7,645 chum. That amount would not be enough for the shorebased sector to fish even one more day (their initial allocation is 22,385 salmon, on June 13th they went from 13,838 salmon to 30,390). In summary, the idea of transfers would be beneficial in principle; however, “what ifs” evaluations from historical data are limited to illustrate performance benefits.

Table 4-7. showing the pollock foregone by year and sector between the Alternative 2 1a) without transferability (default) and with transferability A subset of estimated sum of chum salmon saved (AEQ) by region and year under 3 different allocation schemes and hard caps for Alternative 2, component 2 **option 1a)**, 2004-2011 with and without transferabilit. The shaded column represents the sum of annual estimated AEQ impact that occurred due to pollock fishing whereas the other values represent the amount (in numbers of fish) that would have been saved had the measures been in place.

| | | **Sector** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | CDQ Transferability? | | CP Transferability? | | M Transferability? | | S Transferability? | |
| Cap | Year | No | Yes | No | Yes | No | Yes | No | Yes |
| | 2003 | 33,787 | 61,451 | 32,926 | 67,320 | 28,469 | 42,436 | 220,230 | 191,720 |
| | 2004 | 51,765 | 77,704 | 289,711 | 132,913 | 50,902 | 51,002 | 204,602 | 231,894 |
| | 2005 | 22,469 | 65,580 | 127,176 | 246,828 | 68,474 | 58,303 | 303,437 | 298,886 |
| | 2006 | | 89,774 | 93,943 | 295,256 | | 74,320 | 360,034 | 338,987 |
| **50,000** | 2007 | 15,434 | 13,128 | 82,889 | 71,579 | 22,808 | 22,092 | 103,343 | 103,475 |
| | 2008 | | | | | | | | |
| | 2009 | | | | | | | 13,558 | |
| | 2010 | | | | | | | | |
| | 2011 | 2,323 | 43,597 | 151,590 | 186,988 | 60,464 | 51,428 | 215,455 | 209,896 |
| | | | | | | | | | |
| | 2003 | | | | | | | 28,381 | |
| | 2004 | | 36,085 | 132,913 | 10,724 | 458 | 24,342 | 95,021 | 95,021 |
| | 2005 | | 46,176 | 65,017 | 203,020 | 12,128 | 43,124 | 264,732 | 245,510 |
| | 2006 | | 30,693 | | 171,807 | | 36,076 | 290,957 | 223,714 |
| **200,000** | 2007 | | | | | | | | |
| | 2008 | | | | | | | | |
| | 2009 | | | | | | | | |
| | 2010 | | | | | | | | |
| | 2011 | | | | | 27,827 | | | |
| | | | | | | | | | |
| | 2003 | | | | | | | | |
| | 2004 | | 21,477 | | 3,336 | | 20,322 | 67,238 | 57,316 |
| | 2005 | | 34,094 | | 156,000 | | 32,341 | 238,356 | 196,470 |
| | 2006 | | | | | | | 201,854 | |
| **353,000** | 2007 | | | | | | | | |
| | 2008 | | | | | | | | |
| | 2009 | | | | | | | | |
| | 2010 | | | | | | | | |
| | 2011 | | | | | 7,574 | | | |

### 4.2.2.2 Significance of Alternative 2 (hard caps) on the pollock resource

Alternative 2 (hard cap) management measures are determined to be insignificant for fishing mortality, spatial distribution, and changes in prey availability. Presently the stock is managed based on science covering a wide variety of facets including the capacity of the stock to yield sustainable biomass on a continuing basis. Spatial and temporal distribution changes in potential impacts are closely monitored by scientificly trained at-sea observers. Regular diet compositions and applications to multispecies ecosystem models are conducted to evaluate changes in predator-prey dynamics. In general, variability in environmental conditions seems to affect stock productivity. However, the modifications under this alternative would have an insignificant effect on the ability to sustainably manage the pollock resource.

### 4.2.3 Alternative 3, trigger closures

#### 4.2.3.1 Components selected for analysis

As presented in Chapter 2, the methods for evaluating accounted for bycatch for all options for the June-July and August-October periods to ensure proper application of stock identification results. The options under Alternative 3 are by size of area closure and period from which closures would take place:

| Option* | Closure area | Period/closure size basis |
|---|---|---|
| 1a) | 80% | B season |
| 1b) | 80% | June-July |
| 2a) | 60% | B season |
| 2b) | 60% | June-July |

*Note staff reorganized components and options under Alternative 3 to be consistent with structure and order under Alternative 2

Options for maintaining efficiency in the amount that normal pollock grounds must be diverted (while still reducing bycatch) is a challenging problem and can vary considerably from year to year. For example there is a fair amount of variability between sectors for a given allocation scheme, cap, and trigger option (Table 4-7 through Table 4-10). Integrated results over years and sectors to compare the relative impact of the options on the pollock fishery show that the lower cap levels and sector allocation scheme 3 have the largest impact on the pollock fishery (Table 4-11). In terms of potential tons of pollock that would be diverted, Option 2a appears to have the lowest impact on pollock fishing among the other trigger closure options given cap and sector allocation scheme (Table 4-12).

The dates that closures Dates of closures across options and sector allocations (and caps: Tables 4-13 through 4-16.

The basis for sector specific differences are from the annual data on pollock catch (t):

| | CDQ | CP | M | CV | Total |
|---|---|---|---|---|---|
| 2003 | 149,121 | 522,428 | 130,564 | 652,243 | 1,454,357 |
| 2004 | 149,173 | 519,570 | 129,222 | 637,971 | 1,435,936 |
| 2005 | 149,715 | 517,699 | 130,669 | 647,853 | 1,445,935 |
| 2006 | 150,482 | 528,009 | 131,404 | 645,614 | 1,455,508 |
| 2007 | 139,336 | 488,543 | 121,514 | 572,745 | 1,322,138 |
| 2008 | 99,964 | 347,233 | 85,359 | 427,759 | 960,314 |
| 2009 | 81,478 | 281,603 | 70,308 | 350,367 | 783,756 |
| 2010 | 81,275 | 282,750 | 70,576 | 351,684 | 786,285 |
| 2011 | 116,978 | 423,680 | 109,856 | 519,093 | 1,169,607 |
| Total | 1,117,522 | 3,911,514 | 979,471 | 4,805,328 | 10,813,836 |

Table 4-8. Hypothetical forgone pollock (percent) based on closures due to Alternative 3 (option 1a) hard caps (column sections) for three different allocation schemes (row sections) for the B season (2003-2011 and relative for all years combined).

| | | | Cap |
|---|---|---|---|
| 2ii (sector allocation 1) | 25,000 | 75,000 | 200,000 |
| 2003 | 25% | 2% | |
| 2004 | 45% | 24% | 12% |
| 2005 | 47% | 27% | 20% |
| 2006 | 40% | 17% | |
| 2007 | 19% | | |
| 2008 | | | |
| 2009 | | | |
| 2010 | | | |
| 2011 | 41% | 12% | 3% |
| All years | 28% | 11% | 5% |
| 4ii (sector allocation 2) | 25,000 | 75,000 | 200,000 |
| 2003 | 22% | 2% | |
| 2004 | 42% | 16% | 5% |
| 2005 | 36% | 24% | 16% |
| 2006 | 31% | 20% | 14% |
| 2007 | 17% | | |
| 2008 | | | |
| 2009 | 2% | | |
| 2010 | | | |
| 2011 | 37% | 2% | 1% |
| All years | 24% | 8% | 5% |
| 6i (sector allocation 3) | 25,000 | 75,000 | 200,000 |
| 2003 | 20% | 5% | |
| 2004 | 39% | 12% | 6% |
| 2005 | 36% | 20% | 18% |
| 2006 | 26% | 23% | 17% |
| 2007 | 15% | | |
| 2008 | | | |
| 2009 | 8% | | |
| 2010 | | | |
| 2011 | 37% | 7% | |
| All years | 23% | 15% | 11% |

Table 4-9. Alternative 3 estimated relative amount of pollock fishing (in percentages of pollock catch biomass) that would be diverted from historical fishing grounds by sector allocation (panels) and trigger cap levels for **Option 1a.**

| | **25,000** | | | | **75,000** | | | | **200,000** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2ii (sector allocation 1)** | | | | | | | | | | | |
| Option 1a) | CDQ | CP | MS | CV | CDQ | CP | MS | CV | CDQ | CP | MS | CV |
| 2003 | 25% | 4% | 15% | 35% | 21% | 2% | 12% | 16% | 8% | | 6% | |
| 2004 | 15% | 16% | 14% | 32% | 13% | 15% | 5% | 24% | 1% | 7% | 0% | 11% |
| 2005 | | 2% | 8% | 37% | | 1% | 4% | 33% | | 1% | | 28% |
| 2006 | | 2% | 0% | 31% | | 0% | | 25% | | | | 17% |
| 2007 | 1% | 3% | 0% | 15% | 1% | 3% | 0% | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | 1% | 7% | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 8% | 6% | 27% | 32% | 5% | 6% | 25% | 19% | | 5% | 19% | |
| | 6% | 4% | 8% | 24% | 5% | 4% | 6% | 15% | 1% | 2% | 3% | 7% |
| | **4ii (sector allocation 2)** | | | | | | | | | | | |
| Option 1a) | CDQ | CP | MS | CV | CDQ | CP | MS | CV | CDQ | CP | MS | CV |
| 2003 | 24% | 3% | 12% | 35% | 8% | 1% | 9% | 24% | | | | 4% |
| 2004 | 14% | 16% | 13% | 32% | 2% | 13% | 4% | 25% | | 4% | | 12% |
| 2005 | | 2% | 8% | 38% | | 1% | 2% | 34% | | 0% | | 29% |
| 2006 | | 0% | | 31% | | | | 26% | | | | 20% |
| 2007 | 1% | 3% | 0% | 16% | 0% | 3% | | 10% | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | 1% | 7% | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 7% | 6% | 27% | 35% | | 5% | 21% | 26% | | | 17% | |
| | 6% | 4% | 7% | 24% | 1% | 3% | 4% | 18% | | 1% | 2% | 9% |
| | **6 (sector allocation 3)** | | | | | | | | | | | |
| Option 1a) | CDQ | CP | MS | CV | CDQ | CP | MS | CV | CDQ | CP | MS | CV |
| 2003 | 21% | 2% | 12% | 38% | 1% | | 8% | 31% | | | | 9% |
| 2004 | 13% | 15% | 10% | 32% | 0% | 5% | 0% | 28% | | 0% | | 21% |
| 2005 | | 1% | 7% | 41% | | 1% | | 34% | | | | 33% |
| 2006 | | 0% | | 31% | | | | 29% | | | | 25% |
| 2007 | 1% | 3% | 0% | 17% | | | | 13% | | | | |
| 2008 | | | | 3% | | | | | | | | |
| 2009 | | | | 7% | | | | 3% | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 5% | 5% | 26% | 36% | | 4% | 21% | 28% | | | 13% | 11% |
| | 5% | 4% | 7% | 26% | 0% | 1% | 4% | 21% | | 0% | 1% | 13% |

Table 4-10. Alternative 3 estimated relative amount of pollock fishing (in percentages of pollock catch biomass) that would be diverted from historical fishing grounds by sector allocation (panels) and trigger cap levels for **Option 1b.**

| | 25,000 | | | | 75,000 | | | | 200,000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2ii (sector allocation 1)** | | | | | | | | | | | |
| Option 1b) | CDQ | CP | MS | CV | CDQ | CP | MS | CV | CDQ | CP | MS | CV |
| 2003 | 0% | 1% | 5% | 4% | | | 1% | | | | | |
| 2004 | 4% | 7% | 10% | 2% | 1% | 7% | 8% | | | 7% | 2% | |
| 2005 | | 1% | 8% | 19% | | 1% | 8% | 14% | | 0% | 7% | 11% |
| 2006 | 0% | 2% | | 14% | | 1% | | 14% | | 0% | | 9% |
| 2007 | | 0% | 1% | 1% | | | 0% | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | 0% | 3% | 4% | | | | 0% | | | | |
| 2010 | | | 5% | | | | | | | | | |
| 2011 | 3% | 2% | 15% | 17% | 1% | 2% | 14% | 12% | | 2% | 13% | 4% |
| | 1% | 2% | 5% | 7% | 0% | 1% | 4% | 5% | | 1% | 3% | 3% |
| | **4ii (sector allocation 2)** | | | | | | | | | | | |
| Option 1b) | CDQ | CP | MS | CV | CDQ | CP | MS | CV | CDQ | CP | MS | CV |
| 2003 | | 0% | 5% | 5% | | | | | | | | |
| 2004 | 2% | 7% | 10% | 5% | | 7% | 7% | | | 5% | | |
| 2005 | | 1% | 8% | 19% | | 0% | 8% | 15% | | | 4% | 11% |
| 2006 | | 1% | | 15% | | 1% | | 14% | | | | 12% |
| 2007 | | 0% | 1% | 2% | | | | | | | | |
| 2008 | | | | 0% | | | | | | | | |
| 2009 | | | 1% | 4% | | | | 0% | | | | |
| 2010 | | | 2% | 2% | | | | | | | | |
| 2011 | 3% | 2% | 15% | 17% | | 2% | 14% | 13% | | 0% | 11% | 5% |
| | 1% | 2% | 5% | 8% | | 1% | 4% | 5% | | 1% | 2% | 4% |
| | **6 (sector allocation 3)** | | | | | | | | | | | |
| Option 1b) | CDQ | CP | MS | CV | CDQ | CP | MS | CV | CDQ | CP | MS | CV |
| 2003 | | | 5% | 7% | | | | 2% | | | | |
| 2004 | 1% | 7% | 8% | 8% | | 6% | 5% | 1% | | 2% | | |
| 2005 | | 1% | 8% | 21% | | | 7% | 17% | | | | 12% |
| 2006 | | 1% | | 15% | | 0% | | 14% | | | | 14% |
| 2007 | | | 0% | 3% | | | | 0% | | | | |
| 2008 | | | | 2% | | | | | | | | |
| 2009 | | | 1% | 6% | | | | 1% | | | | |
| 2010 | | | | 4% | | | | | | | | |
| 2011 | 1% | 2% | 15% | 17% | | 2% | 13% | 15% | | | 8% | 8% |
| | 0% | 1% | 5% | 10% | | 1% | 3% | 6% | | 0% | 1% | 4% |

Table 4-11. Alternative 3 estimated relative amount of pollock fishing (in percentages of pollock catch biomass) that would be diverted from historical fishing grounds by sector allocation (panels) and trigger cap levels for **Option 2a.**

| | 25,000 | | | | 75,000 | | | | 200,000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2ii (sector allocation 1)** | | | | | | | | | | | |
| Option 2a) | CDQ | CP | MS | CV | CDQ | CP | MS | CV | CDQ | CP | MS | CV |
| 2003 | 19% | 4% | 8% | 23% | 15% | 2% | 8% | 8% | 8% | | 6% | |
| 2004 | 8% | 11% | 7% | 19% | 7% | 11% | 1% | 14% | 1% | 6% | 0% | 8% |
| 2005 | | 1% | 5% | 27% | | 1% | 2% | 25% | | 0% | | 20% |
| 2006 | | 1% | 0% | 24% | | 0% | | 19% | | | | 13% |
| 2007 | 1% | 3% | 0% | 12% | 1% | 3% | 0% | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | 1% | 4% | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 7% | 5% | 19% | 20% | 4% | 5% | 18% | 11% | | 4% | 13% | |
| | 5% | 3% | 5% | 16% | 3% | 3% | 3% | 10% | 1% | 1% | 2% | 6% |
| | **4ii (sector allocation 2)** | | | | | | | | | | | |
| Option 2a) | CDQ | CP | MS | CV | CDQ | CP | MS | CV | CDQ | CP | MS | CV |
| 2003 | 18% | 2% | 8% | 23% | 8% | 1% | 8% | 13% | | | | 3% |
| 2004 | 7% | 11% | 6% | 19% | 1% | 9% | 1% | 14% | | 3% | | 9% |
| 2005 | | 1% | 5% | 28% | | 0% | 2% | 25% | | 0% | | 22% |
| 2006 | | 0% | | 24% | | | | 20% | | | | 16% |
| 2007 | 1% | 3% | 0% | 12% | 0% | 3% | | 9% | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | | 1% | 4% | | | | | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 6% | 5% | 19% | 20% | | 5% | 15% | 15% | | | 12% | |
| | 4% | 3% | 5% | 16% | 1% | 2% | 3% | 12% | | 0% | 1% | 7% |
| | **6 (sector allocation 3)** | | | | | | | | | | | |
| Option 2a) | CDQ | CP | MS | CV | CDQ | CP | MS | CV | CDQ | CP | MS | CV |
| 2003 | 15% | 2% | 8% | 24% | 1% | | 8% | 19% | | | | 6% |
| 2004 | 7% | 11% | 3% | 19% | 0% | 4% | 0% | 17% | | 0% | | 12% |
| 2005 | | 0% | 5% | 30% | | 0% | | 25% | | | | 25% |
| 2006 | | 0% | | 24% | | | | 22% | | | | 19% |
| 2007 | 1% | 3% | 0% | 12% | | | | 11% | | | | |
| 2008 | | | | 2% | | | | | | | | |
| 2009 | | | | 4% | | | | 1% | | | | |
| 2010 | | | | | | | | | | | | |
| 2011 | 4% | 5% | 18% | 22% | | 4% | 15% | 17% | | | 8% | 8% |
| | 3% | 3% | 4% | 17% | 0% | 1% | 3% | 15% | | 0% | 1% | 9% |

Table 4-12. Alternative 3 estimated relative amount of pollock fishing (in percentages of pollock catch biomass) that would be diverted from historical fishing grounds by sector allocation (panels) and trigger cap levels for **Option 2b.**

| | 25,000 | | | | 75,000 | | | | 200,000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2ii (sector allocation 1)** | | | | | | | | | | | |
| Option 2b) | CDQ | CP | MS | CV | CDQ | CP | MS | CV | CDQ | CP | MS | CV |
| 2003 | | 0% | 5% | 4% | | | 1% | | | | | |
| 2004 | 3% | 5% | 8% | 2% | 1% | 5% | 5% | | | 5% | 2% | |
| 2005 | | 0% | 7% | 14% | | 0% | 7% | 10% | | 0% | 7% | 7% |
| 2006 | | 1% | | 10% | | 1% | | 10% | | | | 6% |
| 2007 | | | 0% | 1% | | | 0% | | | | | |
| 2008 | | | | | | | | | | | | |
| 2009 | | 0% | 2% | 3% | | | | 0% | | | | |
| 2010 | | | 5% | | | | | | | | | |
| 2011 | 0% | 0% | 7% | 9% | 0% | 0% | 7% | 6% | | 0% | 6% | 2% |
| | 0% | 1% | 4% | 5% | 0% | 1% | 3% | 3% | | 1% | 2% | 2% |
| | **4ii (sector allocation 2)** | | | | | | | | | | | |
| Option 2b) | CDQ | CP | MS | CV | CDQ | CP | MS | CV | CDQ | CP | MS | CV |
| 2003 | | | 5% | 5% | | | | | | | | |
| 2004 | 2% | 5% | 8% | 5% | | 5% | 5% | | | 4% | | |
| 2005 | | 0% | 7% | 14% | | 0% | 7% | 10% | | | 4% | 7% |
| 2006 | | 1% | | 11% | | 0% | | 10% | | | | 8% |
| 2007 | | | 0% | 1% | | | | | | | | |
| 2008 | | | | 0% | | | | | | | | |
| 2009 | | | 1% | 3% | | | | 0% | | | | |
| 2010 | | | 2% | 1% | | | | | | | | |
| 2011 | 0% | 0% | 7% | 9% | | 0% | 7% | 6% | | | 6% | 2% |
| | 0% | 1% | 4% | 6% | | 1% | 2% | 3% | | 1% | 1% | 2% |
| | **6 (sector allocation 3)** | | | | | | | | | | | |
| Option 2b) | CDQ | CP | MS | CV | CDQ | CP | MS | CV | CDQ | CP | MS | CV |
| 2003 | | | 5% | 7% | | | | 2% | | | | |
| 2004 | 1% | 5% | 7% | 7% | | 5% | 5% | 1% | | 1% | | |
| 2005 | | 0% | 7% | 16% | | | 7% | 12% | | | | 8% |
| 2006 | | 1% | | 11% | | | | 10% | | | | 10% |
| 2007 | | | 0% | 2% | | | | 0% | | | | |
| 2008 | | | | 1% | | | | | | | | |
| 2009 | | | 1% | 5% | | | | 1% | | | | |
| 2010 | | | | 2% | | | | | | | | |
| 2011 | 0% | 0% | 7% | 9% | | 0% | 6% | 9% | | | 2% | 4% |
| | 0% | 1% | 3% | 7% | | 1% | 2% | 4% | | 0% | 0% | 3% |

Table 4-13. Average proportion of pollock catch that would be estimated to be diverted from closed areas for different cap, sector allocations, and trigger options summarizing over years and sectors.

| | Cap | | |
|---|---|---|---|
| **2ii (sector allocation 1)** | 25,000 | 75,000 | 200,000 |
| Option 1a) | 13.54% | 9.05% | 4.29% |
| Option 1b) | 4.49% | 3.15% | 2.03% |
| Option 2a) | 9.39% | 6.15% | 3.28% |
| Option 2b) | 3.07% | 2.04% | 1.28% |
| **4ii (sector allocation 2)** | 25,000 | 75,000 | 200,000 |
| Option 1a) | 13.49% | 9.80% | 4.24% |
| Option 1b) | 4.83% | 3.13% | 2.02% |
| Option 2a) | 9.23% | 6.73% | 3.22% |
| Option 2b) | 3.42% | 2.01% | 1.30% |
| **6 (sector allocation 3)** | 25,000 | 75,000 | 200,000 |
| Option 1a) | 13.82% | 10.20% | 5.92% |
| Option 1b) | 5.38% | 3.50% | 2.11% |
| Option 2a) | 9.43% | 7.09% | 4.24% |
| Option 2b) | 3.90% | 2.44% | 1.33% |

Table 4-14. Amount of pollock catch (t) that is estimated to be diverted from closed areas for different cap, sector allocations, and **trigger** options summing over years (2003-2011; nine years) and sectors for Alternative 3.

| | Cap | | |
|---|---|---|---|
| **2ii (sector allocation 1)** | 25,000 | 75,000 | 200,000 |
| Option 1a) | 1,464,475 | 978,341 | 463,378 |
| Option 1b) | 485,981 | 340,741 | 220,045 |
| Option 2a) | 1,015,216 | 664,930 | 355,078 |
| Option 2b) | 331,705 | 220,643 | 137,894 |
| **4ii (sector allocation 2)** | 25,000 | 75,000 | 200,000 |
| Option 1a) | 1,458,413 | 1,059,299 | 458,224 |
| Option 1b) | 522,420 | 338,677 | 218,619 |
| Option 2a) | 998,657 | 727,321 | 348,035 |
| Option 2b) | 369,519 | 217,727 | 140,267 |
| **6 (sector allocation 3)** | 25,000 | 75,000 | 200,000 |
| Option 1a) | 1,494,469 | 1,103,155 | 639,949 |
| Option 1b) | 581,864 | 378,881 | 228,162 |
| Option 2a) | 1,020,035 | 766,407 | 458,926 |
| Option 2b) | 422,188 | 264,110 | 143,453 |

Table 4-15. Alternative 3 component 2 closure dates by sector and allocation scheme for each of the 4 options (1a, 1b, 2a, and 2b) for the **25,000 cap** level.

| | | CDQ Allocation | | | CP Allocation | | | M Allocation | | | S Allocation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Opt | Year | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| 1a) | 2003 | 27-Aug | 3-Sep | 10-Sep | 6-Aug | 27-Aug | 27-Aug | 30-Jul | 30-Jul | 20-Aug | 30-Jul | 30-Jul | 23-Jul |
| | 2004 | 22-Jul | 19-Aug | 26-Aug | 17-Jun | 17-Jun | 17-Jun | 8-Jul | 15-Jul | 22-Jul | 29-Jul | 29-Jul | 29-Jul |
| | 2005 | | | | 25-Jun | 25-Jun | 6-Aug | 25-Jun | 25-Jun | 25-Jun | 2-Jul | 25-Jun | 25-Jun |
| | 2006 | | | | 2-Jul | 23-Jul | 30-Jul | 20-Aug | | | 11-Jun | 11-Jun | 11-Jun |
| | 2007 | 20-Aug | 20-Aug | 27-Aug | 13-Aug | 20-Aug | 20-Aug | 23-Jul | 13-Aug | 13-Aug | 20-Aug | 13-Aug | 6-Aug |
| | 2008 | | | | | | | | | | | | 16-Sep |
| | 2009 | | | | | | | 23-Jul | 6-Aug | | 30-Jul | 30-Jul | 23-Jul |
| | 2010 | | | | | | | | | | | | |
| | 2011 | 23-Jul | 20-Aug | 1-Oct | 25-Jun | 2-Jul | 16-Jul | 18-Jun | 18-Jun | 18-Jun | 25-Jun | 18-Jun | 18-Jun |
| 1b) | 2003 | 16-Jul | | | 2-Jul | 30-Jul | | 23-Jul | 23-Jul | 23-Jul | 16-Jul | 9-Jul | 9-Jul |
| | 2004 | 15-Jul | 15-Jul | 22-Jul | 10-Jun | 10-Jun | 17-Jun | 1-Jul | 1-Jul | 8-Jul | 29-Jul | 22-Jul | 15-Jul |
| | 2005 | | | | 18-Jun | 18-Jun | 25-Jun | 25-Jun | 25-Jun | 25-Jun | 25-Jun | 25-Jun | 18-Jun |
| | 2006 | 16-Jul | | | 11-Jun | 25-Jun | 2-Jul | 16-Jul | 23-Jul | 30-Jul | 11-Jun | | |
| | 2007 | 9-Jul | | | 2-Jul | 16-Jul | | 2-Jul | 2-Jul | 16-Jul | 23-Jul | 9-Jul | 2-Jul |
| | 2008 | | | | | | | | | | | 29-Jul | 8-Jul |
| | 2009 | | | | 16-Jul | | | 25-Jun | 2-Jul | 9-Jul | 9-Jul | 9-Jul | 2-Jul |
| | 2010 | | | | 23-Jul | | | 16-Jul | 16-Jul | 30-Jul | | 30-Jul | 23-Jul |
| | 2011 | 2-Jul | 9-Jul | 23-Jul | 25-Jun | 25-Jun | 25-Jun | 18-Jun | 18-Jun | 18-Jun | 18-Jun | 18-Jun | 18-Jun |
| 2a) | 2003 | 27-Aug | 3-Sep | 10-Sep | 6-Aug | 27-Aug | 27-Aug | 30-Jul | 30-Jul | 20-Aug | 30-Jul | 30-Jul | 23-Jul |
| | 2004 | 22-Jul | 19-Aug | 26-Aug | 17-Jun | 17-Jun | 17-Jun | 8-Jul | 15-Jul | 22-Jul | 29-Jul | 29-Jul | 29-Jul |
| | 2005 | | | | 25-Jun | 25-Jun | 6-Aug | 25-Jun | 25-Jun | 25-Jun | 2-Jul | 25-Jun | 25-Jun |
| | 2006 | | | | 2-Jul | 23-Jul | 30-Jul | 20-Aug | | | 11-Jun | 11-Jun | 11-Jun |
| | 2007 | 20-Aug | 20-Aug | 27-Aug | 13-Aug | 20-Aug | 20-Aug | 23-Jul | 13-Aug | 13-Aug | 20-Aug | 13-Aug | 6-Aug |
| | 2008 | | | | | | | | | | | | 16-Sep |
| | 2009 | | | | | | | 23-Jul | 6-Aug | | 30-Jul | 30-Jul | 23-Jul |
| | 2010 | | | | | | | | | | | | |
| | 2011 | 23-Jul | 20-Aug | 1-Oct | 25-Jun | 2-Jul | 16-Jul | 18-Jun | 18-Jun | 18-Jun | 25-Jun | 18-Jun | 18-Jun |
| 2b) | 2003 | 16-Jul | | | 2-Jul | 30-Jul | | 23-Jul | 23-Jul | 23-Jul | 16-Jul | 9-Jul | 9-Jul |
| | 2004 | 15-Jul | 15-Jul | 22-Jul | 10-Jun | 10-Jun | 17-Jun | 1-Jul | 1-Jul | 8-Jul | 29-Jul | 22-Jul | 15-Jul |
| | 2005 | | | | 18-Jun | 18-Jun | 25-Jun | 25-Jun | 25-Jun | 25-Jun | 25-Jun | 25-Jun | 18-Jun |
| | 2006 | 16-Jul | | | 11-Jun | 25-Jun | 2-Jul | 16-Jul | 23-Jul | 30-Jul | 11-Jun | | |
| | 2007 | 9-Jul | | | 2-Jul | 16-Jul | | 2-Jul | 2-Jul | 16-Jul | 23-Jul | 9-Jul | 2-Jul |
| | 2008 | | | | | | | | | | | 29-Jul | 8-Jul |
| | 2009 | | | | 16-Jul | | | 25-Jun | 2-Jul | 9-Jul | 9-Jul | 9-Jul | 2-Jul |
| | 2010 | | | | 23-Jul | | | 16-Jul | 16-Jul | 30-Jul | | 30-Jul | 23-Jul |
| | 2011 | 2-Jul | 9-Jul | 23-Jul | 25-Jun | 25-Jun | 25-Jun | 18-Jun | 18-Jun | 18-Jun | 18-Jun | 18-Jun | 18-Jun |

Table 4-16. Alternative 3 component 2 closure dates by sector and allocation scheme for each of the 4 options (1a, 1b, 2a, and 2b) for the **75,000 cap** level.

| | | CDQ Allocation | | | CP Allocation | | | M Allocation | | | S Allocation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Opt | Year | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| | 2003 | 10-Sep | 24-Sep | 1-Oct | 27-Aug | 1-Oct | | 3-Sep | 10-Sep | 17-Sep | 3-Sep | 20-Aug | 6-Aug |
| | 2004 | 26-Aug | 16-Sep | 23-Sep | 17-Jun | 24-Jun | 22-Jul | 5-Aug | 2-Sep | 23-Sep | 12-Aug | 12-Aug | 5-Aug |
| | 2005 | | | | 6-Aug | 20-Aug | 27-Aug | 2-Jul | 2-Jul | | 9-Jul | 9-Jul | 9-Jul |
| | 2006 | | | | 30-Jul | | | | | | 25-Jun | 18-Jun | 11-Jun |
| 1a) | 2007 | 27-Aug | 24-Sep | | 20-Aug | 3-Sep | | 27-Aug | | | | 17-Sep | 3-Sep |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | 10-Sep |
| | 2010 | | | | | | | | | | | | |
| | 2011 | 1-Oct | | | 16-Jul | 6-Aug | 10-Sep | 25-Jun | 2-Jul | 2-Jul | 13-Aug | 16-Jul | 9-Jul |
| | 2003 | | | | | | | 30-Jul | 30-Jul | | 30-Jul | 30-Jul | 23-Jul |
| | 2004 | 22-Jul | | | 17-Jun | 17-Jun | 17-Jun | 8-Jul | 8-Jul | 15-Jul | 29-Jul | 29-Jul | 29-Jul |
| | 2005 | | | | 25-Jun | 25-Jun | | 25-Jun | 25-Jun | 25-Jun | 2-Jul | 25-Jun | 25-Jun |
| | 2006 | | | | 2-Jul | 23-Jul | 30-Jul | | | | 11-Jun | 11-Jun | 11-Jun |
| 1b) | 2007 | | | | | | | 23-Jul | | | | | 30-Jul |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | 16-Jul | | | 30-Jul | 30-Jul | 23-Jul |
| | 2010 | | | | | | | | | | | | |
| | 2011 | 16-Jul | | | 25-Jun | 2-Jul | 16-Jul | 18-Jun | 18-Jun | 18-Jun | 25-Jun | 18-Jun | 18-Jun |
| | 2003 | 10-Sep | 24-Sep | 1-Oct | 27-Aug | 1-Oct | | 3-Sep | 10-Sep | 17-Sep | 3-Sep | 20-Aug | 6-Aug |
| | 2004 | 26-Aug | 16-Sep | 23-Sep | 17-Jun | 24-Jun | 22-Jul | 5-Aug | 2-Sep | 23-Sep | 12-Aug | 12-Aug | 5-Aug |
| | 2005 | | | | 6-Aug | 20-Aug | 27-Aug | 2-Jul | 2-Jul | | 9-Jul | 9-Jul | 9-Jul |
| | 2006 | | | | 30-Jul | | | | | | 25-Jun | 18-Jun | 11-Jun |
| 2a) | 2007 | 27-Aug | 24-Sep | | 20-Aug | 3-Sep | | 27-Aug | | | | 17-Sep | 3-Sep |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | 10-Sep |
| | 2010 | | | | | | | | | | | | |
| | 2011 | 1-Oct | | | 16-Jul | 6-Aug | 10-Sep | 25-Jun | 2-Jul | 2-Jul | 13-Aug | 16-Jul | 9-Jul |
| | 2003 | | | | | | | 30-Jul | 30-Jul | | 30-Jul | 30-Jul | 23-Jul |
| | 2004 | 22-Jul | | | 17-Jun | 17-Jun | 17-Jun | 8-Jul | 8-Jul | 15-Jul | 29-Jul | 29-Jul | 29-Jul |
| | 2005 | | | | 25-Jun | 25-Jun | | 25-Jun | 25-Jun | 25-Jun | 2-Jul | 25-Jun | 25-Jun |
| | 2006 | | | | 2-Jul | 23-Jul | | | | | 11-Jun | 11-Jun | 11-Jun |
| 2b) | 2007 | | | | | | | 23-Jul | | | | | 30-Jul |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | 30-Jul | 30-Jul | 23-Jul |
| | 2010 | | | | | | | | | | | | |
| | 2011 | 16-Jul | | | 25-Jun | 2-Jul | 16-Jul | 18-Jun | 18-Jun | 18-Jun | 25-Jun | 18-Jun | 18-Jun |

Table 4-17. Alternative 3 component 2 closure dates by sector and allocation scheme for each of the 4 options (1a, 1b, 2a, and 2b) for the **200,000 cap** level.

| | | CDQ Allocation | | | CP Allocation | | | M Allocation | | | S Allocation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Opt | Year | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| | 2003 | 24-Sep | | | | | | 24-Sep | | | | 1-Oct | 17-Sep |
| | 2004 | 16-Sep | | | 8-Jul | 29-Jul | 9-Sep | 30-Sep | | | 9-Sep | 2-Sep | 19-Aug |
| | 2005 | | | | 20-Aug | 3-Sep | | | | | 23-Jul | 16-Jul | 9-Jul |
| | 2006 | | | | | | | | | | 30-Jul | 9-Jul | 25-Jun |
| 1a) | 2007 | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | |
| | 2011 | | | | 27-Aug | | | 16-Jul | 20-Aug | 17-Sep | | | 10-Sep |
| | 2003 | | | | | | | | | | | | |
| | 2004 | | | | 17-Jun | 24-Jun | 8-Jul | 29-Jul | | | | | |
| | 2005 | | | | 23-Jul | | | 25-Jun | 2-Jul | | 9-Jul | 9-Jul | 9-Jul |
| | 2006 | | | | 30-Jul | | | | | | 18-Jun | 11-Jun | 11-Jun |
| 1b) | 2007 | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | |
| | 2011 | | | | 9-Jul | 30-Jul | | 18-Jun | 25-Jun | 2-Jul | 16-Jul | 16-Jul | 2-Jul |
| | 2003 | 24-Sep | | | | | | 24-Sep | | | | 1-Oct | 17-Sep |
| | 2004 | 16-Sep | | | 8-Jul | 29-Jul | 9-Sep | 30-Sep | | | 9-Sep | 2-Sep | 19-Aug |
| | 2005 | | | | 20-Aug | 3-Sep | | | | | 23-Jul | 16-Jul | 9-Jul |
| | 2006 | | | | | | | | | | 30-Jul | 9-Jul | 25-Jun |
| 2a) | 2007 | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | |
| | 2011 | | | | 27-Aug | | | 16-Jul | 20-Aug | 17-Sep | | | 10-Sep |
| | 2003 | | | | | | | | | | | | |
| | 2004 | | | | 17-Jun | 24-Jun | 8-Jul | 29-Jul | | | | | |
| | 2005 | | | | 23-Jul | | | 25-Jun | 2-Jul | | 9-Jul | 9-Jul | 9-Jul |
| | 2006 | | | | | | | | | | 18-Jun | 11-Jun | 11-Jun |
| 2b) | 2007 | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | |
| | 2011 | | | | 9-Jul | 30-Jul | | 18-Jun | 25-Jun | 2-Jul | 16-Jul | 16-Jul | 2-Jul |

### 4.2.3.2 Effect of chum closures on size distribution of pollock

As with the evaluation of hard caps presented above, the same impacts under triggered closures would apply. Namely that it seems likely that the fleet would fish earlier in the summer season and would tend to fish in places further away from the core fishing grounds north of Unimak Island. Both of these effects have would appear to result in catches of pollock that were considerably smaller in mean sizes-at-age. NMFS at-sea observer length frequency data of pollock fishery was compiled inside of candidate chum closure areas (which vary by month based on the 50% closure scenario) and compared to length frequency outside of the areas based 1999-2010 for the months June-October (Table 4-11). The length frequency distribution for pollock found outside these areas is substantially smaller with a mean length of 45.7 cm outside compared to 49.4 cm inside area closures (Figure 4-5). The implication of this difference is that based on mean B-season fishery weights at length, inside the closure areas would require about 1,078 individual pollock to make up one ton of catch whereas outside the closure areas, 24% more pollock (or 1,334 pollock) would be required to make up one ton of pollock catch.

Because this fishery is extensively monitored, the consequences of possibly catching smaller fish due to this alternative would be accounted for in the procedures for setting ABC and OFL. Namely, that as the “selectivity” of the fishery shifts, then the impact on allowable catch levels would be adjusted appropriately so as to avoid overfishing.

#### 4.2.3.3 Pollock fishery inside and outside of closure areas

Analysis of the 33 months from 2003-2010 B-season data, the trigger closure areas (at 50% level) resulted in 11 months having *worse* fishing outside of the areas (outside CPUE is 80% on average of CPUE inside) for **shore-based catcher vessels**. The other 22 months (two thirds of the data) fishing by this sector was *better* outside of the closure areas (outside closure areas was 143% better than inside). Note that this approach assumes homogeneity among vessels fishing inside and outside of closure areas since vessel effects were ignored.

For **at-sea catcher processors**, 22 months of 2003-2010 for B-season data were available for this comparison. Using the 50% trigger closure areas, only 4 of these months had *worse* fishing outside of the areas (outside CPUE is 66% on average of CPUE inside). The other 17 months (77% of the time) fishing was *better* outside of the closure areas (outside closure area was 184% better than inside).

Computing a mean distance (from a point about mid-way between Akutan and Dutch harbor (54°N 166.2°W ) for all shore-based catcher-vessels can provide some insights on the potential effect of enacting the monthly closures using historical data. For example, the differences in distance due to closures indicate a 7% increase distance from “port” based on 2003-2010 data (Figure 4-6). By month, the apparent effect of closures becomes greater later in the B-season (Table 4-12). This suggests another intuitive impact on the pollock fishery (i.e., that area closures will likely result in increased fuel costs and travel times).

#### 4.2.3.4 Significance of Alternative 3 (area closures) on the pollock resource

Alternative 3 (area closures) management measures are determined to be insignificant for fishing mortality, spatial distribution, and changes in prey availability. Presently the stock is managed based on science covering a wide variety of facets including the capacity of the stock to yield sustainable biomass on a continuing basis. Spatial and temporal distribution changes in potential impacts are closely monitored by scientificly trained at-sea observers. Regular diet compositions and applications to multispecies ecosystem models are conducted to evaluate changes in predator-prey dynamics. In general, variability in environmental conditions seems to affect stock productivity. However, the modifications under this alternative would have an insignificant effect on the ability to sustainably manage the pollock resource. Any changes in the size composition of the catch would be monitored and reflected in future ABC recommendations.

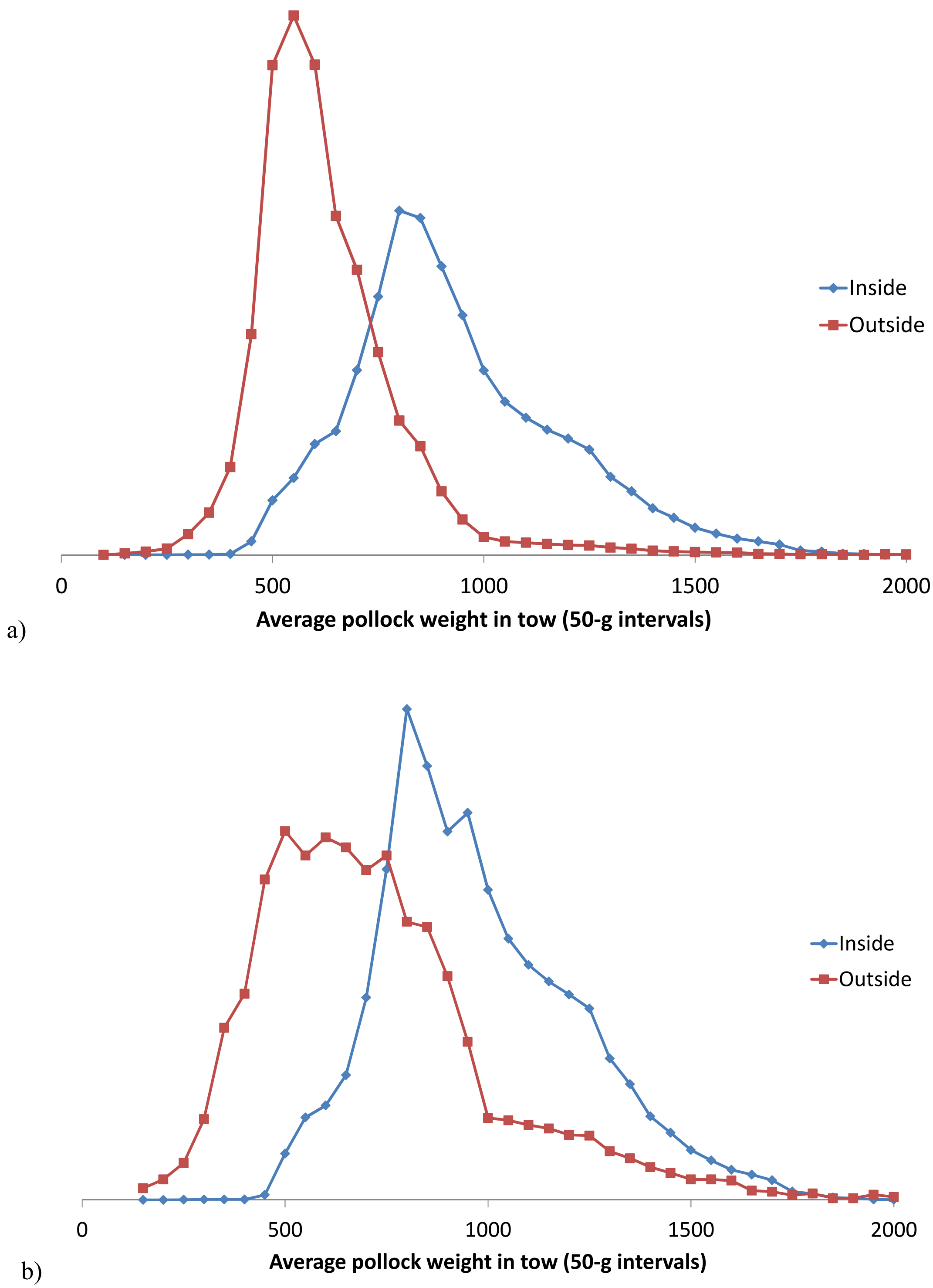
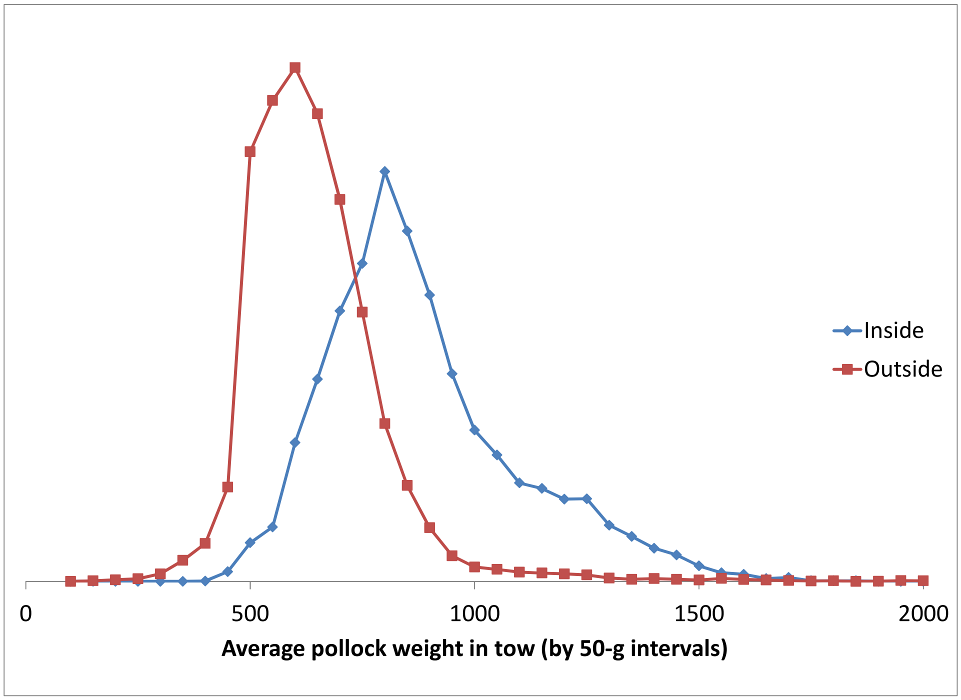
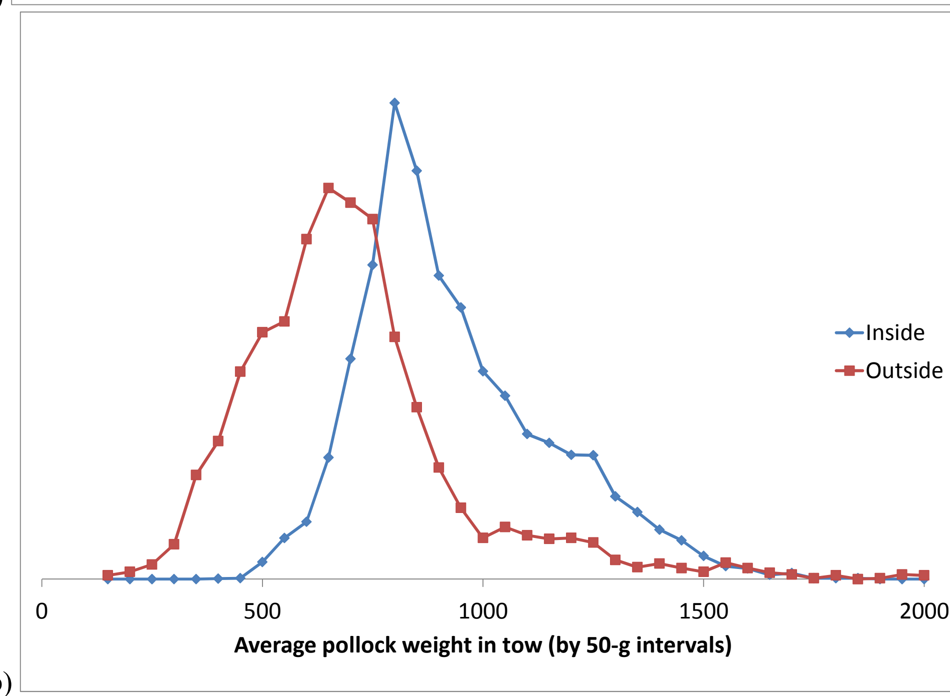



Figure 4-5. Pollock fishery weight frequency inside of 80% chum closure area (for option 1a) for the entire fleet (top) and just the shore-based catcher boat sector (bottom) based on NMFS observer data from 2003-2011 for the months June-October.




a)




b)

Figure 4-6. Pollock fishery weight frequency inside of 80% chum closure area (for option 1a) for the entire fleet (top) and just the shore-based catcher boat sector (bottom) based on NMFS observer data from 2003-2011 for the months June-July only.

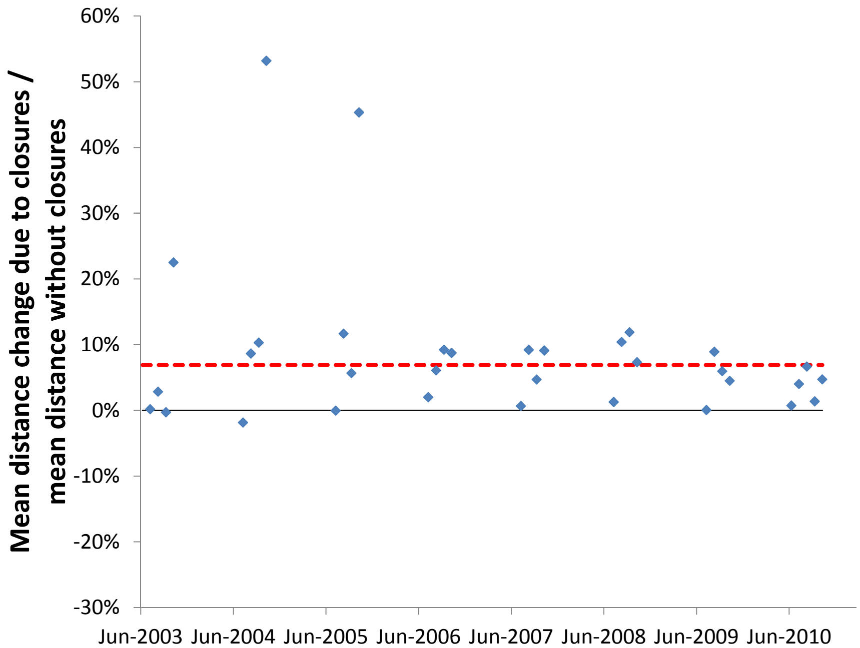



Figure 4-7. Mean distance of all shore-based catcher vessels from 54°N 166.2°W by B-season month expressed as a ratio of difference with closures divided by mean distance without closures, 2003-2010. Dashed line represents overall mean of 7% (i.e., closures result in average increased distance from port by about 7%.

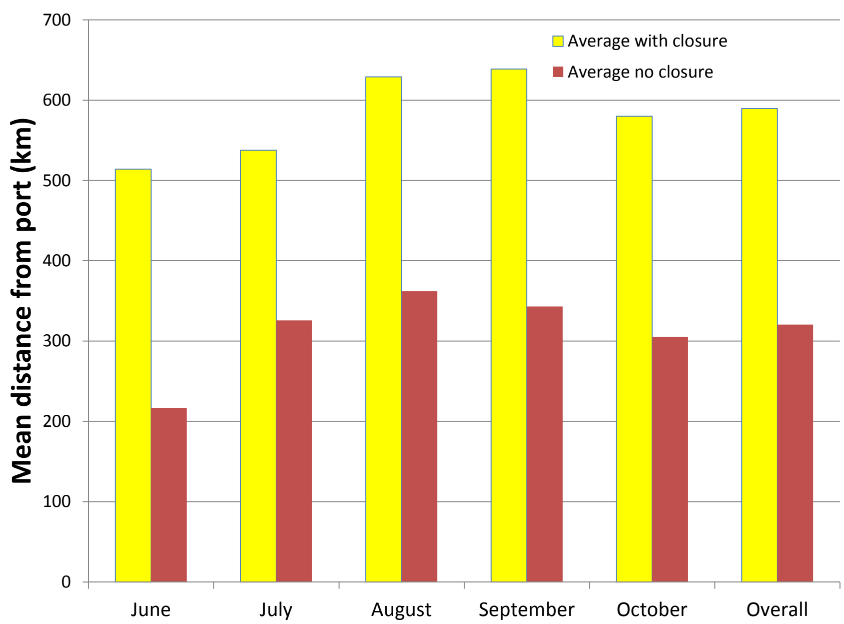



Figure 4-8. Mean distance of all shore-based catcher vessels from 54°N 166.2°W by B-season month, 2003-2011 for Alternative 3 80% large area closures XX (needs updating for 2011 data).

# 5 Chum Salmon

## 5.1 Overview of Chum salmon biology and distribution

Information on chum salmon may be found at the ADF&G website:
www.adfg.state.ak.us/pubs/notebook/fish/chum.php.

Chum salmon have the widest distribution of any of the Pacific salmon species. They range south to the Sacramento River in California and the island of Kyushu in the Sea of Japan. In the north they range east in the Arctic Ocean to the Mackenzie River in Canada and west to the Lena River in Siberia.

Chum salmon often spawn in small side channels and other areas of large rivers where upwelling springs provide excellent conditions for egg survival. They also spawn in many of the same places as do pink salmon (i.e., small streams and intertidal zones). Some chum in the Yukon River travel over 2,000 miles to spawn in the Yukon Territory. These have the brightest color and possess the highest oil content of any chum salmon when they begin their upstream journey. Chum salmon spawning is typical of Pacific salmon with the eggs deposited in redds located primarily in upwelling spring areas of streams.

Chum salmon do not have a period of freshwater residence after emergence of the fry as do Chinook, coho, and sockeye salmon. Chum fry feed on small insects in the stream and estuary before forming into schools in salt water where their diet usually consists of zooplankton. By fall they move out into the Bering Sea and Gulf of Alaska where they spend two or more of the winters of their three to six year lives. In southeastern Alaska most chum salmon mature at four years of age, although there is considerable variation in age at maturity between streams. There is also a higher percentage of chums in the northern areas of the state. Chum salmon vary in size from four to over thirty pounds, but usually range from seven to eighteen pounds, with females generally smaller than males.

Chum salmon are the most abundant commercially harvested salmon species in arctic, northwestern, and Interior Alaska. They are known locally as ‘dog salmon’ and are an important year-round source of fresh and dried fish for subsistence and personal use purposes, but are of relatively less importance in other areas of the state. Sport fishermen generally capture chum salmon incidental to fishing for other Pacific salmon in either fresh or salt water. After entering fresh water, chums are most often prepared as smoked product. In the commercial fishery, most chum salmon are caught by purse seines and drift gillnets, but troll gear and set gillnets harvest a portion of the catch as well. In many areas they have been harvested incidental to the catch of pink salmon. The development of markets for ikura (roe) and fresh and frozen chum in Japan and northern Europe has increased their demand.

Because chum salmon are generally caught incidental to other species, catches may not be good indicators of abundance. In recent years chum salmon catch in many areas has been depressed by low prices. Directed chum salmon fisheries occur in Arctic-Yukon-Kuskokwim area and on hatchery runs in Prince William Sound and Southeast Alaska. Chum salmon runs to Arctic-Yukon-Kuskokwim Rivers appear to be cyclical or volatile; data suggests that most areas are improving following a major decline in the late 1990s and early 2000. Chum salmon in Northern Norton Sound continue to be managed as a stock of concern.

### 5.1.1 Food habits/ecological role

Chum salmon diet composition in summer is primarily euphausids and pteropods with some smaller amounts of amphipods, squid, fish, and gelatinous zooplankton. Chum from the shelf region contained a higher proportion of pteropods than the other regions while Aleutian Islands chum salmon contained higher proportions of euphausids and amphipods. Basin chum salmon samples had higher amounts of fish and gelatinous zooplankton. Fish prey species consumed in the basin included northern lampfish and juvenile Atka mackerel, sculpins, and flatfish while shelf samples consumed juvenile rockfish, sablefish, and pollock.

Ocean salmon feeding ecology is highlighted by the BASIS program given the evidence that salmon are food limited during their offshore migrations in the North Pacific and Bering Sea (Rogers 1980; Rogers and Ruggerone 1993; Aydin et al. 2000, Kaeriyama et al. 2000). Increases in salmon abundance in North America and Asian stocks have been correlated to decreases in body size of adult salmon which may indicate a limit to the carrying capacity of salmon in the ocean (Kaeriyama 1989; Ishida et al. 1993; Helle and Hoffman 1995; Bigler et al. 1996; Ruggerone et al. 2003). International high seas research results suggest that inter and intra-specific competition for food and density-dependant growth effects occur primarily among older age groups of salmon particularly when stocks from different geographic regions in the Pacific Rim mix and feed in offshore waters (Ishida et al. 1993; Ishida et al 1995; Tadokoro et al. 1996; Walker et al. 1998; Azumaya and Ishida 2000; Bugaev et al. 2001; Davis 2003; Ruggerone et al. 2003).
Stomach sample analysis of ocean age .1 and .2 fish from basin and shelf area Chinook salmon indicated that their prey composition was more limited than chum salmon (Davis et al. 2004). This particular study did not collect many ocean age .3 or .4 Chinook, although those collected were located predominantly in the basin (Davis et al. 2004). Summer Chinook samples contained high volumes of euphausiids, squid and fish while fall stomach samples in the same area contained primarily squid and some fish (Davis et al. 2004). The composition of fish in salmon diets varied with area with prey species in the basin primarily northern lamp fish, rockfish, Atka mackerel, Pollock, sculpin and flatfish while shelf samples contained more herring, capelin, Pollock, rockfish and sablefish (Davis et al. 2004). Squid was an important prey species for ocean age .1, .2, and .3 Chinook in summer and fall (Davis et al. 2004). The proportion of fish was higher in summer than fall as was the relative proportion of euphausiids (Davis et al. 2004). The proportion of squid in Chinook stomach contents was larger during the summer in years (even numbered) when there was a scarcity of pink salmon in the basin (Davis et al. 2004).

Results from the Bering Sea shelf on diet overlap in 2002 indicated that the overlap between chum and Chinook salmon was moderate (30%), with fish constituting the largest prey category, results were similar in the basin (Davis et al. 2004). However notably on the shelf, both chum and Chinook consumed juvenile walleye pollock, with Chinook salmon consuming somewhat larger (60-190 mm SL) than those consumed by chum salmon (45-95 mm SL) (Davis et al. 2004). Other fish consumed by Chinook salmon included herring and capelin while chum salmon stomach contents also included sablefish and juvenile rockfish (Davis et al. 2004).

General results from the study found that immature chum are primarily predators of macrozooplankton while Chinook tend to prey on small nektonic prey such as fish and squid (Davis et al. 2004). Prey compositions shifts between species and between seasons in different habitats and a seasonal reduction in diversity occurs in both chum and Chinook diets from summer to fall (Davis et al. 2004). Reduction in prey diversity was noted to be caused by changes in prey availability due to distribution shifts, abundance changes or progression of life-history changes which could be the result of seasonal shift in environmental factors such as changes in water temperature and other factors (Davis et al. 2004).

Davis et al. (2004) found that diet overlap estimates between Chinook and sockeye salmon and Chinook and chum salmon were lower than the estimates obtained for sockeye and chum salmon, suggesting a relatively low level of inter-specific food competition between immature Chinook and immature sockeye or chum salmon in the Bering Sea because Chinook salmon were more specialized consumers. In addition, the relatively low abundance of immature Chinook salmon compared to other species may serve to reduce intra-specific competition at sea. Consumption of nektonic organisms (fish and squid) may be efficient because they are relatively large bodied and contain a higher caloric density than zooplankton, such as pteropods and amphipods (Tadokoro et al. 1996, Davis et al. 1998). However, the energetic investment required of Chinook to capture actively swimming prey is large, and if fish and squid prey abundance are reduced, a smaller proportion of ingested energy will be available for salmon growth (Davis et al. 1998). Davis et al. (2004) hypothesized that inter- and intra-specific competition in the Bering Sea could negatively affect the growth of chum and Chinook salmon, particularly during spring and summer in odd-numbered years, when the distribution of Asian and North American salmon stocks overlap. Decreased growth could lead to reduction in salmon survival by increasing predation (Ruggerone et al. 2003), decreasing lipid storage to the point of insufficiency to sustain the salmon through winter when consumption rates are low (Nomura et al. 2002), and increasing susceptibility to parasites and disease due to poor salmon nutritional condition.

A paper in preparation (Farley and Murphy in prep.) describes one possible hypotehsis for high chum bycatch during the mid 2000's. Their analysis suggests that most of the immature chum salmon are distributed in the Bering Sea Basin; however, during 2004 to 2006 immature chum salmon migrated on to the southeastern Bering Sea shelf to feed on abundant age 0 walleye pollock that were distributed in surface waters during those years. They found a significant correlation with BASIS age 0 walleye pollock catch per unit effort (surface waters) and summer chum bycatch. They also found that the immature chum salmon captured on the southeaster Bering Sea shelf during the BASIS research cruises (2004 to 2006) were feeding exclusively on age 0 pollock. The authors hypothesize that more immature chum salmon migrate onto the southeastern Bering Sea shelf during years with high age 0 pollock abundance in surface waters and that the anomalously warm sea temperatures during those years appear to be associated with high abundance of age 0 pollock in surface waters (Farley and Murphy, in prep.).

### 5.1.2 Hatchery releases

#### 5.1.2.1 Pacific Rim

Commercial salmon fisheries exist around the Pacific Rim with most countries releasing salmon fry in varying amounts by species. The North Pacific Anadromous Fish Commission summarizes information on hatchery releases by country and by area where available. Reports submitted to the NPAFC were used to summarize hatchery information by Country and by US state below (Table 5-1, Table 5-2). For more information see the following: Russia (Anon., 2007; TINRO-centre 2008; 2006; 2005); Canada (Cook and Irvine, 2007); USA (Josephson 2008; 2007; Eggers, 2006; 2005; Bartlett, 2008, 2007; 2006; 2005); Korea (SRT 2008, 2007, 2006, 2005). Chum salmon hatchery releases by country are shown below in Table 5-2 .

For chum salmon, Japanese hatchery releases far exceed releases by any other Pacific Rim country. This is followed by the US and Russia. A further break-out of hatchery releases by area in the US show that the majority of chum salmon fry releases occur in the Alaska region (Table 5-2).

Combined Asian hatchery releases in 2010 (Russia, Japan, Korea) account for 78% of the total releases while Alaskan chum releases account for 20% of the total releases. Chum enhancement projects in Alaska are not active in the AYK region.

Table 5-1 Hatchery releases of juvenile chum salmon in millions of fish.

| Year | Russia | Japan | Korea | Canada | US | Total |
|---|---|---|---|---|---|---|
| 1999 | 278.7 | 1,867.9 | 21.5 | 172.0 | 520.8 | 2,860.9 |
| 2000 | 326.1 | 1,817.4 | 19.0 | 124.1 | 546.5 | 2,833.1 |
| 2001 | 316.0 | 1,831.2 | 5.3 | 75.8 | 493.8 | 2,722.1 |
| 2002 | 306.8 | 1,851.6 | 10.5 | 155.3 | 507.2 | 2,831.4 |
| 2003 | 363.2 | 1,840.6 | 14.7 | 136.7 | 496.3 | 2,851.5 |
| 2004 | 363.1 | 1,817.0 | 12.9 | 105.2 | 630.2 | 2,928.4 |
| 2005 | 387.3 | 1,844.0 | 10.9 | 131.8 | 596.9 | 2,970.9 |
| 2006 | 344.3 | 1,858.0 | 7.3 | 107.1 | 578.8 | 2,895.5 |
| 2007 | 350.4 | 1,870.0 | 13.8 | 142.0 | 653.3 | 3,029.5 |
| 2008 | 508.0 | 1,888.0 | 16.6 | 82.0 | 604.0 | 3,098.6 |
| 2009 | 523.3 | 1,808.4 | 17.2 | 78.9 | 577.7 | 2,994.1 |
| 2010 | 595.7 | 1,851.6 | 20.9 | 64.3 | 645.9 | 3,178.4 |

Table 5-2 U.S. west coast hatchery releases of juvenile chum salmon in millions of fish.

| Year | Alaska | Washington | Oregon | California | Idaho | Combined WA/OR/CA/ID | Total |
|---|---|---|---|---|---|---|---|
| 1999 | 460.9 | 59.9 | 0 | 0 | 0 | | 520.8 |
| 2000 | 507.7 | 38.8 | 0 | 0 | 0 | | 546.5 |
| 2001 | 465.4 | 28.4 | 0 | 0 | 0 | | 493.8 |
| 2002 | 450.8 | 56.4 | 0 | 0 | 0 | | 507.2 |
| 2003 | 435.6 | 60.7 | 0 | 0 | 0 | | 496.3 |
| 2004 | 578.5 | | | | | 51.7 | 630.2 |
| 2005 | 549.0 | | | | | 47.9 | 596.9 |
| 2006 | 541.2 | | | | | 37.6 | 578.8 |
| 2007 | 604.7 | 48.6 | 0 | 0 | 0 | 48.6 | 653.3 |
| 2008 | 567.5 | | | | | 36.0 | 603.5 |
| 2009 | 551.7 | | | | | 25.5 | 577 |
| 2010 | 609.2 | | | | | 36.7 | 645.9 |

A portion of hatchery fish have thermally marked otoliths (Table 5-3). In 2009 approximately 11% of the combined Asian (Japan, Korea, Russia) releases were thermally marked while for the USA, 79% were thermally marked. Of the USA hatchery released that are marked, over 99% of those are from Alaska with a very small proportion <1% from the combined states of Washington, Oregon, California and Idaho. Currently otoliths are not collected in the groundfish observer program for salmon species thus cataloguing the proportion of chum that are of hatchery origin in the bycatch is not possible at this time.

Table 5-3 Number of otolith marked chum salmon (numbers of fish) released from Pacific Rim hatcheries 2009-2010 (note 2010 data are preliminary). Source NPAFC.

| Year | Russia | Japan | Korea | Canada | US | Total |
|---|---|---|---|---|---|---|
| 2009 | 94,798,986 | 155,807,000 | 1,200,000 | 9,608,610 | 456,760,215 | 718,174,811 |
| 2010 | 288,120,000 | 152,865,000 | 6,500,000 | 8,300,000 | 591,077,800 | 1,046,862,800 |

#### 5.1.2.2 Alaska

Hatchery-produced salmon are harvested in traditional common property fisheries, common property hatchery terminal area fisheries, and in private hatchery cost recovery fisheries. As enhanced fish enter terminal areas near hatchery release sites, fishery management is focused on the harvest of hatchery-produced surplus returns. In several locations terminal harvest areas (THAs) must be managed in cooperation with hatchery organizations to provide for broodstock needs and cost recovery harvests. Harvests in hatchery Special Harvest Areas (SHAs) are opened so hatchery operators can harvest returning fish to pay for operating costs and to reserve sufficient broodstock to provide for egg take goals. For some terminal locations only cost recovery harvest takes place; for some locations both common property and cost recovery harvests occur; at other locations only common property harvests occur.

Most hatchery fish harvested in terminal areas are segregated from wild stocks while common property fisheries harvest hatchery fish in mixed-stock fisheries during their migration to terminal areas. Hatchery operators are required to provide ADF&G with estimates of the total number of chum salmon harvested each year. The methods used to estimate harvests in mixed-stock fisheries vary from comprehensive thermal mark sampling to best estimates based on consultation with ADF&G management biologist and hatchery operators. Harvest estimates of wild chum salmon are based on estimates of the harvest of hatchery fish (i.e., subtracting the estimated contribution of hatchery fish to the common property fisheries from the total commercial harvest of chum salmon). More detail on local hatcheries is provided as a component in each of the regional management area sections below.

### 5.1.3 BASIS surveys

The Bering-Aleutian Salmon International Survey (BASIS) is an NPAFC-coordinated program of pelagic ecosystem research on salmon and forage fish in the Bering Sea. Shelf-wide surveys have been conducted beginning in 2006 on the eastern Bering Sea shelf (Helle et al 2007). A major goal of this program is to understand how changes in the ocean conditions affect the survival, growth, distribution, and migration of salmon in the Bering Sea. Research vessels from U.S. (F/V Sea Storm, F/V Northwest Explorer), Japan (R/V Kaiyo Maru, R/V Wakatake Maru), and Russia (R/V TINRO), have participated in synoptic BASIS research surveys in Bering Sea since in 2002 (NPAFC 2001).

The primary findings from the past 5 years (2002–2006) indicate that there are special variations in distribution among species: juvenile coho and Chinook salmon tend to be distributed nearshore and juvenile sockeye, chum, and pink salmon tended to be distributed further offshore. In general, juvenile salmon were largest during 2002 and 2003 and smallest during 2006, particularly in the northeast Bering Sea region. Fish, including age-0 pollock and Pacific sand lance were important components of the diets for all species of juvenile salmon in some years; however, annual comparisons of juvenile salmon diets indicated a shift in primary prey for many of the salmon species during 2006 in both the northeast and southeast Bering Sea regions. In addition, the average catch per unit effort of juvenile salmon fell sharply during 2006 in the southeast Bering Sea region. It is speculated that spring sea surface temperatures on the eastern Bering Sea shelf likely impact growth rate of juvenile western Alaska salmon through bottom-up control in the ecosystem. Cold spring SSTs lead to lower growth and marine survival rates for juvenile western Alaska salmon, while warm spring SSTs have the opposite effect (NPAFC 2001).

Figure 5-1 shows the relative abundance of juvenile salmon in the Northern Shelf Region of the Bering Sea as determined by the U.S. BASIS cruises from 2002 to 2007. The very low numbers of chum juveniles in 2004 may explain the relatively low chum salmon bycatch in the BSAI groundfish fishery in 2007. The numbers of juvenile chum salmon appear to be rebounding in 2006 and 2007 (Chris Kondzela, AFSC, personal communication).

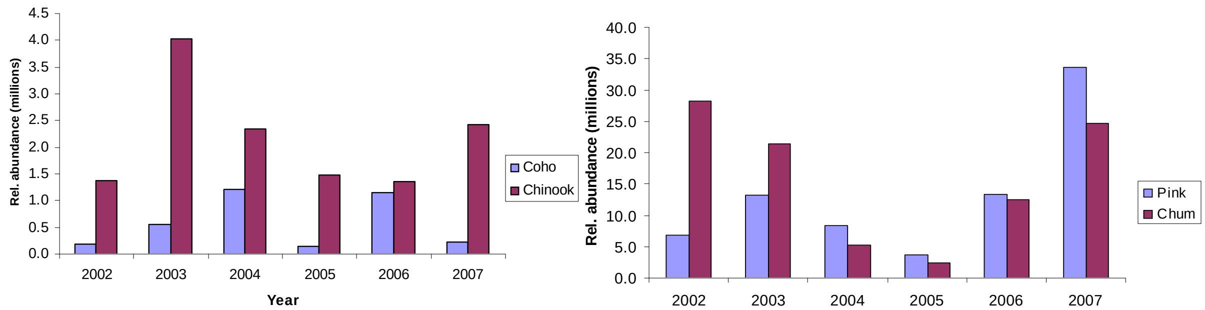



Figure 5-1 Relative abundance of juvenile salmon in the Northern Shelf Region (60°N-64°N latitude) of the U.S. BASIS survey, 2002-2007. *Source: Chris Kondzela, NMFS AFSC.*

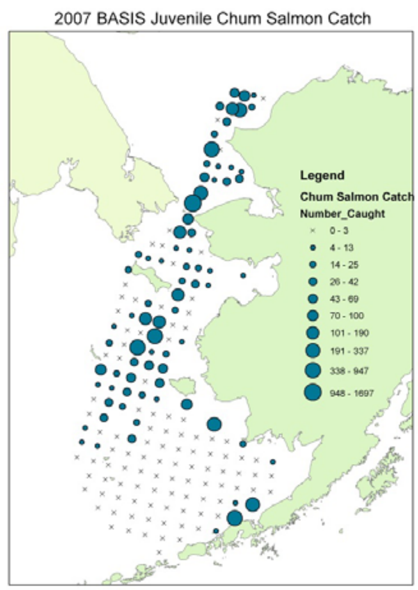



Figure 5-2 U .S. BASIS juvenile Chum salmon catches in 2007. Source: Chris Kondzela, AFSC

Stock mixtures of salmon from BASIS surveys in the Bering Sea have provided new information on oceanic migration and distribution of regional stock groups in the Bering Sea. Recent results from Japanese surveys indicate that 81% of the immature chum salmon in the Bering Sea basin were from Asian (Russia and Japan) populations during August-September in 2002. Results from U.S. surveys on the Bering Sea shelf and Aleutian chain indicate considerable spatial variation in stock mixtures; however, when pooled over location mixtures were very similar to mixtures present in the basin with 80% of the immature chum salmon from Asian populations. Immature chum salmon from western Alaska comprised 2% and 8% of immature chum salmon on the southern Bering Sea shelf and northern Bering Sea shelf, respectively. Stock mixtures of juvenile chum salmon have identified where migratory routes of western Alaska and Russian chum salmon stocks overlap and has helped identify the contribution of Russian stocks to the total biomass of juvenile chum salmon on the eastern Bering Sea shelf (JTC 2008).

During the June-July 2005 BASIS survey chum salmon was the most dominant fish species in upper epipelagic layer in the survey area (52 % from overall fish biomass estimates; NPAFC 2006). Chum salmon was a dominant Pacific salmon species in terms of its quantity (46% from overall Pacific salmon quantity). The rate of chum salmon occurrence in trawl catches was highest (92%) among all fish species (NPAFC 2006). During the survey period age 0.1 chum salmon has just started entering Bering Sea along the major pathway of Central Bering Sea Current. Age 0.2 chum salmon was distributed in the Aleutian and Commander Basins. This age group of chum salmon migrated into the Russian EEZ earlier than 0.1 along the major pathway of Central Bering Sea Current (NPAFC 2006). Near Navarin Cape and Kronotsky Capes age 0.2 chum was most proximate to the shore as compared with other areas (NPAFC 2006). Large-size (FL>53 cm) immature chum salmon was numerous in the northwestern Aleutian Basin and Navarin Shelf area (NPAFC 2006). Age 0.3 and higher was distributed almost throughout entire survey area (rate of occurrence in catches – 73%), except for inshore areas (NPAFC 2006). Maturing chum salmon individuals were noted in a high percentage of trawl catches (87 %). The overall biomass of chum salmon in the survey areas was estimated as 311.59 thousand tons (49% - immature and 51% - mature chum). Overall quantity estimates were 138.96 million individuals (57% - immature and 43% - mature chum salmon) (NPAFC 2006)

In 2007, the U.S. BASIS program sampled in the Bering Straits and the Chukchi Sea, and found water temperatures warmer than in the Bering Sea. Substantial numbers of juvenile pink and chum salmon were caught that were larger than those caught south of the Bering Straits. Juvenile chum salmon in this area and from the Chukchi Sea may also originate from the Yukon River (JTC 2008).

Genetic evaluations were recently completed on chum salmon samples from the 2006 and 2007 summer and fall BASIS cruises (McCraney et al. 2010; Figure 5-3 and Figure 5-4). Substantial differences were found in the stock composition of chum salmon between the continental slope and northern shelf environments compared with the southern continental shelf in the eastern Bering Sea, with more consistent stock composition in former and limited inter-annual variability while substantial inter-annual variability was found in the southern continental shelf region. The continental slope and northern shelf environments were dominated by Asian stocks while the southern continental shelf was dominated by North American stocks (McCraney et al. 2010).

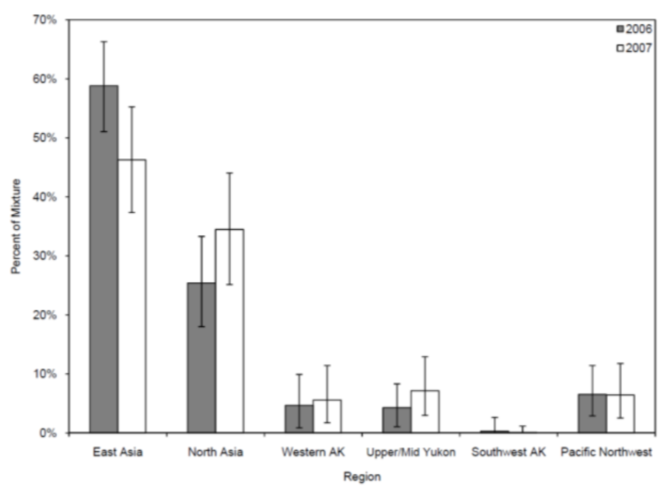



Figure 5-3 Stock composition of chum salmon in the north shelf habitat of the Bering Sea from 2006-07, as estimated by microsatellites. Error bars indicate 95% credible intervals. From McCraney et al. 2010.

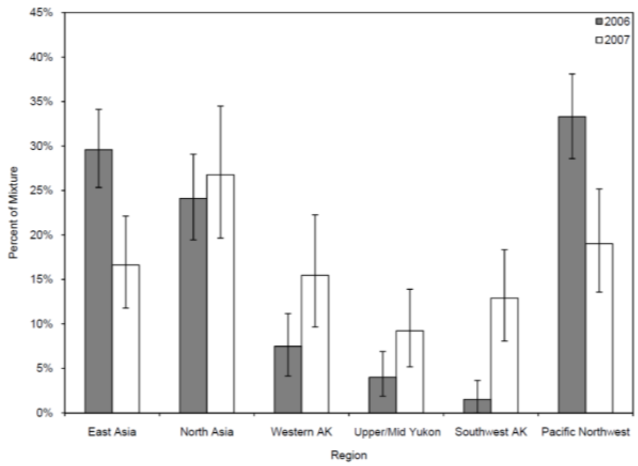



Figure 5-4 Stock composition of chum salmon in the south shelf habitat of the Bering Sea from 2006-07, as estimated by microsatellites. Error bars indicate 95% credible intervals. from McCraney et al. 2010

The BASIS program is now moving into BASIS Phase II, building upon the work undergone in BASIS Phase I. Some of the main findings of Phase I included research indicating that the observed (2002-2006) shift in increased salmon returns to western Alaska was related to increased carrying capacity for juvenile salmon in the eastern and western Bering Sea (Farley and Moss in review; Farley and Trudel in review; Gritsenko et al. in review). Despite the increase in oceanic salmon abundance, salmon carrying capacity in offshore regions of the Bering Sea also appeared to be sufficient for the growth of immature salmon (Azumaya et al. 2008).

BASIS phase II is intended to be a 5-year (2009-2013) program of field, laboratory and computer modeling research combined with previous field efforts for better tracking of longer-lived salmon species (sockeye, chum and Chinook) through a complete Bering Sea production cycle (NPAFC 2009). This will ideally enable a clearer understanding of salmon carrying capacity in the Bering Sea (NPAFC 2009).

### 5.1.4 Migration corridors

BASIS surveys have established that the distribution and migration pathways of western Alaska juvenile salmon vary by species. Farley et al. (2006; Figure 5-5) reported on the distribution and movement patterns of main species in this region. The Yukon River salmon stocks are distributed along the western Alaska coast from the Yukon River to latitude 60ºN. Kuskokwim River salmon stocks are generally distributed south of latitude 60ºN from the Kuskokwim River to longitude 175ºW. Bristol Bay stocks are generally distributed within the middle domain between the Alaska Peninsula and latitude 60ºN and from Bristol Bay to longitude 175ºW. The seaward migration from natal freshwater river systems is south and east away from the Yukon River for Yukon River chum salmon, to the east and south away from the Kuskokwim River for Kuskokwim River chum, Chinook, and coho salmon, and east away from Bristol Bay river systems for Bristol Bay sockeye salmon stocks.

Previous reports have studied seasonal migration patterns of Asian and North American chum salmon in the Bering Sea (Fredin et al. 1977). These show distinct differences in the Bering Sea based upon immature and maturing fish in migratory patterns between North American and Asian origin stocks (Figure 5-6), however data used to estimate these migration trends are dated (1950-1960s; Myers et al. 2006).

Migration routes of chum salmon from Japanese hatcheries were estimated based on genetic stock identification over several years (Figure 5-7). Urawa (2000, 2003) estimated that chum salmon from Japanese hatcheries begin to migrate into the Bering Sea in their second summer/fall, migrating south and east late in the fall to the Gulf of Alaska to spend their second winter. In subsequent years they migrate between feeding grounds in the Bering Sea and Gulf of Alaska in summer and fall prior to returning as maturing fish to Japan via the western Bering Sea (Urawa 2000; 2003).

High seas tagging experiments from 1954-2006 provide insights on the distribution, biology and ecology of immature and maturing AYK origin chum salmon migrating in the North Pacific Ocean and Bering Sea (Myers et al. 2009). In particular, their compilation shows that immature AYK chum salmon were primarily in the GOA with distribution shifting from spring to summer to west or northwest (Figure 5-8; Myers et al. 2009). They suggest that maturing AYK chum are distributed in the Northeast Pacific (GOA and south) in April and shift westward into the GOA by May and then the Bering Sea beginning in June (Myers et al. 2009). By July they indicate that maturing Yukon summer chum have already returned to coastal areas and spawning streams while Yukon Fall chum at that time were distributed across a broad front in the western GOA, Aleutians, and eastern and western Bering Sea (Myers et al. 2009).

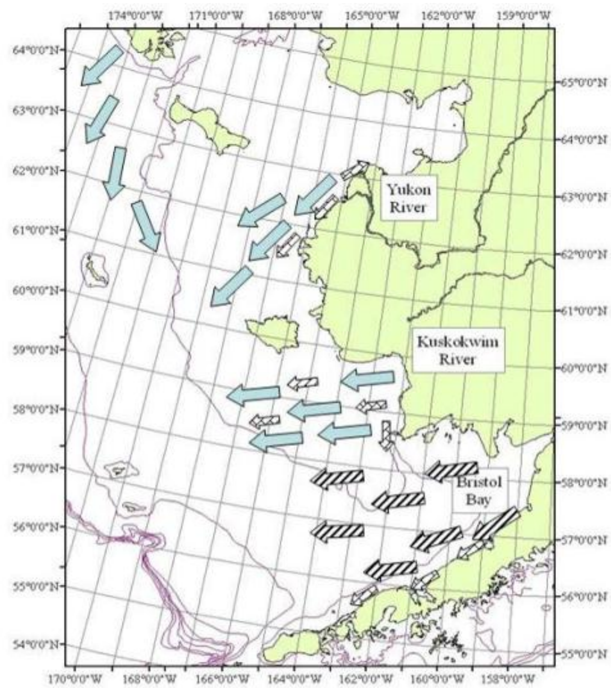



Figure 5-5. Seaward migration pathways for juvenile chum (solid arrow), sockeye (slashed line arrow), coho, and Chinook (boxed line arrow) salmon along the eastern Bering Sea shelf, August through October. *Source: Farley et al 2007.*

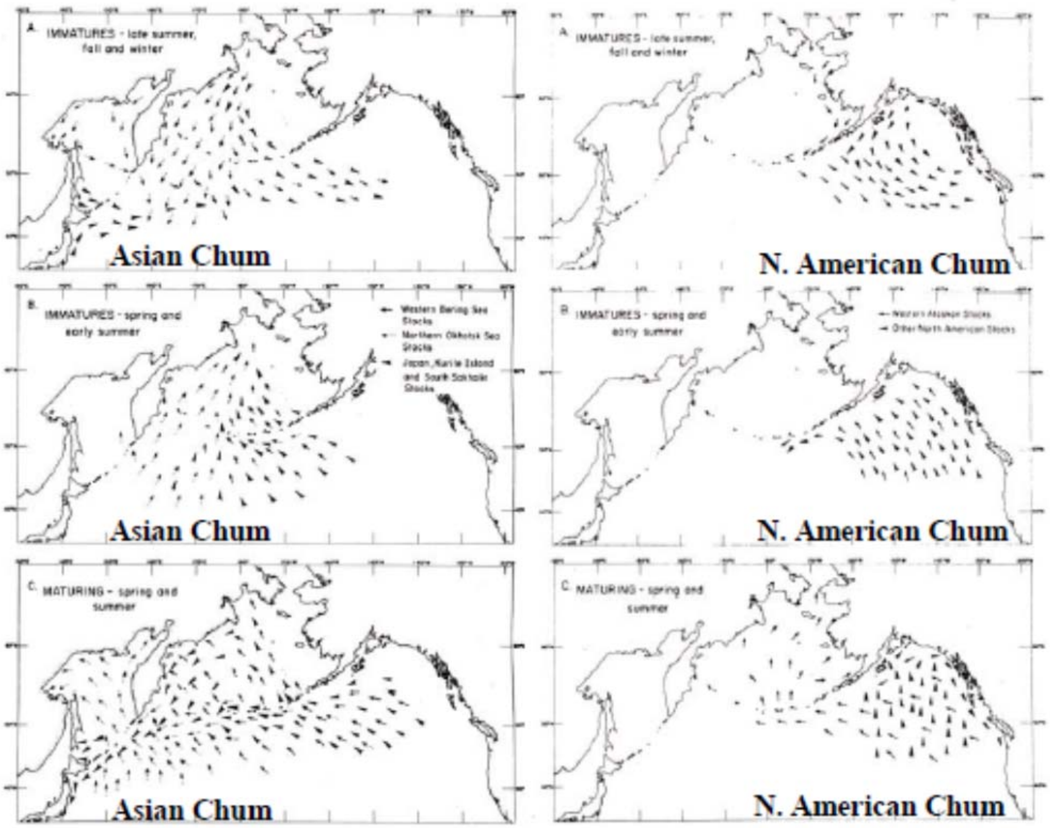



Figure 5-6. Models of seasonal ocean migration patterns of Asian and North American chum salmon. Arrows indicate direction of movement of immatures in later summer, fall and winter (top panels), immatures in spring and early summer (center panels), and maturing fish in spring and summer (bottom panels). Source: Fredin et al 1977.

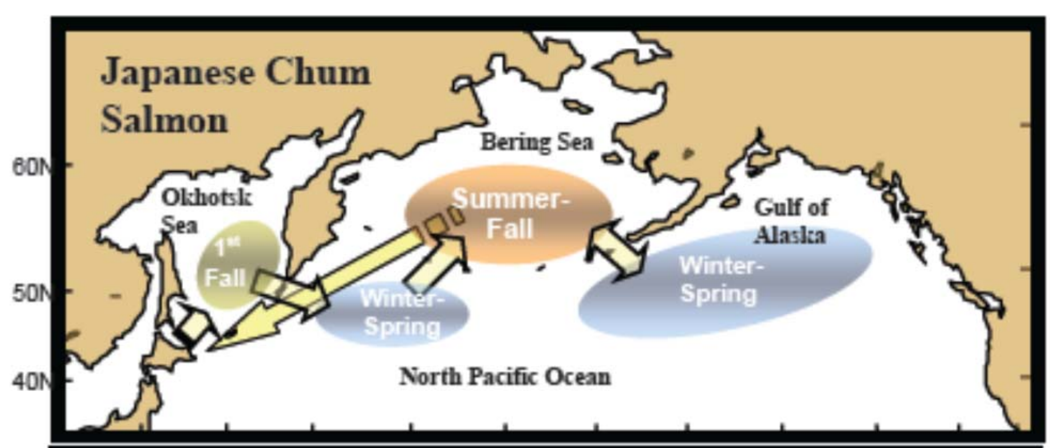



Figure 5-7. Model for Japanese hatchery chum salmon as estimated by genetic stock identification (Urawa 2000; 2003).

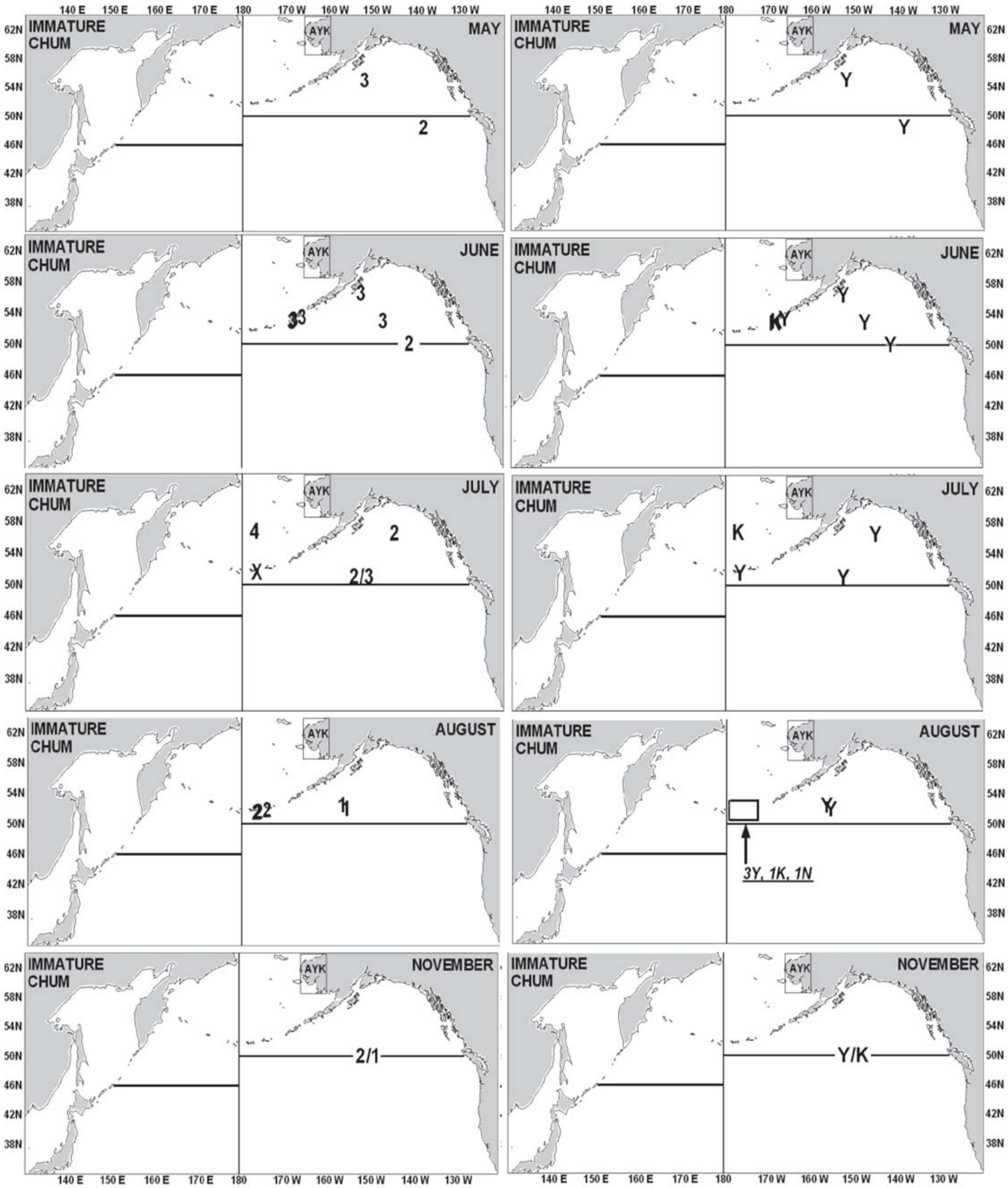



Figure 5-8. The known ocean distribution of immature Norton Sound (N), Yukon (Y), and Kuskokwim (K) chum salmon by month, ocean age-group (left panels), and stock (right panels), as indicated by high seas tag experiments 1954–2006. Numbers in left panels are ocean age at release; X = ocean age unknown; forward slash between two numbers indicates recoveries from two age groups released at or near the same ocean location. In August (right panel), labeled arrow (underline, italics) pointing at multiple recoveries (inside box) shows number of recoveries per stock. Number of recoveries by month of release: May = 2 fsh, June = 6, July = 5, August = 7, November = 2. Reported dates of recovery of adult fsh in the AYK region ranged from June 16 to September 24. **From Myers et al. (2009).**

### 5.1.1 Carrying capacity and run size overview for North Pacific

Hatchery releases of chum salmon are listed in section 0. Chum salmon hatchery releases are the largest of all Pacific salmon species (Eggers 2009). Hatchery stocks of chum and pink salmon have been estimated to comprise 38% of the recent biomass of all salmon species in the North Pacific (Eggers 2010). Because of this, considerable research has focused on the carrying capacity of the North Pacific for salmon species and the impact of increased hatchery stocks on the growth and survival of wild salmon stocks (e.g., Kaeriyama et al. 2009).

Estimates of abundance trends vary but the most abundant salmon species caught in the North Pacific is pink salmon, followed by sockeye and chum salmon. One estimate of the relative abundance (1952-2005) indicated that pink salmon comprise on average 70% of the total abundance of the three while sockeye comprise 17% and chum 13% (Ruggerone et al. 2010). Catches have steadily increased in coastal Japan, Russia and central and southeast Alaska while catches in western Alaska have been decreasing in general after reaching a high in the mid-1990s (Kaeriyama et al. 2009). In British Columbia and the western United States (WA, OR, and CA) catches have been decreasing since the mid-1980s (Eggers 2004).

Ruggerone et al. estimated wild and hatchery salmon abundance across the Pacific Rim from 1990-2005. For chum salmon, wild abundance was highest in mainland Russia (32% of North Pacific total) followed by Kamchatka, western Alaska, Southeast Alaska, central Alaska and southern BC in roughly equal proportions (ranging from 10-16% of North Pacific total; Figure 5-9; Ruggerone et al. 2009).

Pacific-wide, hatchery releases of chum salmon have exceeded wild production since the mid-1980s (Figure 5-10; Ruggerone et al. 2009). Their study notes that Japan produced more than 83% of hatchery chum. Within Alaska, wild salmon runs north of southeast Alaska declined over this time period, especially in Prince William Sound where hatchery-origin chum now represent approximately 73% of total chum salmon abundance (Ruggerone et al. 2009). They raise the question whether large scale hatchery releases have influenced the growth and survival of wild chum salmon similar to arguments on the impact of pink salmon hatcheries in Prince William Sound (Hilborn and Eggers 2000, 2001; Werthheimer et al. 2001, 2004a, 2004b).

Wild chum salmon stocks across the North Pacific have had dramatic declines including those from Japan, South Korea, the Amur River (Russia and China), western Alaska, the Columbia River, and the summer-run chum salmon in Hood Canal, WA (Ruggerone et al 2009). This raises many questions about the potential density-dependence and possibility for chum salmon (and salmon species in general) competing in the North Pacific for a limited “common pool” of food resources in international waters (Ruggerone et al 2009). Current efforts are underway to estimate the overall carrying capacity of the North Pacific and to estimate the dependence of chum and other salmon species on prey and prey abundance and prey variability due to climate changes.

Kaeriyama et al (2009) estimated the run size and carrying capacity of Pacific salmon species in relation to long-term climate change and interactions between wild and hatchery salmon. Their work builds upon previous investigations by Kaeriyama and Edpalina (2004). They indicate that the combined catch of sockeye, chum and pink salmon comprise over 90% of the total catch of Pacific salmon, and that temporal changes has a 30 or 40 year periodicity corresponding to long-term climate change indications such as the Pacific Decal Oscillation (PDO) and regime shifts (Kaeriyama et al. 2009). Productions trends were similar for both North American and Asian populations. While catch and run sizes for Pacific Rim populations of chum salmon in general have been increasing since the 1970s, wild chum salmon populations have been decreasing, while hatchery chum salmon have increased substantively in Japan and southeast Alaska, comprising more than 80% of catch and 40% of run size (Kaeriyama et al. 2009). Estimated hatchery releases from 1990-2005 have apparently comprised 62% of chum salmon total abundance (wild and hatchery for pink, chum, and sockeye which combined comprise about 93% of oceanic salmon abundance; Ruggerone et al 2010).

Previous studies on Japanese chum salmon have shown that increases in run size may lead to a reduction in body size and an increase in average age at maturity that suggest a population density-dependent effect (Kaeriyama 1998). Sockeye salmon have also shown indications of density-dependent growth where greater marine growth contributed to higher survival rates and higher abundances (Ruggerone et al. 2007). Density-dependent growth from resulting from increases in hatchery salmon may affect wild chum populations (Kaeriyama et al. 2009). Significant correlations were observed between the estimated carrying capacity of three salmon species (sockeye, chum and pink) and the Aleutian Low Pressure Index (ALPI) indicating that these population trends may be synchronized with long-term trends in climate change (Kaeriyama et al. 2009). It has been suggested that carrying capacities for salmon have shifted downwards since the 1998/99 regime shift (Kaeriyama et al. 2009).

More recently a spatially explicit bioenergetics model was used to predict juvenile chum salmon growth rate potential (GRP) in the eastern Bering Sea during years of cold and warm sea surface temperatures (SST) as a means to understand the link between juvenile chum salmon prey demand and supply. Cold spring SSTs were generally correlated with higher juvenile growth rates and lower annual average GRP (Farley and Moss 2009). This may be related to cold spring temperature effects on the productivity of prey (Hunt and Stabeno 2002). Juvenile chum salmon were larger during years with SSTs in the northern region but not in the southern region (Farley and Moss 2009). Stock specific results for Kuskokwim and Yukon fall abundance in relation to SST suggest the possibility of increased size-selected predation on juvenile Kuskokwim chum salmon in cold years (Farley and Moss, 2009). This is hypothesized to be less of a factor on Yukon River chum salmon (Farley and Moss 2009).

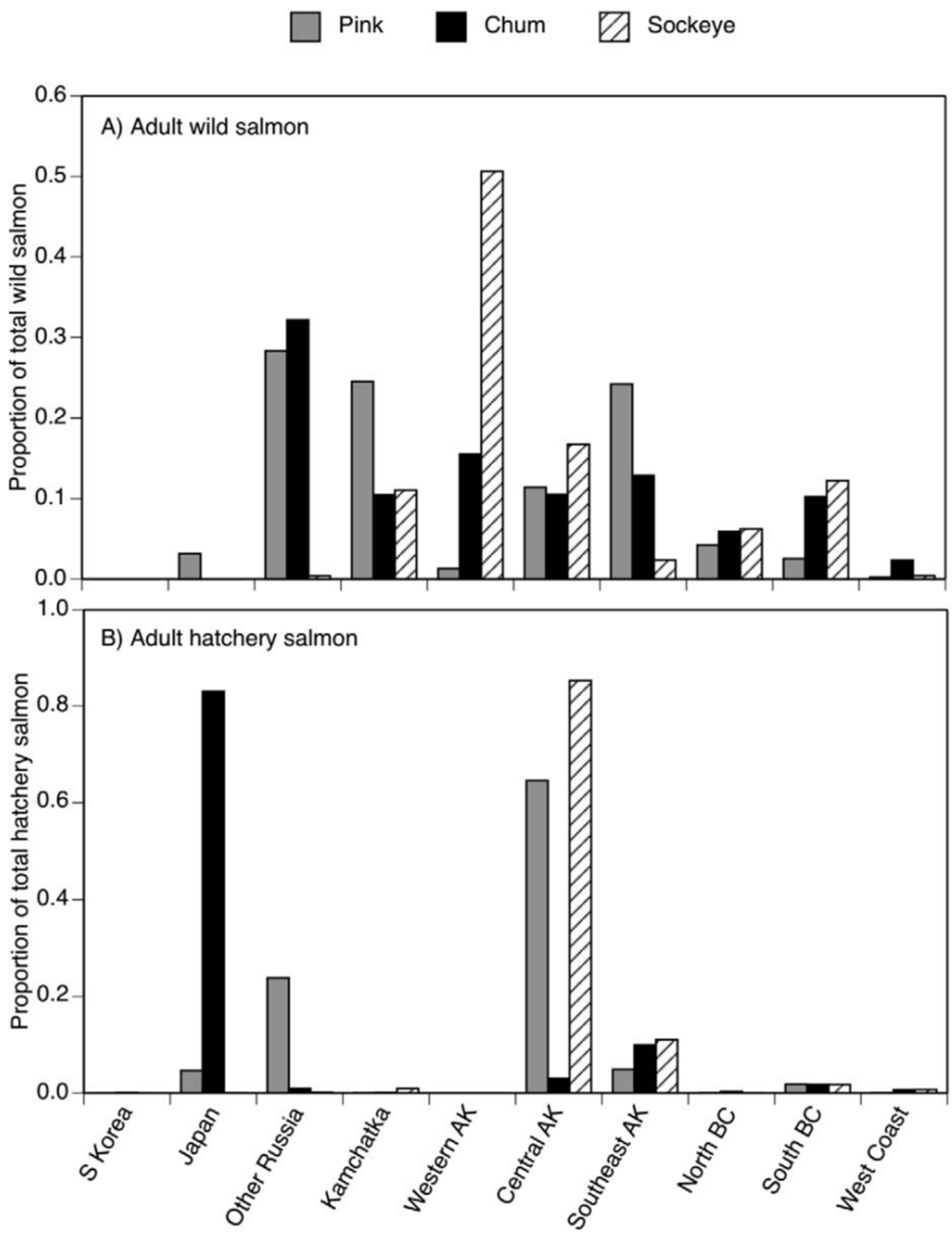



Figure 5-9. Relative contribution from each region to Pacific Rim production of adult (A) and hatchery (B) salmon during 1990-2005 (from Ruggerone et al. 2010)

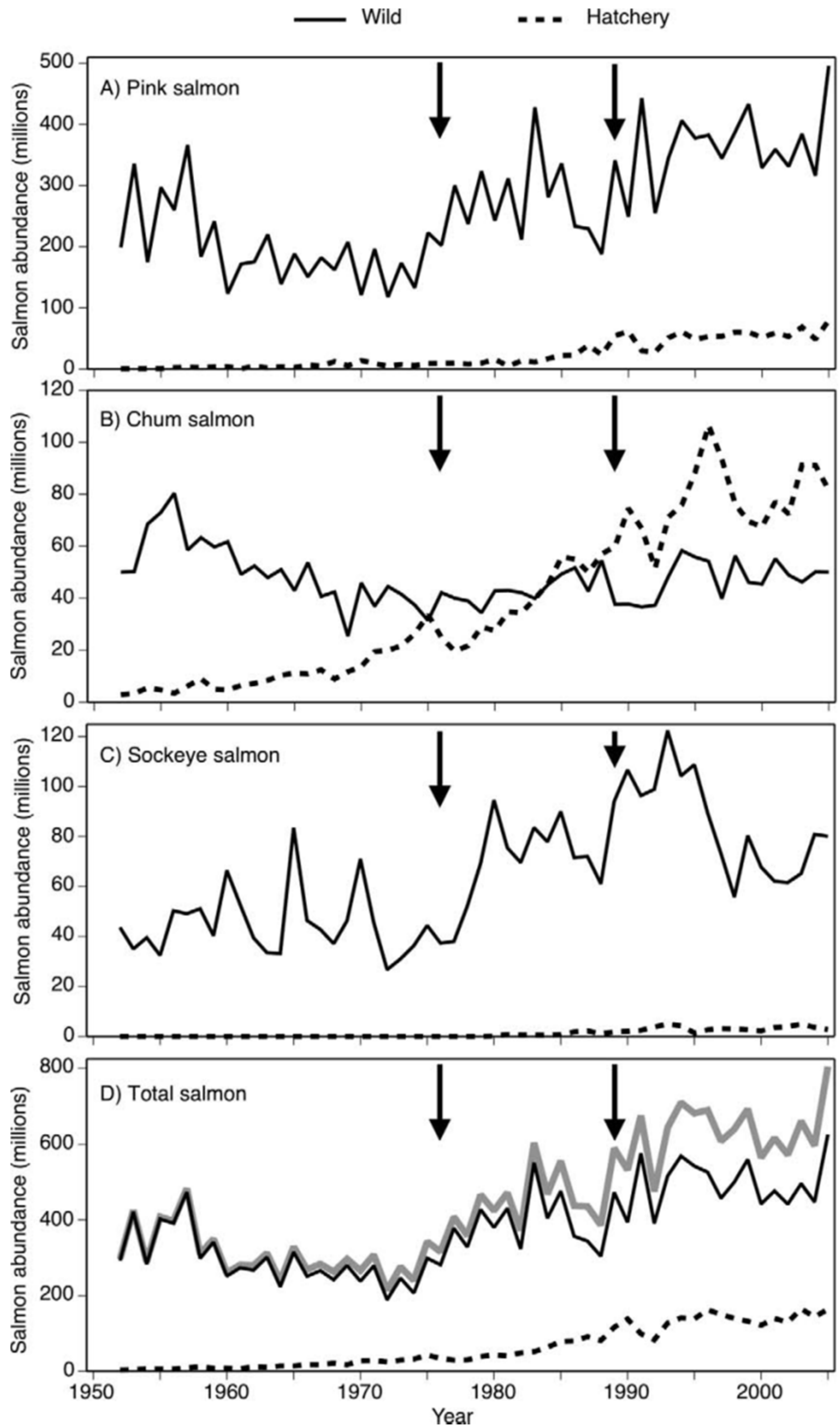



Figure 5-10. Annual adult abundance (catch plus number of spawners) of wild (solid lines) and hatchery (dashed lines) (A) pink salmon, (B) chum salmon and (c) sockeye salmon and (D) totals across species from 1952 to 2005 (from Ruggerone et al 2009).

## 5.2 Chum salmon assessment overview by major river system or region in Alaska

### 5.2.1 Management of salmon stocks

The Alaska State Constitution, Article VII, Section 4, states that “Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial users.” In 2000, the Alaska Board of Fisheries (board) adopted the Sustainable Salmon Fisheries Policy (SSFP) for Alaska, codified in 5 AAC 39.222. The SSFP defines sustained yield to mean an average annual yield that results from a level of salmon escapement that can be maintained on a continuing basis; a wide range of average annual yield levels is sustainable and a wide range of annual escapement levels can produce sustained yields (5 AAC 39.222(f)(38)).

The SSFP contains five fundamental principles for sustainable salmon management, each with criteria that will be used by ADF&G and the board to evaluate the health of the state’s salmon fisheries and address any conservation issues and problems as they arise. These principles are (5 AAC 39.222(c)(1-5):

- Wild salmon populations and their habitats must be protected to maintain resource productivity;
- Fisheries shall be managed to allow escapements within ranges necessary to conserve and sustain potential salmon production and maintain normal ecosystem functioning;
- Effective salmon management systems should be established and applied to regulate human activities that affect salmon;
- Public support and involvement for sustained use and protection of salmon resources must be maintained;
- In the face of uncertainty, salmon stocks, fisheries, artificial propagation, and essential habitats must be managed conservatively.

This policy requires that ADF&G describe the extent salmon fisheries and their habitats conform to explicit principles and criteria. In response to these reports the board must review fishery management plans or create new ones. If a salmon stock concern is identified in the course of review, the management plan will contain measures, including needed research, habitat improvements, or new regulations, to address the concern.

A healthy salmon stock is defined as a stock of salmon that has annual runs typically of a size to meet escapement goals and a potential harvestable surplus to support optimum or maximum yield. In contrast, a depleted salmon stock means a salmon stock for which there is a conservation concern. Further, a stock of concern is defined as a stock of salmon for which there is a yield, management, or conservation concern (5 AAC 39.222(f)(16)(7)(35)). Yield concerns arise from a chronic inability to maintain expected yields or harvestable surpluses above escapement needs. Management concerns are precipitated by a chronic failure to maintain escapements within the bounds, or above the lower bound of an established goal. A conservation concern may arise from a failure to maintain escapements above a sustained escapement threshold (defined below).

Escapement is defined as the annual estimated size of the spawning salmon stock. Quality of the escapement may be determined not only by numbers of spawners, but also by factors such as sex ratio, age composition, temporal entry into the system, and spatial distribution within salmon spawning habitat ((5 AAC 39.222(f)(10)). Scientifically defensible salmon escapement goals are a central tenet of fisheries management in Alaska. It is the responsibility of ADF&G to document, establish, and review escapement goals, prepare scientific analyses in support of goals, notify the public when goals are established or modified, and notify the board of allocative implications associated with escapement goals.

The key definitions contained in the SSFP with regard to scientifically defensible escapement goals and resulting management actions are: biological escapement goal, optimal escapement goal, sustainable escapement goal, and sustained escapement threshold. Biological escapement goal (BEG) means the escapement that provides the greatest potential for maximum sustained yield. BEG will be the primary management objective for the escapement unless an optimal escapement or inriver run goal has been adopted. BEG will be developed from the best available biological information and should be scientifically defensible on the basis of available biological information. BEG will be determined by ADF&G and will be expressed as a range based on factors such as salmon stock productivity and data uncertainty (5 AAC 39.222(f)(3)).

Sustainable escapement goal (SEG) means a level of escapement, indicated by an index or an escapement estimate, which is known to provide for sustained yield over a five to ten year period. An SEG is used in situations where a BEG cannot be estimated or managed for. The SEG is the primary management objective for the escapement, unless an optimal escapement or inriver run goal has been adopted by the board. The SEG will be developed from the best available biological information and should be scientifically defensible on the basis of that information. The SEG will be stated as a range (SEG Range) or a lower bound (Lower Bound SEG) that takes into account data uncertainty. The SEG will be determined by ADF&G and the department will seek to maintain escapements within the bounds of the SEG Range or above the level of a lower Bound SEG (5 AAC 39.222(f)(36)).

Sustained escapement threshold means a threshold level of escapement, below which the ability of the salmon stock to sustain itself is jeopardized. In practice, SET can be estimated based on lower ranges of historical escapement levels, for which the salmon stock has consistently demonstrated the ability to sustain itself. The SET is lower than the lower bound of the BEG and also lower than the lower bound of the SEG. The SET is established by ADF&G in consultation with the board for salmon stocks of management or conservation concern (5 AAC 39.222(f)(39)).

Optimal escapement goal (OEG) means a specific management objective for salmon escapement that considers biological and allocative factors and may differ from the SEG or BEG. An OEG will be sustainable and may be expressed as a range with the lower bound above the level of SET (5 AAC 39.222(f)(25)).

The Policy for Statewide Salmon Escapement Goals is codified in 5 AAC 39.223. In this policy, the board recognizes ADF&G's responsibility to document existing salmon escapement goals; to establish BEGs, SEGs, and SETs; to prepare scientific analyses with supporting data for new escapement goals or to modify existing ones; and to notify the public of its actions. The Policy for Statewide Salmon Escapement Goals further requires that BEGs be established for salmon stocks for which the department can reliably enumerate escapement levels, as well as total annual returns. Biological escapement goals, therefore, require accurate knowledge of catch and escapement by age class. Given such measures taken by ADF&G, the board will take regulatory actions as may be necessary to address allocation issues arising from new or modified escapement goals and determine the appropriateness of establishing an OEG. In conjunction with the SSFP, this policy recognizes that the establishment of salmon escapement goals is the responsibility of both the board and ADF&G.

#### 5.2.1.1 Chum salmon escapement

Stock-specific harvest information is not available for the vast majority of wild chum salmon stocks in Alaska, which are predominantly harvested in mixed stock fisheries far from their spawning grounds.

Chum salmon are mostly harvested incidental to other salmon species in common property fisheries that are managed based on abundance of the target species. For example, summer-run chum salmon stocks in Southeast Alaska are harvested incidentally in directed pink salmon purse seine fisheries. The increase in the pink salmon population has masked the abundance of chum salmon and greatly limited ADF&G's ability to estimate numbers of chum salmon in many or most streams in Alaska.

Chum salmon escapement estimates are made using a variety of methods including aerial surveys, foot surveys, and weir counts. Estimating chum salmon escapements using aerial observations is more difficult than estimating escapements of other species of salmon. Chum salmon migrate into small sloughs and side creeks as well as into major river systems, and may also occupy more turbid systems, making observations difficult.

Available information for most chum salmon stocks in Alaska fits into the "fair" or "poor" categories as defined by Bue and Hasbrouck (*unpublished*)[35], primarily due to lack of stock-specific harvest information, estimates of total escapement, or estimates of return by age. A fair category determination is made when escapement is estimated or indexed and harvest is estimated with reasonably good accuracy but precision lacking for one if not both; no age data exists and/or data is insufficient to estimate total return and construct brood tables. A poor category determination is made when escapement is indexed (e.g., single foot/aerial survey) such that the index provides a fairly reliable measure of escapement but no harvest and age data is available.

### 5.2.2 Statewide summary for major Alaska stocks

**Western Alaska includes the Alaska Peninsula, Bristol Bay, Kuskokwim, Yukon, Norton Sound, and Kotzebue Sound management areas. Nushagak, Kuskokwim, Yukon, Unalakleet, and Kobuk rivers comprise the chum salmon index stocks for this region along with Kuskokwim Bay and Norton Sound stocks. Western Alaska chum salmon stocks declined sharply in the late 1990s through the early 2000s, rebuilt rapidly with record and near record runs in the mid 2000s, and abundance has been variable since 2007.**

Chum salmon stocks in areas outside of western Alaska include those found in the Aleutian Islands, Kodiak, Chignik, Upper Cook Inlet, Lower Cook Inlet, Prince William Sound, and Southeast Alaska. Escapement goals are generally comprised of stock-aggregate goals from several individual index streams. There is no escapement goal or chum salmon escapement surveys in the Aleutian Islands area.

Table 5-4 provides a summary of stock status for chum salmon stocks across Alaska in 2011. Average to above average run sizes were seen in Kuskokwim, Yukon, Kotzebue rivers as well as in the GOA Kodiak, Chignik and Cook Inlet rivers. In Norton Sound, the eastern and northern Norton Sound stocks saw above average run sizes in 2011, however Northern Norton Sound remains a Stock of Yield concern. Subsistence and commercial fisheries occurred in all river systems, however the summer run Yukon commercial fishery was limited by low returns of Chinook salmon. Sport fisheries were allowe in all but the Nome subdistrict of Northern Norton sound and escapement goals were met in most river systems.

**Table 5-4 Statewide summary of chum salmon stock status 2011**

[35] Bue, B. G., and J. J. Hasbrouck. *Unpublished*. Escapement goal review of salmon stocks of Upper Cook Inlet, Report to the Alaska Board of Fisheries, 2001. Alaska Department of Fish and Game, Anchorage.

| Chum salmon stock | Total run size? | Escapement goals met?[1] | Subsistence fishery? | Commercial fishery? | Sport fishery? | Stock of concern? |
|---|---|---|---|---|---|---|
| Bristol Bay | Below average | 1 of 1 | Yes | Yes | Yes | No |
| Kuskokwim Bay | Average | 1 of 1 | Yes | Yes | Yes | No |
| Kuskokwim River | Above Average | 2 of 2 | Yes | Yes | Yes | No |
| Yukon River summer run | Above Average | 2 of 2 | Yes | Yes, but limited by low Chinook | Yes | No |
| Yukon River fall run | Above average | 7 of 8 | Yes | Yes | Yes | No |
| Eastern Norton Sound | Above average | 1 of 1 | Yes | Yes | Yes | No |
| Northern Norton Sound | Above average | 7 of 7 | Yes | Yes | Yes, except for Nome Subdistrict | Yield concern (since 2007) |
| Kotzebue | Above average | No surveys in 2011 | Yes | Yes | Yes | No |
| North Peninsula | Below average | 1 of 2 | Yes | Yes | Yes | No |
| South Peninsula | Average | 4 of 4 | Yes | Yes | Yes | No |
| Aleutian Islands | n/a | n/a | Yes | Yes | Yes | No |
| Kodiak | Average | 2 of 2 | Yes | Yes | Yes | No |
| Chignik | Average | 1 of 1 | Yes | Yes | Yes | No |
| Upper Cook Inlet | Above average | 1 of 1 | Yes | Yes | Yes | No |
| Lower Cook Inlet | Average | 9 of 12 | Yes | Yes | Yes | No |
| Prince William Sound | Below Average | 5 of 5 | Yes | Yes | Yes | No |
| Southeast | Below average | 7 of 8 | Yes | Yes | Yes | No |

[1] Some aerial survey-based escapement goals were not assessed due to inclement weather or poor survey conditions.

Table 5-5 show comparative information on chum stock status in 2010. In 2010, all stocks exhibited average to above average abundance except for the South Alaska Peninsula stocks and Yukon River fall chum salmon, which were below average. Subsistence restrictions were implemented on the Yukon River fall chum run and six of eight escapement goals were achieved. Two of the four escapement goals in the South Alaska Peninsula were not achieved and the area was closed to commercial fishing from August 4 through September 14 due to low escapements of both pink and chum salmon. Norton Sound 2010 chum salmon runs were some of the strongest on record. More southerly stocks in Kuskokwim Bay and Nushagak River showed above average runs from 2008–2010 and the most northerly stocks in Noatak and Kobuk rivers were also above average.

Commercial fisheries occurred in most areas of western Alaska in 2010. North Alaska Peninsula, Norton Sound, and Kuskokwim Bay had some of the largest chum salmon commercial harvests on record. Two Yukon River (summer run) and Kuskokwim River chum salmon harvests were more modest owing to potential for incidental harvest of weak Chinook salmon stocks and limited processing capacity in the Kuskokwim River. Generally, these were the largest commercial harvests since 1998 for most of western Alaska, and in Norton Sound, since 1986. Commercial fisheries targeting Yukon River fall chum salmon were limited to a late season terminal fishery in the Tanana River, as some restrictions were placed on subsistence fisheries and the sport fishery was closed.

In 2010, average escapement was achieved in Chignik, Prince William Sound, and Lower Cook Inlet areas. Below average escapement occurred in Kodiak and Southeast Alaska. There is only one chum salmon escapement goal in Upper Cook Inlet and the upper range of that goal was exceeded in 2010. Although spawning escapement goals were met in most of the Lower Cook Inlet streams, escapement into McNeil River failed to reach the lower goal for the sixteenth time in the past 21 years despite the continued ban on targeted commercial fishing.

Commercial fisheries occurred in all areas with above average harvests for chum salmon in Chignik, Upper Cook Inlet, Lower Cook Inlet, and Prince William Sound areas. Kodiak chum salmon harvests were below the most recent 10-year average.

Table 5-5. Over view of Alaskan chum salmon stock performance, 2010.

| Chum salmon stock | Total run size? | Escapement goals met?[1] | Subsistence fishery? | Commercial fishery? | Sport fishery? | Stock of concern? |
|---|---|---|---|---|---|---|
| Bristol Bay | Above average | 1 of 1 | Yes | Yes | Yes | No |
| Kuskokwim Bay | Above average | 2 of 2 | Yes | Yes | Yes | No |
| Kuskokwim River | Average | 2 of 2 | Yes | Yes | Yes | Yield concern discontinued 2007 |
| Yukon River summer run | Average | 2 of 2 | Yes | Yes, but limited by low Chinook | Yes | Management concern discontinued 2007 |
| Yukon River fall run | Below average | 6 of 8 | Restrictions | Limited season (Tanana River) | No | Yield concern discontinued 2007 |
| Eastern Norton Sound | Above average | 1 of 1 | Yes | Yes | Yes | No |
| Northern Norton Sound | Above average | 7 of 7 | Yes | Yes | Yes, except for Nome Subdistrict | Yield concern (since 2000) |
| Kotzebue | Above average | 6 of 6 | Yes | Yes | Yes | No |
| North Peninsula | Average | 2 of 2 | Yes | Yes | Yes | No |
| South Peninsula | Below average | 2 of 4 | Yes | Yes | Yes | No |
| Aleutian Islands | n/a | n/a | Yes | Yes | Yes | No |
| Kodiak | Below average | 2 of 2 | Yes | Yes | Yes | No |
| Chignik | Average | 1 of 1 | Yes | Yes | Yes | No |
| Upper Cook Inlet | Above average | 1 of 1 | Yes | Yes | Yes | No |
| Lower Cook Inlet | Average | 9 of 12 | Yes | Yes | Yes | No |
| Prince William Sound | Average | 5 of 5 | Yes | Yes | Yes | No |
| Southeast | Below average | 6 of 8 | Yes | Yes | Yes | No |

[1] Some aerial survey-based escapement goals were not assessed due to inclement weather or poor survey conditions.

### 5.2.3 Chum salmon stocks in western Alaska

#### 5.2.3.1 Bristol Bay

The Bristol Bay management area includes all coastal and inland waters east of a line from Cape Newenham to Cape Menshikof (Figure 5-11). The area includes nine major river systems: Ugashik, Egegik, Naknek, Alagnak (Branch), Kvichak, Nushagak, Wood, Igushik, and Togiak. Collectively, these rivers are home to the largest commercial sockeye salmon fishery in the world. Sockeye salmon are by far the most abundant salmon species that return to Bristol Bay each year, but Chinook, chum, coho, and (in even years) pink salmon returns are important to the fishery as well. The Bristol Bay area is divided into 5 management districts (Ugashik, Egegik, Naknek-Kvichak, Nushagak, and Togiak) that correspond to the major river drainages. The management objective for each river is to achieve escapements within established ranges for the major salmon species while harvesting fish excess of those ranges through orderly fisheries. In addition, regulatory management plans have been adopted for individual species in certain districts.

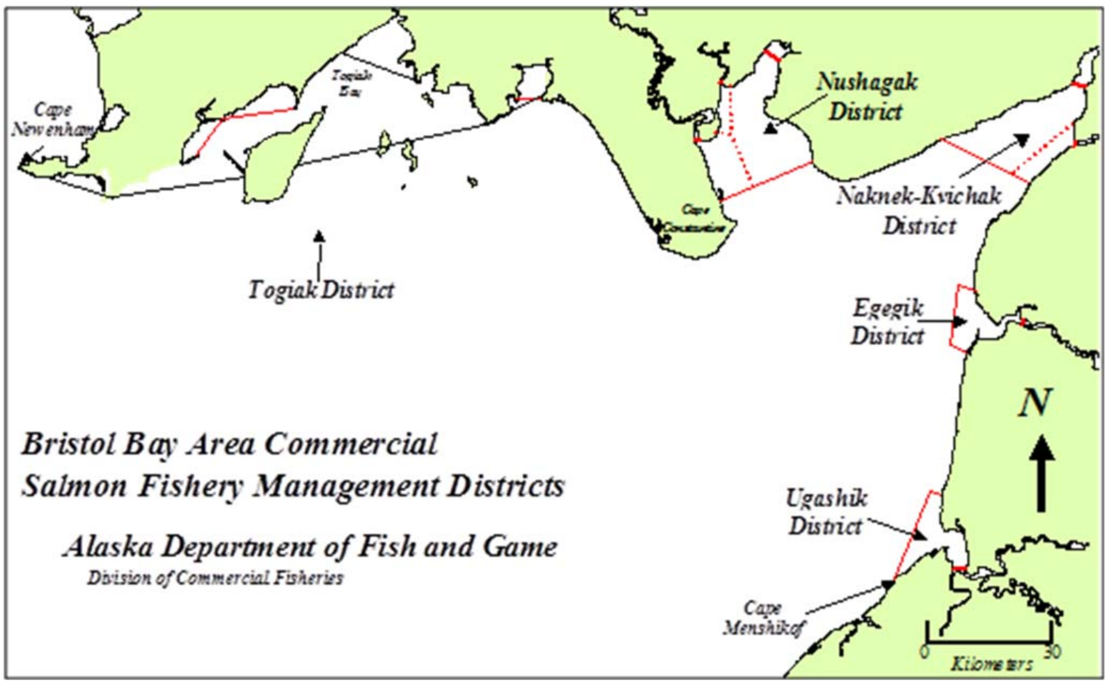



Figure 5-11. Bristol Bay area commercial fisheries salmon management districts

The five species of Pacific salmon found in Bristol Bay are the focus of major commercial, subsistence, and sport fisheries. Annual commercial catches for the most recent 20-year span (1990–2009) average nearly 25.7 million sockeye, 64,900 Chinook, 947,000 chum, 97,000 coho, and 170,000 (even-years only) pink salmon (Morstad et al. 2010). Since 1990, the value of the commercial salmon harvest in Bristol Bay has averaged $120.70 million, with sockeye salmon being the most valuable, worth an average $118.6 million. Subsistence catches are comprised primarily of sockeye salmon and average approximately 142,000 fish. Sport fisheries harvest all species of salmon, with most effort directed toward Chinook and coho salmon stocks.

Management of the commercial fisheries in Bristol Bay is primarily focused on sockeye salmon. Discrete stocks are managed with harvests directed at terminal areas around the mouths of major river systems. Each stock is managed to achieve a spawning escapement goal based on sustained yield. Escapement goals are achieved by regulating fishing time and area by emergency order (EO) and/or adjusting weekly fishing schedules. Legal gear for the commercial salmon fishery includes both drift (150 fathoms) and set (50 fathoms) gillnets. There are 1,863 drift gillnet permits and 981 set gillnet permits in Bristol Bay.

Chum salmon are harvested incidentally to sockeye salmon. The total commercial harvest in Bristol Bay was 1.40 million chum salmon in 2009 (Morstad et al 2010). This was 38% more than the 20-year average of 946,000 chum salmon. Approximately half of the commercial chum salmon harvest occurs in the Nushagak District with the reminder split between Togiak, Naknek-Kvichak, Egegik, and Ugashik Districts.

#### *5.2.3.1.1 Nushagak River*

***Stock Size***

The largest run of chum salmon in Bristol Bay occurs in the Nushagak River. The 2009 total run of chum salmon to the Nushagak River was 1,213,821 (Table 5-6). The total run was 421,878 (53%) more than the recent 20-year (1989-2008) average of 791,943 and 28% more than the recent 10-year (1999-2008) average of 947,042 (Table 5-6).

***Escapement***

Chum salmon are enumerated in the Nushagak River using Dual Frequency Identification (DIDSON) sonar. The spawning escapement in the Nushagak River was 438,481 chum salmon in 2009 (Table 5-7). The Nushagak River has a sustainable escapement goal (SEG) threshold of 190,000 chum salmon. Chum salmon escapement has exceeded the 190,000 threshold in most years since 1989 (Table 5-7).

***Harvest & Exploitation Rate***

A total of 775,340 chum salmon were harvested in the commercial fishery of the Nushagak District in 2009. It is assumed that these chum salmon are bound for the Nushagak River as this is the only river with a significant chum population within the District. The 2009 commercial harvest of chum salmon was 61% higher than the 20-year average of 481,481 and 31% higher than the 10-year average of 591,806. The exploitation rate in 2009 was 64%, which was 5% higher than both the 10-year and 20-year averages. The commercial harvest in 2009 was one of largest harvests of chum salmon in the Nushagak District since 1966; only harvests in 2005, 2006 and 2007 have been larger.

***2010 Summary***

The 2010 total Bristol Bay chum salmon harvest was approximately 1.09 million (Salomone et al. 2011). Naknek-Kvichak and Ugashik Districts produced harvests above their 20-year averages while Egegik, Nushagak and Togiak Districts produced less chum salmon that their 20-year averages. The Nushagak District was the largest producer of chum salmon, where over 509,000 were harvested.

***Age Composition/Maturity***

The 2009 age composition of the total run was 2% (19,082) age-0.2, 61% (736,745) age-0.3, 37% (453,785) age-0.4, and <1% (4,208) age-0.5%. The 2009 age composition is similar to what we have observed historically for Chum salmon in the Nushagak River. Age-0.3 fish have comprised the majority of the production of chum salmon in the Nushagak River (Table 5-7).

Table 5-6. Commercial harvest, spawning escapement, total run and exploitation rate of Nushagak River chum salmon, 1989–2009.

| Year | Harvest[a] | Escapement[b] | Total Run | Exploitation |
|---|---|---|---|---|
| 1989 | 523,910 | 377,512 | 901,422 | 58% |
| 1990 | 375,361 | 329,793 | 705,154 | 53% |
| 1991 | 463,780 | 252,436 | 716,216 | 65% |
| 1992 | 398,691 | 302,678 | 701,369 | 57% |
| 1993 | 505,799 | 217,230 | 723,029 | 70% |
| 1994 | 328,260 | 378,928 | 707,188 | 46% |
| 1995 | 390,158 | 212,612 | 602,770 | 65% |
| 1996 | 331,414 | 225,029 | 556,443 | 60% |
| 1997 | 185,635 | 61,456 | 247,091 | 75% |
| 1998 | 208,551 | 299,215 | 507,766 | 41% |
| 1999 | 170,795 | 242,312 | 413,107 | 41% |
| 2000 | 114,454 | 141,324 | 255,778 | 45% |
| 2001 | 526,602 | 564,724 | 1,091,326 | 48% |
| 2002 | 276,845 | 419,964 | 696,809 | 40% |
| 2003 | 740,311 | 295,413 | 1,035,724 | 71% |
| 2004 | 477,370 | 283,811 | 761,181 | 63% |
| 2005 | 966,050 | 456,025 | 1,422,075 | 68% |
| 2006 | 1,150,880 | 661,002 | 1,811,882 | 64% |
| 2007 | 953,282 | 161,483 | 1,114,765 | 86% |
| 2008 | 541,469 | 326,300 | 867,769 | 62% |
| Last 20 | 481,481 | 310,462 | 791,943 | 59% |
| Last 10 | 591,806 | 355,236 | 947,042 | 59% |
| Last 5 | 817,810 | 377,724 | 1,195,534 | 68% |
| Last 3 | 881,877 | 382,928 | 1,264,805 | 70% |
| Min | 114,454 | 61,456 | 247,091 | 40% |
| Max | 1,150,880 | 661,002 | 1,811,882 | 86% |
| 2009 | 775,340 | 438,481 | 1,213,821 | 64% |

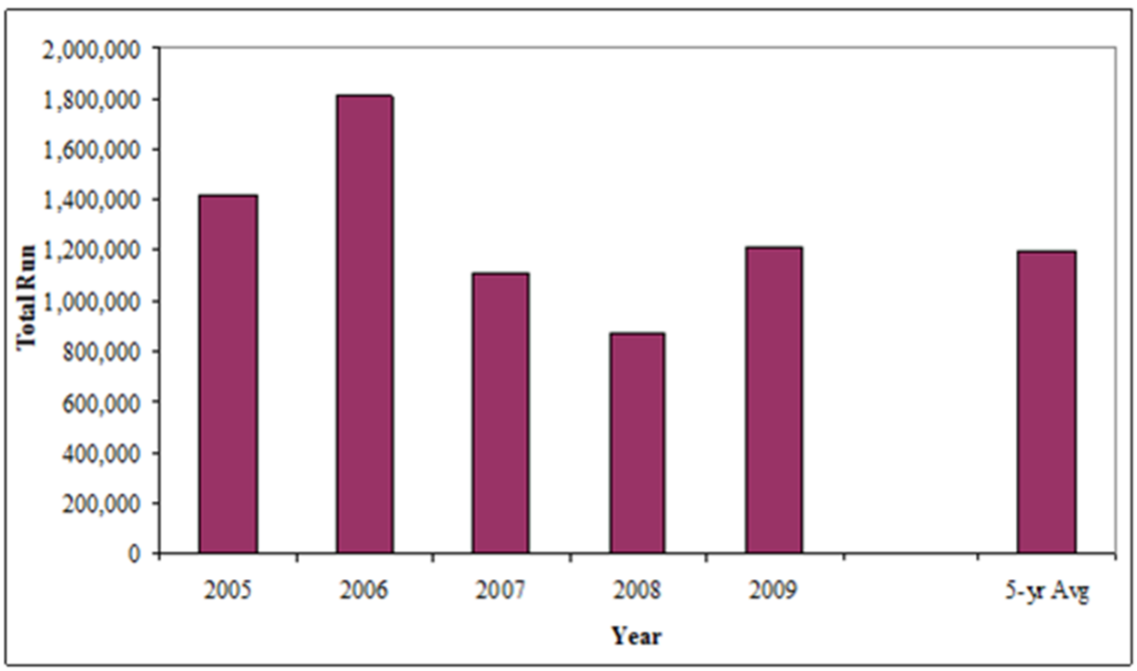



Figure 5-12. Total chum salmon run, Nushagak River, 2005-2009 with 5-year average. 2009 data are preliminary.

Table 5-7. Nushagak River chum salmon escapement and return by brood year, 1974–2009.

| Brood Year | | Escapement | | Return[a] by Age Class | | | | | | | | | | | | Total | | R/S | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 0.2 | | 0.3 | | 0.4 | | 1.3 | | 0.5 | | 1.4 | | | | | |
| 1974 | b | | | | b | | b | | b | 0 | | | | 0 | | | c | | |
| 1975 | b | | | | b | | b | 17,771 | | 0 | | 11,602 | | 0 | | | c | | |
| 1976 | b | | | | b | 1,436,331 | | 343,806 | | 0 | | 14,633 | | 0 | | 1,794,770 | c | | |
| 1977 | b | | | 164,828 | | 581,222 | | 372,808 | | 0 | | 135,772 | | 0 | | 1,264,630 | c | | |
| 1978 | b | | | 31,513 | | 295,832 | | 514,886 | | 0 | | 17,609 | | 0 | | 865,850 | c | | |
| 1979 | b | | | 7,546 | | 265,589 | | 136,704 | | 0 | | 1,755 | | 0 | | 411,604 | c | | |
| 1980 | a,f | 969,000 | g | 13,813 | | 1,041,451 | | 124,114 | | 0 | | 933 | | 0 | | 1,180,311 | | 1.22 | |
| 1981 | a,f | 177,000 | g | 16,320 | | 420,953 | | 107,737 | | 0 | | 11,703 | | 0 | | 556,731 | | 3.15 | |
| 1982 | a,f | 254,000 | g | 135,918 | | 577,903 | | 328,472 | | 0 | | 7,165 | | 0 | | 1,049,458 | | 4.1 | |
| 1983 | a | 164,000 | g | 1,490 | | 210,647 | | 212,349 | | 0 | | 5,536 | | 0 | | 430,014 | | 2.62 | |
| 1984 | a | 362,000 | g | 0 | | 305,954 | | 152,642 | | 0 | | 1,117 | | 0 | | 459,709 | | 1.27 | |
| 1985 | e | 288,000 | g | 31,177 | | 463,150 | | 184,088 | | 0 | | 1,384 | | 0 | | 879,800 | | 3.05 | |
| 1986 | e | 200,300 | g | 2,337 | | 448,869 | | 239,882 | | 0 | | 1,708 | | 0 | | 692,806 | | 3.46 | |
| 1987 | | 147,435 | h | 2,161 | | 463,300 | | 304,142 | | 0 | | 27,670 | | 0 | | 797,273 | | 5.41 | |
| 1988 | | 186,418 | h | 13,443 | | 309,174 | | 409,756 | | 0 | | 19,960 | | 0 | | 752,333 | | 4.04 | |
| 1989 | | 377,512 | h | 608 | | 284,824 | | 427,478 | | 0 | | 32,452 | | 0 | | 745,022 | | 1.97 | |
| 1990 | | 329,795 | h | 1,179 | | 258,307 | | 234,463 | | 0 | | 5,079 | | 0 | | 501,628 | | 1.52 | |
| 1991 | | 252,436 | h,l | 1,050 | | 296,267 | | 144,219 | | 0 | | 959 | | 0 | | 442,495 | | 1.75 | |
| 1992 | | 302,678 | h,l | 37,488 | | 406,374 | | 84,028 | | 0 | | 2,991 | | 0 | | 530,803 | | 1.75 | |
| 1993 | | 217,230 | h | 709 | | 160,857 | | 74,492 | | 0 | | 3,476 | | 0 | | 239,504 | | 1.1 | |
| 1994 | | 378,928 | h | 1,272 | | 425,824 | | 144,158 | | 377 | | 56,189 | | 0 | | 629,772 | | 1.66 | |
| 1995 | | 212,412 | h | 4,459 | | 263,104 | | 108,470 | | 0 | | 0 | | 0 | | 377,233 | | 1.77 | |
| 1996 | | 225,029 | h | 0 | | 77,560 | | 188,397 | | 0 | | 4,941 | | 0 | | 270,890 | | 1.2 | |
| 1997 | | 61,436 | h | 12,359 | | 899,278 | | 241,345 | | 1,235 | | 4,350 | | 1,186 | | 1,159,953 | | 18.87 | |
| 1998 | | 299,215 | h | 3,651 | | 410,008 | | 153,572 | | 10,677 | | 539 | | 0 | | 578,479 | | 1.93 | |
| 1999 | | 242,312 | h | 39,048 | | 861,720 | | 364,456 | | 0 | | 2,821 | | 0 | | 1,268,045 | | 5.32 | |
| 2000 | | 141,320 | h | 4,219 | | 297,237 | | 177,157 | | 0 | | 9,851 | | 0 | | 488,463 | | 3.46 | |
| 2001 | | 564,726 | h | 78,950 | | 1,241,318 | | 670,277 | | 1,481 | | 12,159 | | 0 | | 2,004,185 | | 3.55 | |
| 2002 | | 419,944 | h | 700 | | 1,111,017 | | 573,389 | | 0 | | 16,262 | | 0 | | 1,701,468 | | 4.05 | |
| 2002 | | 419,944 | h | 700 | | 1,111,017 | | 573,389 | | 0 | | 16,262 | | 0 | | 1,701,468 | | 4.05 | |
| 2003 | | 251,413 | h | 19,255 | | 525,542 | | 338,534 | | 0 | | 4,208 | j | 0 | j | 887,539 | c | | |
| 2004 | | 283,811 | h | 3,675 | | 499,671 | | 453,785 | j | 0 | j | | e | | e | 957,131 | e | | |
| 2005 | | 456,025 | h | 13,303 | | 736,345 | j | | e | | e | | e | | e | 750,050 | e | | |
| 2006 | | 441,082 | h | 19,082 | j | | e | | e | | e | | e | | e | 19,082 | e | | d |
| 2007 | | 161,463 | h | | e | | e | | e | | e | | e | | e | 0 | e | | d |
| 2008 | | 326,300 | h | | | | | | | | | | | | | | | | d |
| 2009 | | 438,481 | h | | | | | | | | | | | | | | | | d |

-continued-

Table 5-7 continued

| Brood Year | Escapement | Return[a] by Age Class 0.2 | 0.3 | 0.4 | 1.3 | 0.5 | 1.4 | Total | R/S |
|---|---|---|---|---|---|---|---|---|---|
| 1980-2002 | | 2% | 64% | 32% | 0% | 1% | 0% | 100% | |
| Average | 294,581 | 17,585 | 497,179 | 246,813 | 599 | 9,967 | 52 | 772,194 | 3.4 |
| Median | 252,436 | 3,651 | 410,040 | 188,397 | 0 | 4,941 | 0 | 629,772 | 2.62 |
| Minimum | 61,456 | 0 | 77,560 | 74,492 | 0 | 0 | 0 | 239,594 | 1.1 |
| Maximum | 969,000 | 135,918 | 1,241,318 | 670,277 | 10,677 | 56,189 | 1,186 | 2,004,185 | 18.87 |

a Return = commercial catch plus escapement estimate. Source: ADF&G Bristol Bay salmon catch & escapement reports, 1980-1998.

b Nushagak chum data not included in annual catch & escapement reports prior to 1980.

c Incomplete returns from brood year escapement.

d Insufficient data to preform this calculation.

e The commercial chum catch statistics for these years were reported as Nushagak-Igushik District totals.

f The chum escapement statistics for these years were reported as Nushagak-Mulchatna River totals.

g These escapement numbers may also include aerial survey estimates. Miller (1996) reports lower Nushagak River chum escapements for these years in his Nushagak River sonar report.

h This Nushagak River chum escapement was derived from Portage Creek sonar.

I Miller (1996) revised the 1991 and 1992 chum escapement estimates to 287,281 and 302,858 respectively.

j Estimate based on 2009 preliminary return numbers.

### 5.2.4 Kuskokwim Area

The Kuskokwim Salmon Management Area encompasses the Kuskokwim River drainage and all waters of Alaska that flow into the Bering Sea between Cape Newenham and the Naskonat Peninsula, including Nelson, Nunivak, and St. Matthew Islands. Subsistence and sport fishing for salmon can occur throughout the area but commercial salmon fishing is restricted to four discrete districts: two within the Kuskokwim River and two in marine waters of Kuskokwim Bay (see Figure 5-13).


Figure 5-13. Map of Kuskokwim River Alaska, showing the distribution of commercial harvest areas and escapement monitoring sites.

### *5.2.4.1.1 Kuskokwim River*

Salmon spawn and rear throughout the Kuskokwim River drainage, which is the second largest river in Alaska, draining an area of about 130,000 $km^2$ along its 1,500 km course from interior Alaska to the Bering Sea (Johnson and Daigneault 2008; Figure 5-13). The river produces Chinook (*Oncorhynchus tshawytscha)*, chum (*O. keta)*, sockeye (*O. nerka)*, pink *(O. gorbuscha)*, and coho salmon (*O. kisutch)*, each with numerous stock assemblages and overlapping migratory timings as they enter the lower Kuskokwim River. Subsistence, commercial, and sport fisheries are directed at harvest of Chinook, chum, sockeye, and coho salmon. The commercial and sport fisheries are relatively modest in size, but the Kuskokwim River subsistence fishery is one of the largest in Alaska (e.g., Fall et al. 2007). Subsistence and sport fisheries occur throughout the drainage, but the commercial fishery is confined to two discrete commercial fishing districts. District 1 extends from the mouth of the Kuskokwim River (rkm 0) upstream to Bogus Creek (rkm 203). Since 2000, District 1 may be managed as two subdistricts with fisherman required to only fish in one or the other subdistrict,of depending on fish processing capacity (Whitmore et al 2008). Subdistrict 1-A is that portion of District 1 upstream (“above”) Bethel (rkm 106) and subdistrict 1-B is downstream (“below”) of Bethel. District 2 is in the middle Kuskokwim River from rkm 262 near Lower Kalskag, and extends upstream to the rkm 322 at Chuathbaluk. The District 2 commercial fishery has been inactive, with the last harvest occurring in 2000 (Whitmore et al 2008). Historically, there was also a District 3 that encompassed waters upstream of District 2, but District 3 was deleted from regulation in 1966 due to inactivity of the commercial fishery.

### *5.2.4.1.2 Kuskokwim River chum*

***Introduction***

Entering the lower river from early June through mid-August, Kuskokwim River chum salmon are the most abundant salmon species in the drainage (Estensen et al. 2009). Two genetically distinct populations have been identified: the more predominant summer chum salmon that spawn mostly in July and August, and the less common fall chum salmon that spawn mostly in September (Gilk et al. 2005). Spawning distributions do not overlap between these two populations; summer chum salmon spawn mostly in tributaries of the lower and middle Kuskokwim River, and fall chum salmon are limited to a few upper Kuskokwim River tributaries. There is evidence that run timings through the lower Kuskokwim River do overlap between summer and fall chum salmon, but details are limited. Genetically, summer chum in the Kuskokwim and Yukon rivers are very similar; however, Kuskokwim fall chum are distinct from either river's summer chum, and from Yukon fall chum populations. Genetic mixed-stock analysis has shown that both summer and fall chum are exploited in the Kuskokwim River in-river fisheries but, unlike the Yukon River, management practices do not distinguish between the two populations.

Low chum salmon abundance from 1997 through 2000 prompted the Alaska Board of Fisheries to declare Kuskokwim River chum salmon as a stock of yield concern in September 2000 (Burkey et al. 2000). The chum salmon runs to the Kuskokwim River improved throughout 2000s, with near record runs from 2005 through 2007, which led to the stock of concern finding being lifted in January 2007 (Linderman and Bergstrom 2006).

***Stock Assessment Background***

*Escapement*

Escapement monitoring is limited to summer chum salmon and occurs on seven tributaries: six employing weirs and one sonar (Table 5-8). Collectively, these monitoring projects provide a means to index annual escapement abundance, but they do not provide absolute total annual abundance estimates. Efforts by Bue et al. (2008) and Shotwell and Adkison (2004) to reconstruct the total in-river chum salmon abundance based on these indices have been moderately successful. The estimates produced by each of these methods show a similar pattern in the variation of chum salmon abundances across years, but the values from the Shotwell and Adkison (2004) model are consistently lower than those produced by the Bue et al. (2008) model. The Bue et al. model had the advantage of more escapement information, so is thought to better reflect actual chum salmon abundance. Still, reliable historical total annual chum salmon abundance estimates for the Kuskokwim River remain elusive due to inadequate abundance estimates needed to scale the model.

Table 5-8. Kuskokwim River chum salmon escapement by projects, 1975-2009.

| Year | Kwethluk R. Weir | Tuluksak R. Weir | Aniak R. Sonar | George R. Weir | Kogrukluk R. Weir | Tatlawiksuk R. Weir | Takotna R. Weir |
|---|---|---|---|---|---|---|---|
| | Escapement Project | | | | | | |
| 1975 | | | | | | | |
| 1976 | | | | | 8,117 | | |
| 1977 | | | | | | | |
| 1978 | | | | | 48,125 | | |
| 1979 | | | | | 18,599 | | |
| 1980 | | | 1,600,032 | | | | |
| 1981 | | | 646,849 | | 57,374 | | |
| 1982 | | | 529,758 | | 61,859 | | |
| 1983 | | | 166,452 | | | | |
| 1984 | | | 317,688 | | 41,484 | | |
| 1985 | | | 273,306 | | 15,005 | | |
| 1986 | | | 219,770 | | 14,693 | | |
| 1987 | | | 204,834 | | | | |
| 1988 | | | 485,077 | | 39,543 | | |
| 1989 | | | 295,993 | | 39,547 | | |
| 1990 | | | 246,813 | | 26,765 | | |
| 1991 | 30,595 | 7,675 | 366,687 | | 24,188 | | |
| 1992 | | 11,183 | 87,467 | | 34,104 | | |
| 1993 | | 13,804 | 15,278 | | 31,901 | | |
| 1994 | | 15,724 | 474,356 | | 46,635 | | |
| 1995 | | | | | 31,265 | | |
| 1996 | | | 402,195 | 19,393 [a] | 48,478 | | 2,872 |
| 1997 | 10,659 | | 289,654 | 5,907 [a] | 7,958 | | 1,779 |
| 1998 | | | 351,792 | | 36,441 | | |
| 1999 | | | 214,429 | 11,552 [a] | 13,820 | 9,599 [a] | |
| 2000 | 11,691 | | 177,384 | 3,492 [a] | 11,491 | 7,044 [a] | 1,254 |
| 2001 | | 19,321 | 408,830 | 11,601 [a] | 30,570 | 23,718 [a] | 5,414 |
| 2002 | 35,854 | 9,958 | 472,346 | 6,543 | 51,570 | 24,542 | 4,377 |
| 2003 | 41,812 | 11,724 | 477,544 | 33,666 | 23,413 | | 3,393 |
| 2004 | 38,646 [a] | 11,796 | 673,445 | 14,409 [a] | 24,201 [a] | 21,245 | 1,630 |
| 2005 | | 35,696 | 1,173,155 | 14,828 | 197,723 | 55,720 | 6,467 |
| 2006 | 47,489 | 25,648 | 1,108,626 | 41,467 | 176,508 | 32,301 | 12,613 |
| 2007 | 57,230 | 17,286 | 699,178 | 55,842 | 49,505 | 83,246 | 8,900 |
| 2008 | 20,048 | 12,518 | 427,911 | 29,978 | 44,978 | 30,896 | 5,691 |
| 2009 | 32,028 | 13,658 | 479,531 | 7,941 | 84,940 | 19,975 | 2,487 |

[a] Escapement was adjusted to account for inoperable periods.

*Escapement Goals*
There is no formal escapement goal for the overall Kuskokwim River chum salmon run; however, escapement goals have been established for the Kogrukluk River (assessed by weir) and the Aniak River (assessed with sonar counts unapportioned to species). These goals have been annually achieved or exceeded in all but one of the last 10 years (Figure 5-15). Escapement goals have not been established at the five other locations where chum salmon escapements are currently being monitored. Escapement goals mentioned in this report focus on those goals established prior to the 2010 Board of Fisheries cycle.

***Maturity***
Age composition of Kuskokwim River chum salmon is estimated for the commercial fishery and escapements through scale sampling (Molyneaux et al. 2009). The compositions tend to be similar, but they are not combined to provide age compositions estimates of the total run. Table 5-9 describes average maturity schedule based on the District 1 commercial fishery.

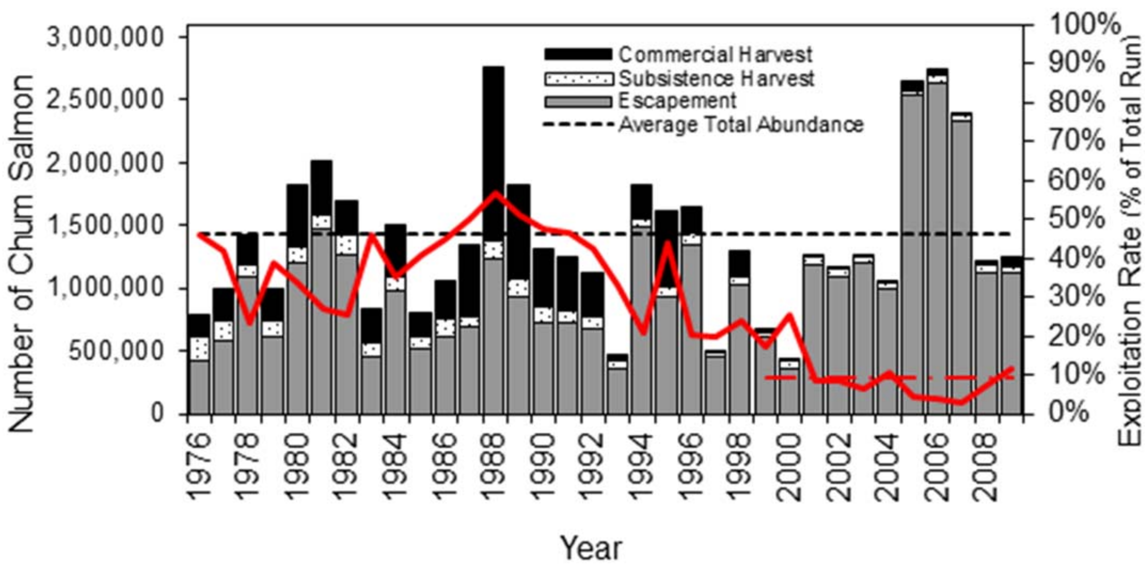



Figure 5-14. Draft Kuskokwim River chum salmon run reconstruction 1976-2009, showing total annual abundance and exploitation rates based on Bue et al. 2009.

Current escapement goals for Kuskokwim River chum salmon stocks are as follows:

| Stock Unit | Enumeration Method | Current Escapement Goal | | |
|---|---|---|---|---|
| | | Goal | Type | Year Established |
| Chum Salmon | | | | |
| Aniak River | Sonar | 220,000–480,000 | SEG | 2007 |
| Kogrukluk River | Weir | 15,000–49,000 | SEG | 2005 |

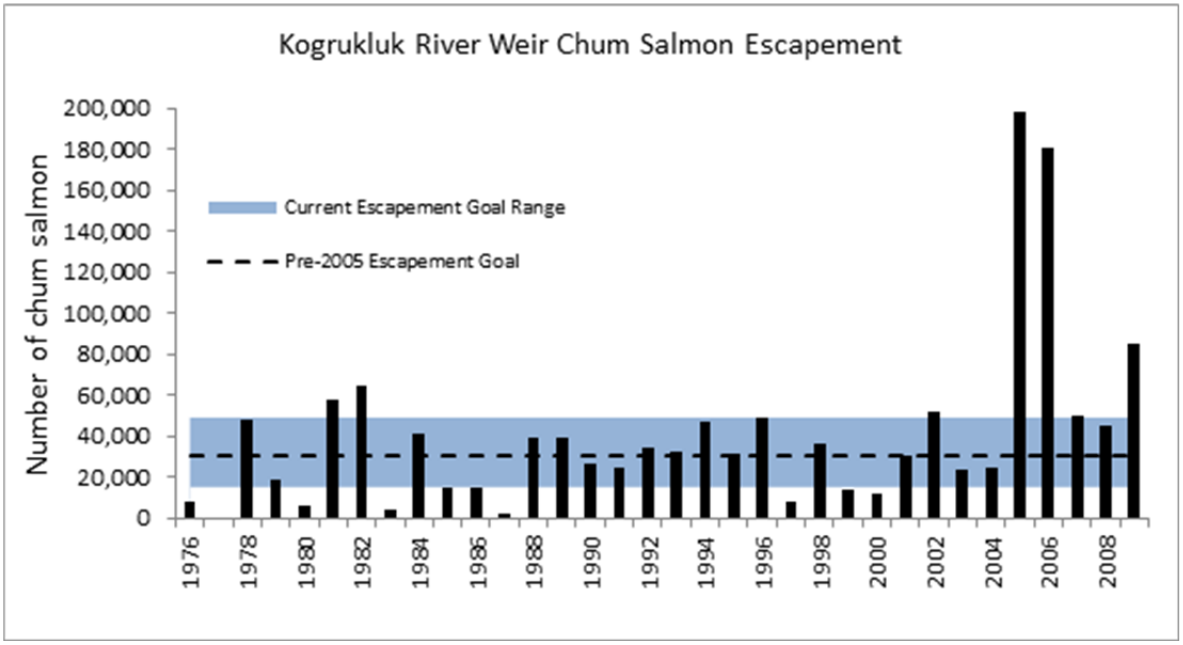



Figure 5-15. Chum salmon escapement at Kogrukluk River weir, 1976-2009 with escapement goal range (15,000 - 49,000) adopted in 2005, and the minimum escapement goal (30,000) used from 1983 to 2004.

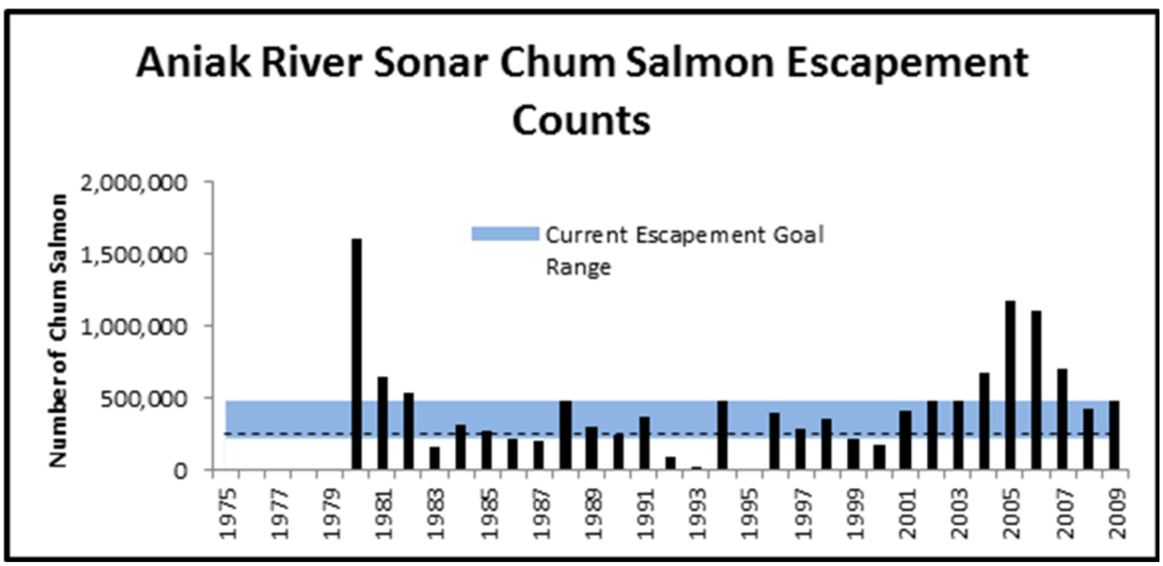



Figure 5-16. Chum salmon escapement index at the Aniak River Sonar site, 1980-2009 with the escapement goal range (220,000-480,000) adopted in 2007, and the minimum escapement goal (250,000) used from 1983 to 2004.

Table 5-9. Average age structure of Kuskokwim River chum salmon, as identified from the commercial harvest (Molyneaux et al. 2009).

| | Age Class | | | | |
|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | 7 |
| Proportion of harvest | 0.02 | 0.65 | 0.32 | 0.01 | 0.00 |

### *Harvest and Exploitation*

Historically, Kuskokwim River chum salmon, though an important subsistence species, have been primarily targeted for commercial harvest (Figure 5-14). From 1976 to 1989 the average commercial harvest was 430,868, but from 2000 to 2009 ther average declined to 26,893 due to low market interest in chum salmon and limited local processing capacity. In 2009, there was a modest increase in commercial harvest to 76,790 fish, the largest harvest since 1998, which was the result of improved processing capacity from a new fish processing plant in Platinum. Since 2005, commercial chum salmon harvests have contributed about 2% to the total exvessel value of the District 1 commercial salmon fishery. Average annual subsistence harvest is approximately 50,000 chum salmon (Figure 5-14), and harvest has been within or above the Amount Necessary for Subsistence every year since 1990. Preliminary run reconstruction information indicates the total in-river exploitation rate of chum salmon in 2009 was approximately 12%, compared to the recent 10-year average of 9% (Figure 5-14; Bue et al. 2008). Through the mid-1990s exploitation rates likely ranged between 20% and 60%.

### *2010 Summary*

Chum salmon escapements were evaluated through enumeration at weirs on seven tributary streams and a tributary sonar project on the Aniak River. Chum salmon escapements in 2010 ranged from above average to below average at all monitored locations. Chum salmon escapement to the Kogrukluk River exceeded the upper end of the escapement goal, and the Aniak River achieved the upper end of the escapement goal range. Chum salmon run timing was normal.

Commercial harvest on the Kuskokwim River in 2010 was 93,148 chum salmon, which was the largest harvest since 1998. Catch rates were average to above average from late June through July. Subsistence fishing was allowed seven days a week throughout the summer with the exception of closed periods six hours before, during, and three hours after commercial fishing periods in June, July, and August. Subsistence harvest in the Lower Kuskokwim River was normal for chum salmon. However, many subsistence fishermen reported difficulties with drying and preserving their harvests as a result of the wet and cool weather conditions that persisted throughout the summer.

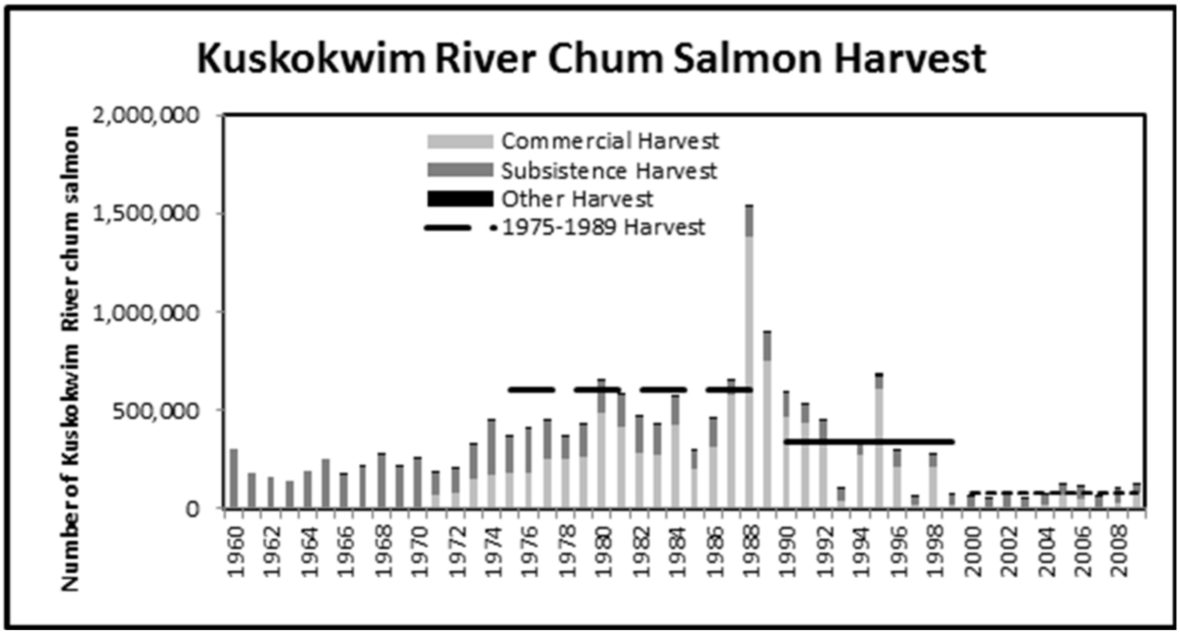



Figure 5-17. Kuskokwim River chum salmon harvest, from commercial, subsistence, test, and sport fisheries, 1960-2009, with approximately decadal average harvest ranges.

***Outlook***

The Kuskokwim River has no formal forecast for salmon returns. Broad expectations are developed based on parent-year escapements and recent year trends. The 2011 chum salmon returns are expected to exceed the 2010 abundance with an anticipated available surplus of 300,000 chum salmon.

### 5.2.4.2 Kuskokwim Bay

The Kuskokwim Bay in southwest Alaska is approximately 160 km wide by 160 km long and includes all waters from Cape Newenham to Cape Avinof. The primary salmon spawning tributaries are the Kuskokwim, Kanektok, Arolik, and Goodnews rivers. For management purposes Kukokwim Bay refers to the Kanektok, Arolik, and Goodnews Rivers. These drainages produce Chinook (*Oncorhynchus tshawytscha)*, chum (*O. keta)*, sockeye (*O. nerka)*, pink *(O. gorbuscha)*, and coho salmon (*O. kisutch)*.

Kuskokwim Bay has two commercial salmon fishing districts. District 4 extends from the northern-most edge of the mouth of Weelung Creek to the southern-most tip of the south mouth of Arolik River, and 3 miles from the coast into Kuskokwim Bay (Figure 5-18). The Kanektok and Arolik Rivers are the main spawning tributaries in District 4. District 5 extends east of a line from ADF&G regulatory markers located approximately 2 miles south and 2 miles north on the seaward side of the entrance of Goodnews Bay and east to a line between the mouth of Ukfigag Creek to the mouth of the Tunulik River (Figure 5-19). The Goodnews River drainage is the main spawning tributary in District 5 with the Middle and North Forks of the Goodnews River contributing the majority of salmon production.

Kuskokwim Bay supports commercial, subsistence, and sport fisheries harvesting predominately Chinook, sockeye, chum, and coho salmon. Although some pink salmon are harvested, there is no directed interest in harvest. While the commercial fishery is confined to the identified commercial fishing districts, the subsistence and sport fisheries occur within the commercial fishing districts and within the Kanektok, Arolik, and Goodnews Rivers.

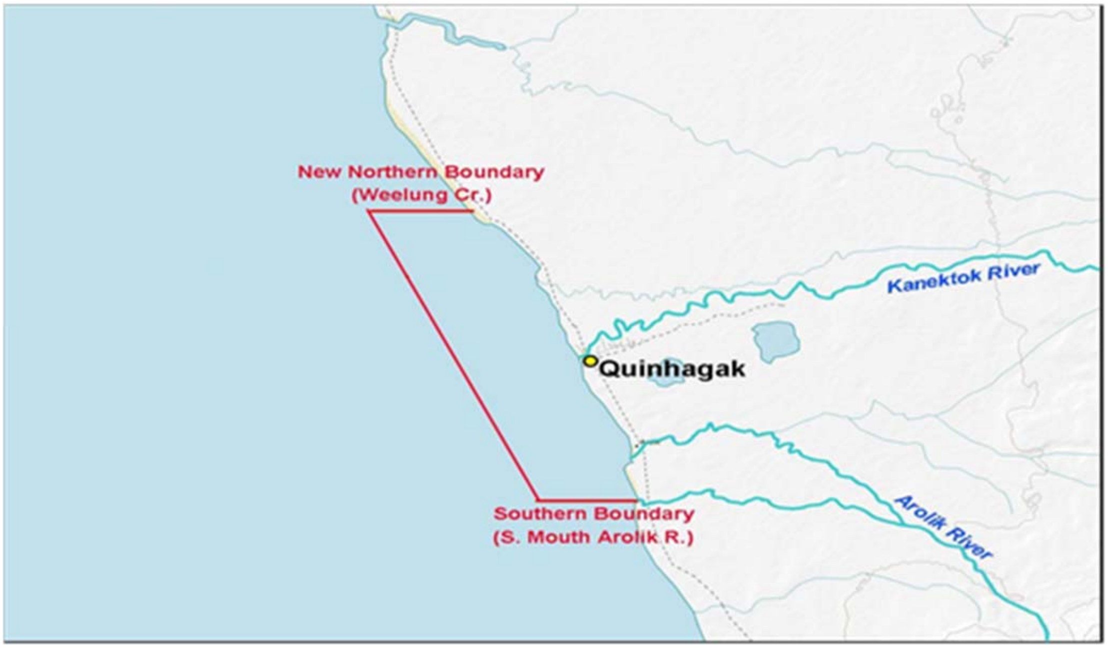



Figure 5-18. District 4 commercial fishing boundaries, Kuskokwim Bay, Alaska.

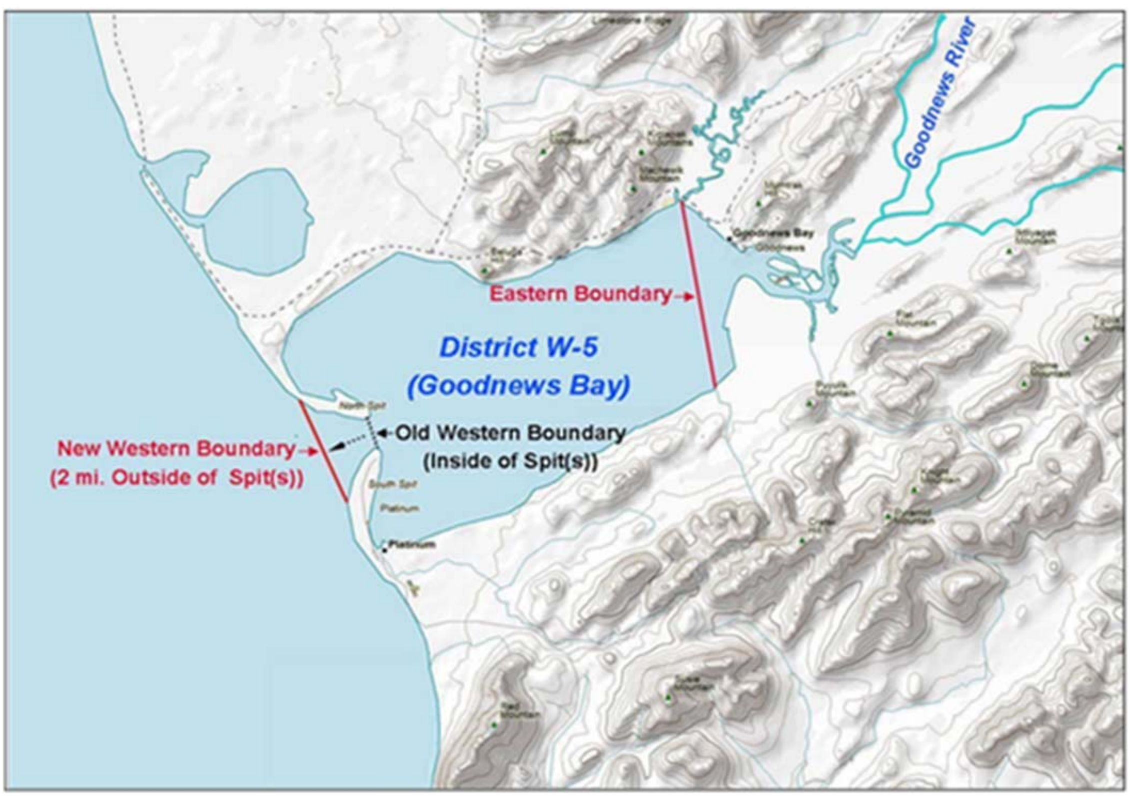



Figure 5-19. District 5 commercial fishing boundaries, Kuskokwim Bay, Alaska.

### *5.2.4.2.1 Kuskokwim Bay chum*

***Introduction***

Kuskokwim Bay chum salmon are harvested incidentally to sockeye salmon directed commercial fisheries in Districts 4 and 5. There is also a small subsistence harvest of chum salmon in Goodnews Village, Platinum, and Quinhagak, but these are likely harvested incidentally to Chinook and sockeye salmon.

***Stock Assessment Background***

*Escapement*

Kuskokwim Bay chum salmon start entering the rivers in late June and continue through early August. Chum salmon spawn throughout the Kanektok, Arolik, and Goodnews River drainages. Escapements are monitored using weirs on the Kanektok River and Middle Fork Goodnews River. These weirs observe only a portion of the total escapement into these drainages because of the location of weirs within the drainages (Figure 5-20, Figure 5-21). Since 2005 at Kanektok weir, escapement estimates have ranged from 51,652 to 133,215 (Table 5-10). Since 2005 at Middle Fork Goodnews River weir, escapement estimates have ranged from 19,715 to 54,699 (Table 5-10). Aerial surveys for chum salmon have not been flown since 2004.

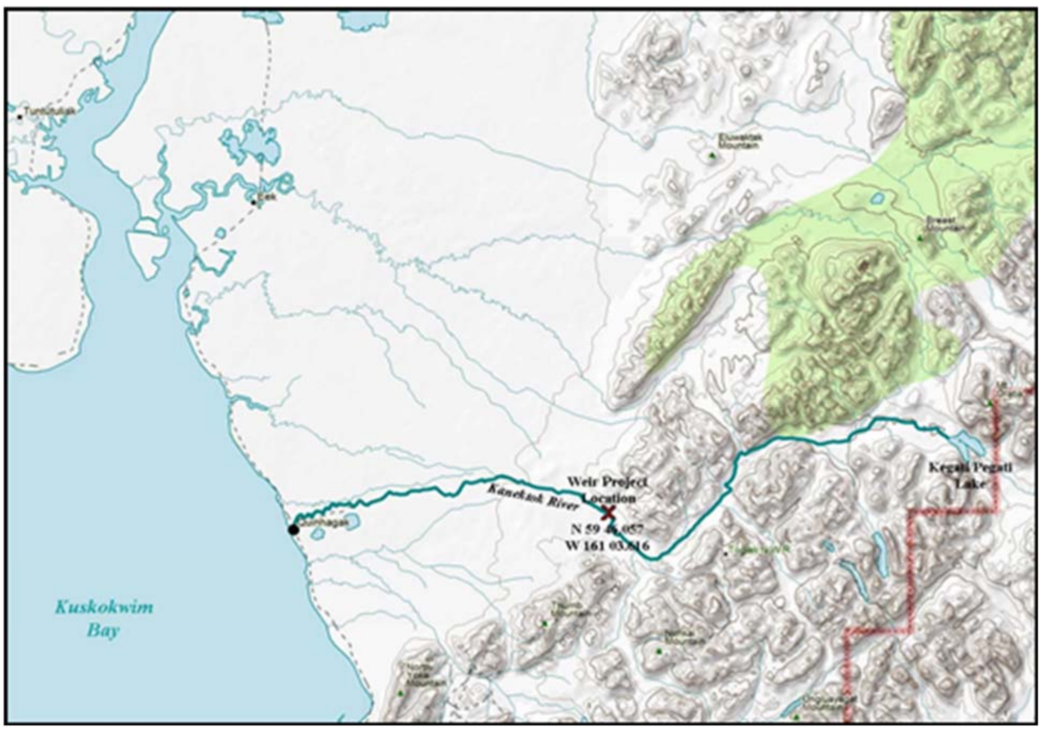



Figure 5-20. Kanektok River drainage and weir location, Kuskokwim Bay, Alaska.

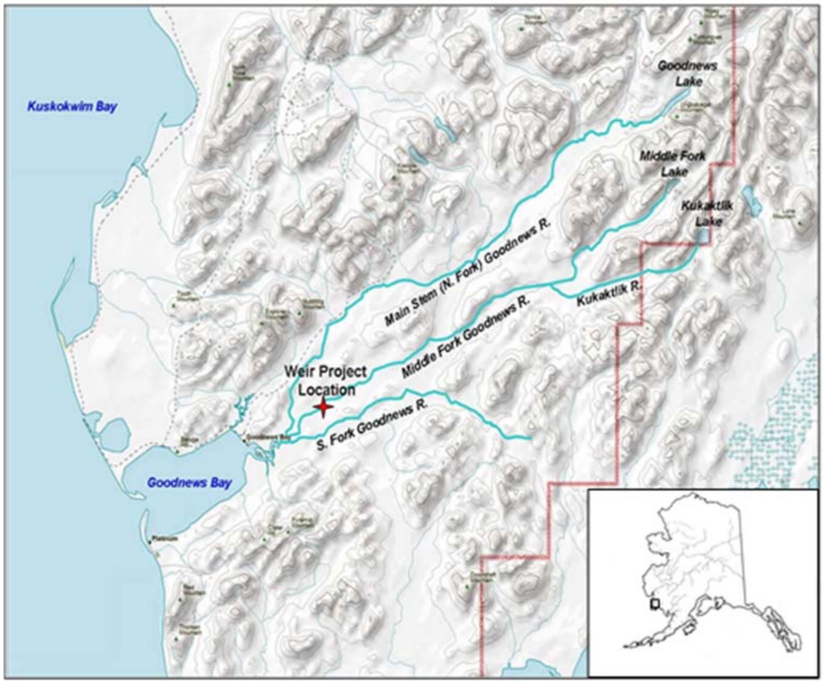



Figure 5-21. Goodnews River drainage and weir location, Kuskokwim Bay, Alaska.

Table 5-10. Chum salmon escapement at monitoring projects, Kuskokwim Bay, 1981-2009

| Year | Middle Fork Goondews R. [d] Weir | Kanektok R. Weir |
|---|---|---|
| 1981 | 21,827 | |
| 1982 | 6,767 | |
| 1983 | 15,548 | |
| 1984 | 19,003 | |
| 1985 | 10,367 | |
| 1986 | 14,764 | |
| 1987 | 17,517 | |
| 1988 | 20,799 | |
| 1989 | 10,380 | |
| 1990 | 6,410 | |
| 1991 | 31,644 | |
| 1992 | 22,023 | |
| 1993 | 14,952 | |
| 1994 | 34,849 [b] | |
| 1995 | 33,699 | |
| 1996 | 40,450 [b] | |
| 1997 | 17,369 | |
| 1998 | 28,832 | |
| 1999 | 19,513 | |
| 2000 | 13,791 [c] | |
| 2001 | 26.829 [c] | 1,056 [a] |
| 2002 | 30.300 | 42,009 [c] |
| 2003 | 21,637 | 40,066 |
| 2004 | 31,616 | 46,444 |
| 2005 | 26,690 | 53,580 |
| 2006 | 54,699 | |
| 2007 | 48,285 | 133,215 |
| 2008 | 44,310 [b] | 54,024 [c] |
| 2009 | 19,715 | 51,652 [c] |

[a] Field operations were incomplete and total annual escapement was not estimated.

[b] Field operations were incomplete; more than 20 percent of the total annual escapement is based on daily passage estimates.

[c] Field operations were incomplete; sum of daily counts is an underestimate of total escapement, but considered reasonable. Additional estimates were not made.

[d] Prior to 1991 escapment was estimated at Middle Fork Goodnews River using a tower

## *Escapement goals*

There are two formal escapement goals for chum salmon in Kuskokwim Bay. There is an aerial survey SEG threshold of greater than 5,200 for Kanektok River and an SEG threshold of greater than 12,000 at the Middle Fork Goodnews River weir. Both of these SEG's were established in 2005. Escapement goals have not been established at the Kanektok River weir because of an insufficient number of escapement estimates (Volk et al., 2009).

The escapement goal for Kanektok River aerial surveys has not been evaluated since it was established because aerial surveys for chum salmon have not been flown since 2004 (Estensen et al., 2009). The escapement goal at the Middle Fork Goodnews River weir has been achieved every year since it was established (Figure 5-22).

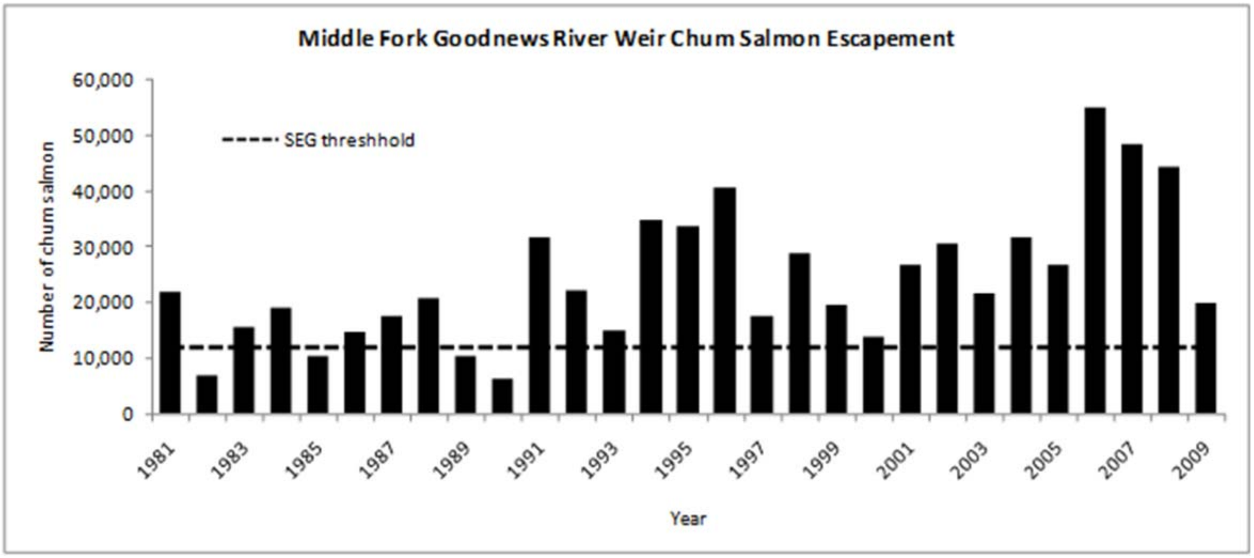



Figure 5-22. Chum salmon escapement, Middle Fork Goodnews River weir, Kuskokwim Bay, 1981-2009.

### *Maturity*

Kuskokwim Bay chum salmon age composition is estimated through scale sampling in Districts 4 and 5 commercial fisheries and at the escapement projects (Table 5-11).

Table 5-11. Age composition of commercially harvested chum salmon, Kuskokwim Bay, 2009.

| | Age Class | | | | |
|---|---|---|---|---|---|
| | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
| District 4 (Quinhagak) | 0.02 | 0.60 | 0.37 | 0.02 | 0.00 |
| District 5 (Goodnews Bay) | 0.01 | 0.51 | 0.47 | 0.01 | 0.00 |

### *Harvest and Exploitation*

Historically, Kuskokwim Bay chum salmon harvests were at a low in 1985; average to above average from 1987 to 1999; and below average from 2000 to 2005, with 2005 experiencing the minimum harvest of 13,529 and 2,568 in Districts 4 and 5, respectively. Harvests have increase since 2005 (Figure 5-23). The 2009 harvest of 91,158 chum salmon in District 4 was the highest on record and 121% above the historical average (1981-2008) of 41,256 fish. The 2009 commercial harvest of 16,985 chum salmon in District 5 was 38% above the historical average (1981-2008) of 12,304 fish (Table 5-12).

#### ***2010 Summary***

Subsistence fishing was allowed seven days per week throughout the season with the exception of closed periods 16 hours before, during, and six hours after commercial fishing periods. These closures were reduced to eight hours before, during, and six hours after commercial fishing periods beginning July 13. Subsistence harvests in 2010 were described as adequate and amounts necessary for subsistence use is expected to have been achieved

Commercial chum salmon harvests were above average with 106,610 chum salmon harvested in the Quinhagak District and 26,914 chum salmon in the Goodnews Bay District. The escapement goal threshold for chum salmon was achieved on the Middle Fork of the Goodnews River.

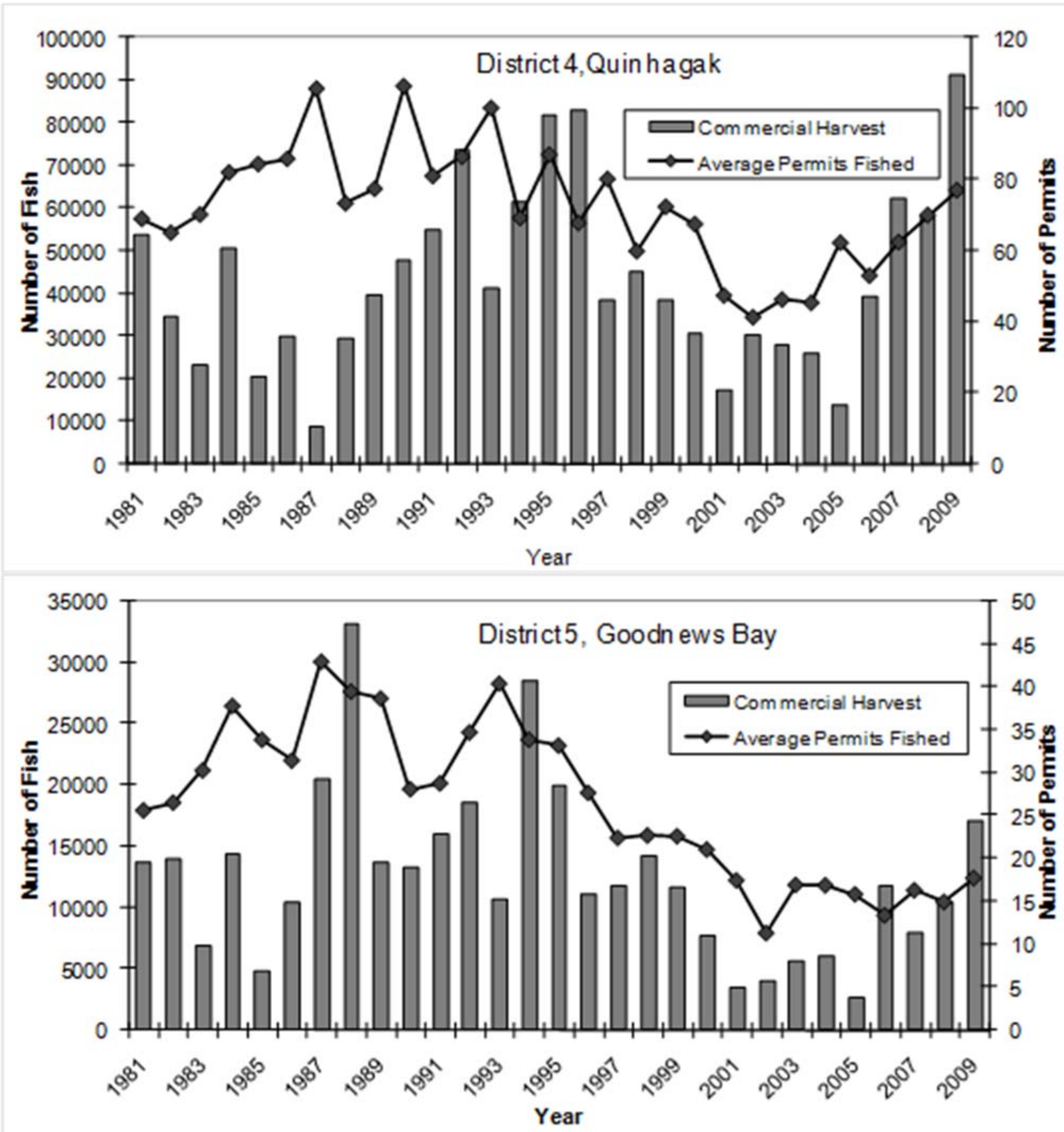



Figure 5-23. Commercial harvest of chum salmon and fishing effort, Districts 4 and 5, Kuskokwim Bay, 1981-2009.

Table 5-12. Commercial harvest of chum salmon by district, Kuskokwim Bay, 1981-2009.

| Year | District 4 | District 5 |
|---|---|---|
| 1981 | 53,334 | 13,642 |
| 1982 | 34,346 | 13,829 |
| 1983 | 23,090 | 6,766 |
| 1984 | 50,422 | 14,340 |
| 1985 | 20,418 | 4,784 |
| 1986 | 29,700 | 10,356 |
| 1987 | 8,557 | 20,381 |
| 1988 | 29,247 | 33,059 |
| 1989 | 39,395 | 13,622 |
| 1990 | 47,717 | 13,194 |
| 1991 | 54,493 | 15,892 |
| 1992 | 73,383 | 18,520 |
| 1993 | 40,924 | 10,657 |
| 1994 | 61,301 | 28,477 |
| 1995 | 81,462 | 19,832 |
| 1996 | 83,005 | 11,093 |
| 1997 | 38,435 | 11,729 |
| 1998 | 45,095 | 14,155 |
| 1999 | 38,091 | 11,562 |
| 2000 | 30,553 | 7,450 |
| 2001 | 17,209 | 3,412 |
| 2002 | 29,319 | 3,799 |
| 2003 | 27,868 | 5,593 |
| 2004 | 25,850 | 5,965 |
| 2005 | 13,529 | 2,568 |
| 2006 | 39,151 | 11,568 |
| 2007 | 62,232 | 7,853 |
| 2008 | 57,033 | 10,408 |
| 2009 | 91,158 | 16,985 |
| Historical Average (1981-2009) | 42,976 | 12,465 |

Average annual subsistence harvest in Quinhagak has been approximately 1,385 chum salmon annually. Average annual subsistence harvest in Platinum and Goodnews Bay Village has been approximately 350 chum salmon annually.

Sport fish harvest of chum salmon is minimal in Kuskokwim Bay with the Kanektok River averaging approximately 140 fish annually and Goodnews River averaging less than 25 fish annually.

### *Outlook*

The Kuskokwim Bay has no formal forecast for salmon returns. Broad expectations are developed based on parent-year escapements and recent year trends.

## 5.2.5 Yukon River

The Yukon Area includes all waters of Alaska within the Yukon River drainage and coastal waters from Naskonat Peninsula to Point Romanof, northeast of the village of Kotlik. For management purposes, the Yukon Area is divided into 7 districts and 10 subdistricts (Figure 5-24). Commercial fishing may be allowed along the entire 1,224 miles of Yukon River in Alaska and along the lower 225 miles of Tanana River. Coastal District includes the majority of coastal marine waters within the Yukon Area and is only open to subsistence fishing. Lower Yukon Area (Districts 1, 2, and 3) includes coastal waters of the Yukon River delta and that portion of the Yukon River drainage downstream of Old Paradise Village (river mile 301). Upper Yukon Area (Districts 4, 5, and 6) is the Alaskan portion of the Yukon River drainage upstream of Old Paradise Village.

Chinook *Oncorhynchus tshawytscha*, chum *O. keta*, and coho *O. kisutch* salmon are the target species harvested in Yukon River commercial, subsistence, personal use, and sport fisheries. Subsistence fishing in portions of the Yukon Area is under dual regulatory authority of Alaska Department of Fish and Game (ADF&G) and U.S. Fish and Wildlife Service (USFWS). Yukon River chum salmon consists of an earlier and typically more abundant summer chum salmon run, and a later fall chum salmon run. No directed commercial fishing has occurred for pink *O. gorbuscha* salmon, which overlap in run timing with summer chum salmon. However, sporadic sales of incidental harvests of pink salmon have been documented.

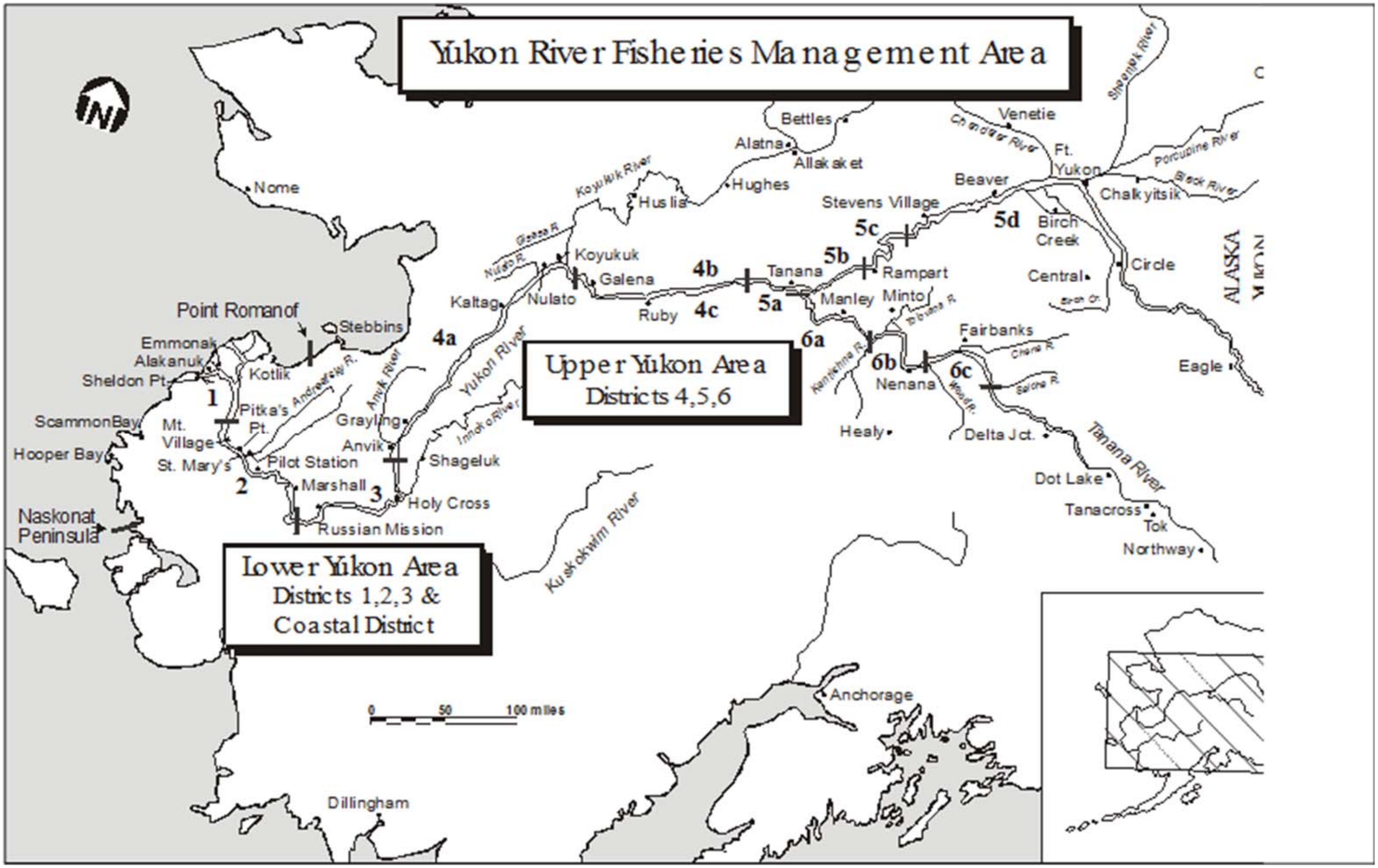



Figure 5-24. Alaska portion of the Yukon River drainage showing communities and fishing districts.

#### 5.2.5.1 Summer run

In response to the guidelines established in the SSFP (5 AAC 39.222(f)(21)), the BOF classified Yukon River summer chum salmon stock as a management concern at its September 2000 work session. This determination of a management concern was based on documented low escapements during 1998–2000 and an anticipated low run in 2001. An action plan was subsequently developed by the department (ADF&G 2000) and enacted by the BOF in January 2001. The classification as a management concern was continued at the January 2004 BOF meeting due to established escapement goals not being achieved in East Fork Andreafsky River from 1998–2003 and in Anvik River in 1998–2001 and 2003 (Salomone and Bergstrom 2004).

Given the collectively large spawning escapements of the Yukon River summer chum salmon stock over the 3 years preceding the January 2007 BOF meeting (2004–2006), including a near record run in 2006, the stock no longer met stock of management concern criteria (Clark et al. 2006). Although Yukon River drainage subsistence and commercial harvests from 1999–2003 were significantly below the 1989–1998 historic baseline average, a near average surplus yield available during 2004–2006 was not taken, primarily due to the lack of commercial markets. Based on definitions provided in the SSFP (5 AAC 39.222(f)(21) and (42)), the BOF discontinued the classification as a stock of concern in January 2007. This report focuses on the recent 5-year period prior to the January 2010 BOF cycle meeting.

***Stock Assessment Background***

*Escapement*

Most summer chum salmon spawn in the Yukon River drainage downstream of and within the Tanana River drainage (Figure 5-24). The Yukon River summer chum salmon run is typically managed as a single stock for which there is currently a drainagewide OEG of 600,000, measured at Pilot Station sonar, as identified in the regulatory management plan, 5 AAC 05.362. *Yukon River Summer Chum Salmon Management Plan*. An approximate estimate of total run of summer chum salmon in Yukon River can be obtained by summing: (1) the sonar based estimates of summer chum salmon passage at Pilot Station, which successfully estimated summer chum salmon passage in the years 1995 and 1997–2009, (2) total harvest of summer chum salmon in District 1 and that portion of District 2 below the Pilot Station sonar site, and (3) summer chum salmon escapement estimates in East and West forks of Andreafsky River. The estimate is approximate because some commercial and subsistence harvest in District 2 may not be accurately reported by location in relation to the Pilot Station sonar site, the escapement to West Fork Andreafsky is estimated based on the numbers observed in East Fork (Clark 2001), and some minor stocks of summer chum salmon spawn in tributaries below Pilot Station. However, Pilot Station sonar counts are so much greater than total catch and monitored escapement, that the total run estimate is primarily based upon sonar passage estimates. The total run of Yukon River summer chum salmon estimated in this manner averaged about 1.8 million fish during the 14-year period (1995 and 1997–2009), ranging from a low of about 550,000 fish in 2000 and 2001 to over 4.0 million fish in 1995 and 2006, about an 8-fold level of variation (Figure 5-22). Summer chum salmon run strength was poor to below average from 1998 through 2003 with 2000 and 2001 being the weakest runs on record. More recently, summer chum salmon runs have shown marked improvement with estimated drainagewide escapement exceeding 1.0 million salmon annually since 2001, with approximately 3.9 million in 2006, the largest escapement on record. The drainagewide OEG of 600,000 summer chum salmon was not met in 2000 and 2001, but has been exceeded annually since that time (Figure 5-25).

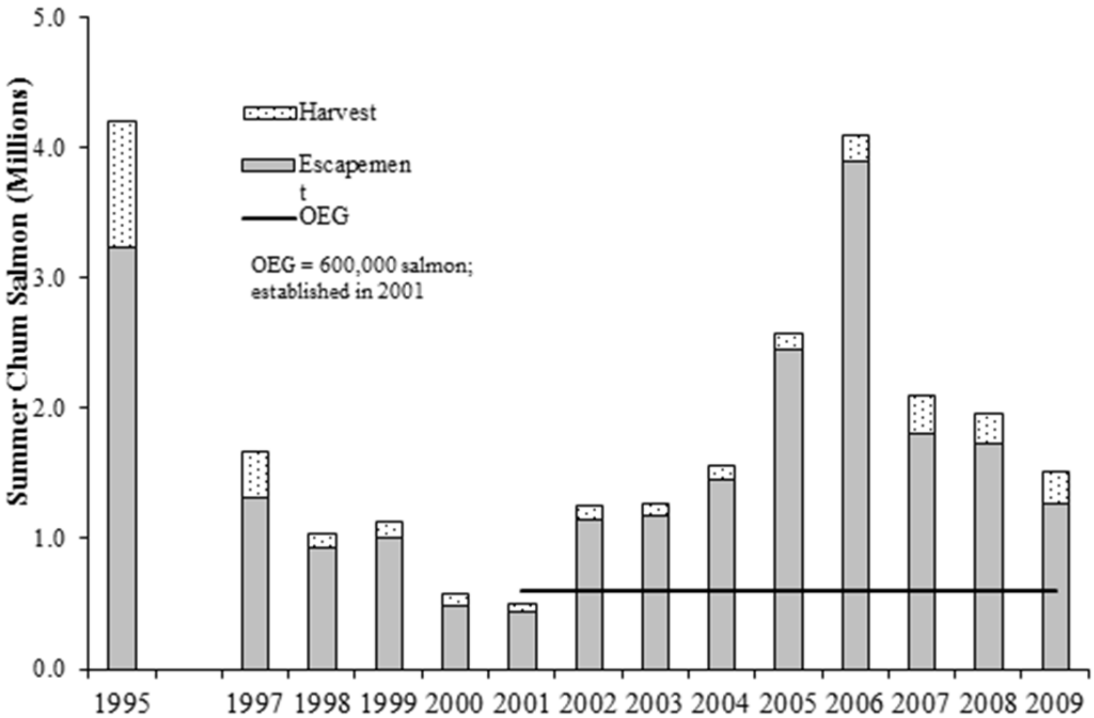



Figure 5-25. Estimated total annual runs of summer chum salmon by harvest and escapement and drainage-wide OEG, Yukon River, 1995 and 1997-2009. Data are unavailable for 1996.

### *Escapement Goals*

Prior to the 2010 Board of Fisheries cycle, the comprehensive management plan identified summer chum salmon runs above a projected run size of 1 million fish as surplus available for commercial harvest (Table 5-13). Thus, in effect, there is an escapement threshold of 1 million minus the annual subsistence harvest. Typically this equates to a riverwide escapement greater than approximately 900,000 fish. Escapement goal analysis of fall chum salmon indicates that there is a wide range of escapement that will provide similar yield and this would likely be the case for summer chum salmon. Of note is that the near record abundance in 2006 was from some of the lowest parent year escapements on record (2001 and 2002).

Table 5-13. Yukon River drainage summer chum salmon management plan overview. Note: This management plan was modified at the 2010 Board of Fisheries cycle meeting.

| | Required Management Actions Summer Chum Salmon-Directed Fisheries | | | |
|---|---|---|---|---|
| Projected Run Size [a] | Commercial | Personal Use | Sport | Subsistence |
| 600,000 or Less | Closure | Closure | Closure | Closure [b] |
| 600,000 to 700,000 | Closure | Closure | Closure | Possible Restrictions [c] |
| 700,001 to 1,000,000 | Restrictions [d] | Restrictions [e] | Restrictions [e] | Normal Fishing Schedules |
| Greater Than 1,000,000 | Open [f] | Open | Open | Normal Fishing |

[a] The department will use the best available data including preseason projections, mainstem river sonar passage estimates, test fisheries indices, subsistence and commercial fishing reports, and passage estimates from escapement monitoring projects to assess the run size.

[b] The department may, by emergency order, open subsistence chum salmon directed fisheries where indicators show that the escapement goal(s) in that area will be achieved.

[c] The department shall manage the fishery to achieve drainage wide escapement of no less than 600,000 summer chum salmon, except that the department may, by emergency order, open a less restrictive directed subsistence summer chum fishery in areas that indicator(s) show that the escapement goal(s) in that area will be achieved.

[d] The department may, by emergency order, open commercial fishing in areas that show the escapement goal(s) in that area will be achieved.

[e] The department may, by emergency order, open personal use and sport fishing in areas that indicator(s) show the escapement goal(s) in that area will be achieved.

[f] The department may open a drainage-wide commercial fishery with the harvestable surplus distributed by district or subdistrict in proportion to the guideline harvest levels established in 5 AAC 05.362. (f) and (g).

From 2001 – 2009 there were two established BEGs for summer chum salmon in the Yukon River drainage. The BEG range for Anvik River has been 350,000–700,000 chum salmon and the BEG range for East Fork Andreafsky River was 65,000 – 300,000 chum salmon. The BEG for Anvik River has been met or exceeded in 26 of 30 years (86%) since 1980; the 4 years when the BEG was not met were 2000, 2001, 2003, and 2009 (Figure 5-26). Assessment of annual escapements has occurred in 22 of 29 years since 1981 in East Fork Andreafsky River with the BEG met or exceeded in 12 out of 22 years (54%), and last met in 2007 (Figure 5-26).

Recent BEGs for Yukon River summer chum salmon are as follows:

| Stream (Project Type) | Current Goal | Type of Goal |
|---|---|---|
| East Fork Andreafsky River (Weir) | 60,000 –300,000 | BEG |
| Anvik River Index (Sonar) | 350,000–700,000 | BEG |

Note: East Fork Andreafsky escapement goal was adjusted to an SEG threshold of >40,000 in the 2010 BOF cycle.

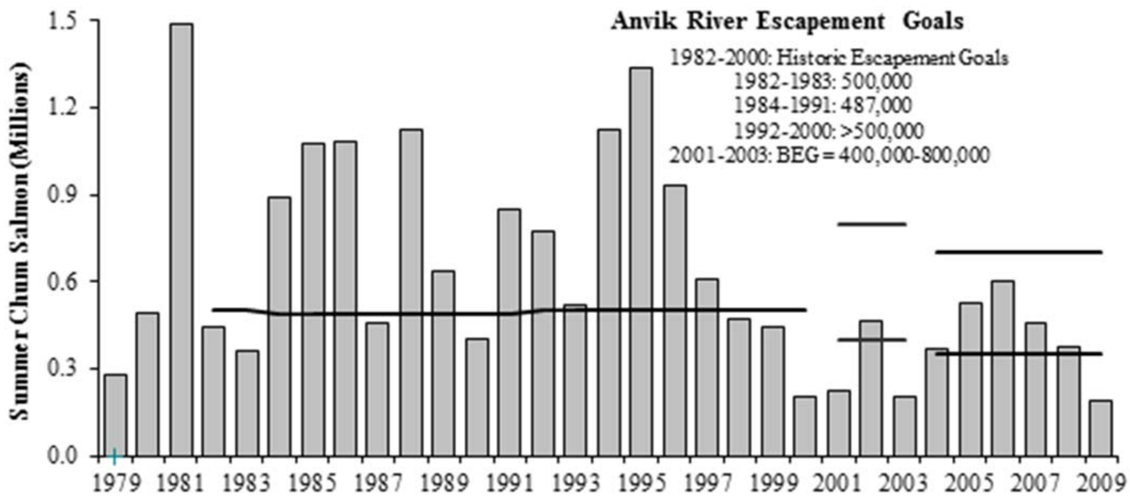
Table 5-14. Yukon River summer chum salmon historical escapement 1980-2009, and Pilot Station sonar passage estimates 1995 and 1997-2009 in numbers of fish.

| Year | Pilot Station Sonar | East Fork Andreafsky River | Anvik River Sonar | Kaltag Creek Tower | Nulato River Tower | Gisasa River Weir | (Clear Creek tower or weir) | Henshaw Creek Weir |
|---|---|---|---|---|---|---|---|---|
| 1980 | | | 492,676 | | | | | |
| 1981 | | 147,312 [a] | 1,486,182 | | | | | |
| 1982 | | 181,352 [a] | 444,581 | | | | | |
| 1983 | | 110,608 [a] | 362,912 | | | | | |
| 1984 | | 70,125 [a] | 891,028 | | | | | |
| 1985 | | [b] | 1,080,243 | | | | | |
| 1986 | | 167,614 [c] | 1,085,750 | | | | | |
| 1987 | | 45,221 [c] | 455,876 | | | | | |
| 1988 | | 68,937 [c] | 1,125,449 | | | | | |
| 1989 | | | 636,906 | | | | | |
| 1990 | | | 403,627 | | | | | |
| 1991 | | | 847,772 | | | | | |
| 1992 | | | 775,626 | | | | | |
| 1993 | | | 517,409 | | | | | |
| 1994 | | 200,981 [b,d] | 1,124,689 | 47,295 | 148,762 [b] | 51,116 [b] | | |
| 1995 | 3,556,445 | 172,148 [d] | 1,339,418 | 77,193 | 236,890 | 136,886 | 116,735 | |
| 1996 | [e] | 108,450 [d] | 933,240 | 51,269 | 129,694 | 158,752 | 100,912 | |
| 1997 | 1,415,641 | 51,139 [d] | 609,118 | 48,018 | 158,395 | 31,800 | 76,454 | |
| 1998 | 826,385 | 67,720 [d] | 469,574 | 8,113 | 50,750 | 21,142 | 212 [b] | |
| 1999 | 973,708 | 32,587 [d] | 441,305 | 5,339 | 30,456 | 10,155 | 11,283 [b] | [b] |
| 2000 | 456,271 | 24,783 [d] | 205,460 | 6,727 | 24,308 | 11,410 | 19,376 | 27,271 |
| 2001 | 441,450 | [b,d] | 224,058 | [b] | [b] | 17,946 [b] | 3,674 | 35,031 |
| 2002 | 1,088,463 | 44,194 [d] | 462,396 | 13,583 | 72,286 | 33,481 | 13,150 | 25,249 |
| 2003 | 1,168,518 | 22,461 [d] | 205,682 | 3,056 [b] | 17,814 [b] | 25,999 | 5,230 | 22,556 |
| 2004 | 1,357,826 | 64,883 [d] | 365,556 | 5,247 | [f] | 37,851 | 15,661 | 86,474 |
| 2005 | 2,439,616 | 20,127 [d] | 525,391 | 22,093 | [f] | 172,259 | 26,420 | 237,481 |
| 2006 | 3,767,044 | 102,260 [d] | 992,378 [g] | [f] | [f] | 261,305 | 29,166 [h] | [b] |
| 2007 | 1,726,885 | 69,642 [d] | 459,038 | [f] | [f] | 46,257 | [f] | 32,080 |
| 2008 | 1,665,667 | 57,259 [d] | 374,929 | [f] | [f] | 36,938 | [f] | 97,281 |
| 2009 | 1,285,437 [i] | 8,770 [d,i] | 193,099 [i] | [f] | [f] | 25,904 [i] | [f] | 156,201 [i] |
| 2005-2009 avg. | 2,176,930 | 51,612 | 508,967 | n/a | n/a | 108,533 | n/a | 130,761 |
| BEG | | 65,000-130,000 | 350,000-700,000 | n/a | n/a | n/a | n/a | n/a |

Note: Years with no data are years in which the project was not operated or was inoperable for a large portion of the season due to water conditions.

[a] Sonar counts used.
[b] Incomplete count caused by late installation and/or early removal of project, or high water.
[c] Tower counts used.
[d] Weir counts used.
[e] Pilot Station sonar operated in training mode only and no estimates were generated.
[f] Project did not operate.
[g] HTI and DIDSON sonar equuipment were both used in 2006, and the estimate reported is DIDSON derived.
[h] Videography count used.
[i] Data are preliminary.

The Anvik River BEG was met in 2004–2008 (Figure 5-26). A substantial decrease in Anvik River summer chum salmon production began with the 1993 brood year and has continued through the 2004 brood year. These escapements produced salmon that returned in 1997 through 2009. Escapements during this time period included large escapements in 1994, 1995, and 1996 (Figure 5-26) that failed to replace themselves (recruits per spawner (R/S) <1.0; Clark and Sandone 2001).



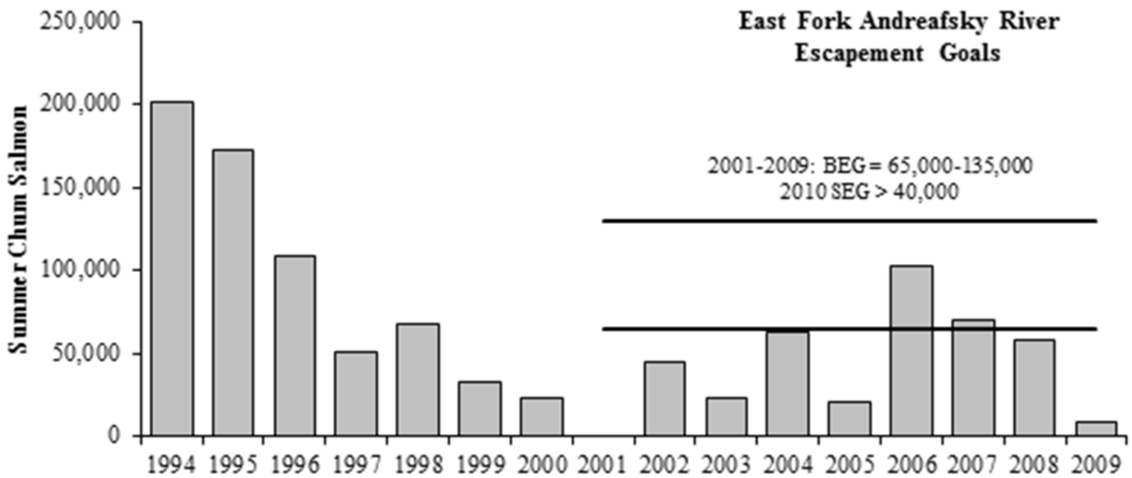




Figure 5-26. Summer chum salmon escapement estimates and escapement goals for Anvik River sonar (1979-2009), and E.F. Andreafsky River weir (1994-2009).

Stock composition of Yukon River summer chum runs has been in flux over the last decade. Anvik River, the largest producer of summer chum salmon, contribution to the overall Yukon River stock production above Pilot Station sonar has decreased from approximately 46% during the period from 1995 through 2002 to an average of 24% after 2002. This reduction corresponds with a shift to increased production in other chum salmon spawning streams such as in the Koyukuk River drainage, where record escapements of 170,000 and 260,000 in Gisasa River were observed in 2005 and 2006, respectively. However, runs in the Tanana River drainage are also exhibiting instability with record escapements of over 100,000 summer chum salmon observed in Salcha River in 2005 and 2006, yet less than 15,000 observed in 2007. These fluctuations have been observed elsewhere in the Yukon River drainage. The disparate strength of individual stocks within and among years seems to signal a shift in summer chum production, and exploratory aerial surveys were conducted in 2009 to better assess primary locations of summer chum salmon escapement in lower and middle Yukon River tributaries.

Although the Yukon River summer chum salmon stock appears to have recovered as a whole, the BEG for East Fork Andreafsky summer chum salmon has been met twice, in 2006 and 2007, since 2002 (Figure 5-26). However, the 2004 East Fork Andreafsky River escapement was within 2,000 summer chum salmon of the lower range of the BEG of 65,000. It is interesting to note that from 2002 through

2006, no directed summer chum salmon commercial fisheries occurred below the mouth of Andreafsky River, with the exception of a 3-hour commercial period in 2006, and the subsistence exploitation rate is relatively low. It is thought that Andreafsky River fish enter the Yukon River delta late in the run and are watermarked, making them less desirable to commercial buyers and fishermen. Further, it is believed that Andreafsky River fish are not readily susceptible to harvest because most, if not all, subsistence harvest has been completed by the time Andreafsky River summer chum salmon enter lower Yukon River. Regardless, under current management practices, Andreafsky River summer chum salmon are managed incidental to the overall Yukon River summer chum salmon run, and no management actions have been taken specifically for this tributary stock.

### *Maturity*

While data are not available to estimate the age composition of the overall Yukon River summer chum salmon return, data are available for the Anvik River. Since the Anvik River represents approximately 25% of the overall run in recent years, it is believed that it is likely representative of the overall population. The 2000-2009 average age composition for the Anvik River is dominated by age-4 fish.

| | Age Class | | | | |
|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | 7 |
| Proportion | 0.014 | 0.529 | 0.427 | 0.031 | 1.00E-04 |

### ***Harvest***

Combined commercial and subsistence harvests show a substantial decrease from the 1980s and 1990s compared to the recent 5-year (2005–2009) average of approximately 226,994 (Figure 5-27). The recent decline in utilization is largely due to reductions in commercial harvest. Commercial harvest of summer chum salmon averaged about 394,400 during the 1990s and 130,611 from 2005 through 2009. Below average runs from 1998 through 2003 resulted in low available yields of summer chum salmon. In 2004, a modest surplus was identified, whereas in 2005 and 2006, substantial surpluses were available for commercial harvest. However, there was little exploitation of these available surpluses due to poor commercial market conditions for summer chum salmon. From 1997 through 2006, the commercial harvest of summer chum salmon was primarily incidental to directed Chinook salmon fisheries. Since 2007 there has been renewed market interest and directed summer chum salmon commercial opportunity has been provided in 2007 through 2009. Unfortunately, despite harvestable surpluses available in these years, redevelopment of this fishery has been largely hindered by management strategies taken in response to poor Chinook salmon runs, which co-migrate with summer chum salmon. Management actions taken to reduce Chinook salmon harvest, including incidental harvest in summer chum salmon-directed fisheries, have negatively affected the summer chum salmon fishery.

### ***2010 Summary***

Inseason run strength assessment of summer chum salmon was based on the lower river test fisheries (LYTF) at Emmonak and Mountain Village, the Pilot Station sonar, and subsistence fishermen catch reports. Management decisions regarding summer chum salmon were delayed until the third quarter point in the Chinook salmon run at LYTF, just after the peak of the summer chum salmon run. A total run size of 1.4 million chum salmon was projected. A short commercial fishing period was announced for June 26 in District 1, with nets restricted to six-inch maximum mesh size. Test fishery information prior to the commercial opening indicated a drop in the summer chum salmon entering the river, so the opening was delayed until June 28 to avoid over-harvesting Chinook salmon. A total of 30,295 chum salmon were harvested during the first opening. Fishing was again delayed until July 1 when the commercial fishery resumed on a more regular schedule for Districts 1 and 2.

The department scheduled eight commercial fishing periods targeting summer chum salmon in District 1 and seven in District 2. The harvest from both Districts is 183,215 summer chum salmon, which is 181% above the 2000 - 2009 average harvest of 65,143 fish.

A summer chum salmon directed commercial fishery in Subdistrict 4-A opened on July 7. Subsistence salmon fishing periods were not altered by commercial salmon fishing periods. Chinook salmon were kept for subsistence use. The harvest in 4-A is 44,207 summer chum salmon.

District 6 was managed using inseason assessment information provided by projects operated in the Tanana River drainage. Based on the available surplus and market interest, the first commercial fishing period occurred on July 19. There were a total of seven commercial fishing periods targeting chum salmon in District 6 with a total harvest of 5,466 summer chum salmon.

The total Yukon Area commercial harvest was 232,888 summer chum salmon, which is 195% above the 2000-2009 average harvest.

Summer chum salmon escapements were variable, but most tributaries experienced good escapements. East Fork Andreafsky SEG and Anvik BEG were met. Salcha River escapement, however, was approximately 7,000 fish less than expected. The Pilot Station sonar summer chum passage estimate through July 18 was 1,327,581 fish, and the reconstructed run size for 2010 is approximately 1.6 million fish.

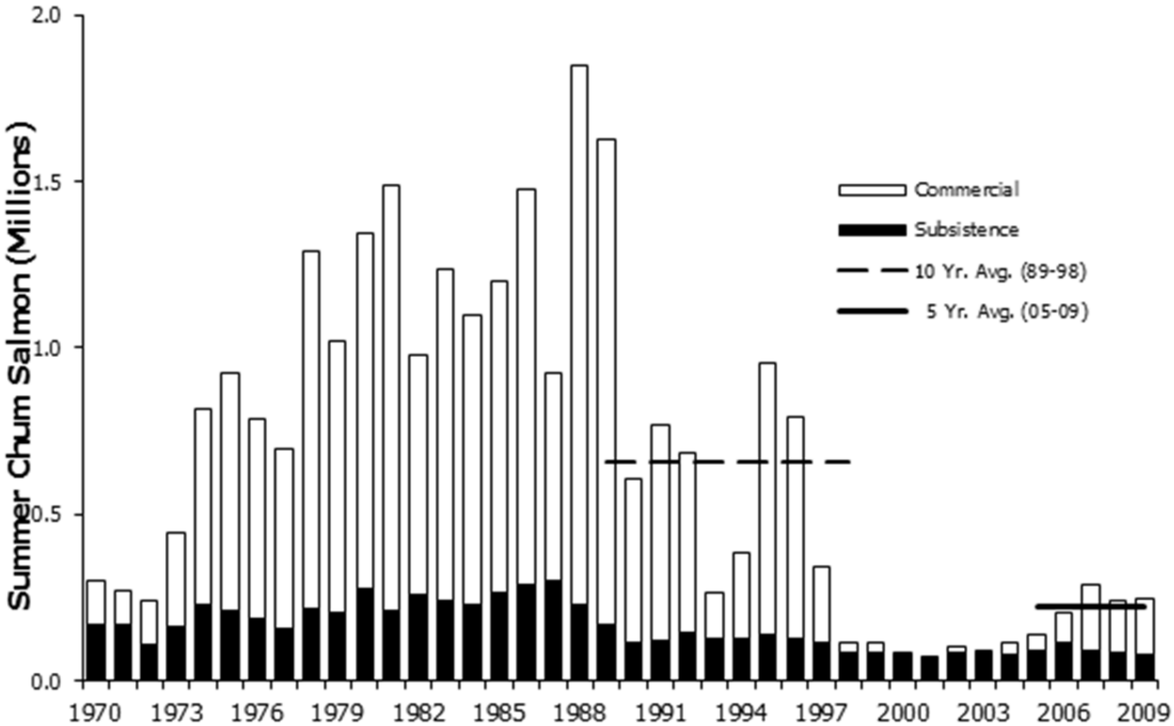



Figure 5-27. Yukon River summer chum salmon subsistence and commercial harvests from 1970 to 2009, compared to the 1989–1998 average (approximately 665,100 fish) and the 2005–2009 average (226,994 fish).

### *Exploitation Rates*

Annual total run estimates can be coupled with total inriver utilization to estimate exploitation rates exerted on Yukon River summer chum salmon for the years 1995 and 1997–2009 (Figure 5-28). Total exploitation rates exerted by Yukon River fisheries on summer chum salmon over 14 years averaged about 12.2%, ranging from as high as 23.0% in 1995 to as low as 4.3% in 2006. Note that both these years had run sizes in excess of 4.0 million fish. Exploitation rates on the 2 lowest runs, approximately 550,000 fish, in 2000 and 2001, were 15.1% and 13.1%, respectively (Figure 5-28). Exploitation rates have been increasing slightly since 2007 owing to increased market interest; however, these harvest rates are low in comparison to exploitation rates exerted on most Alaska salmon populations and primarily reflect the lack of commercial markets.

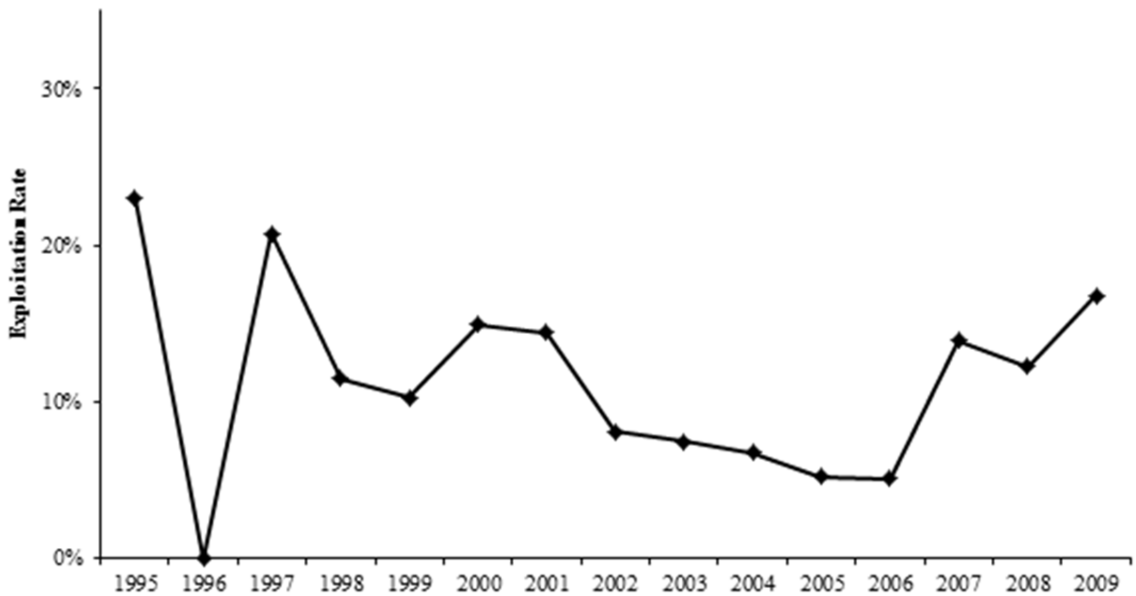



Figure 5-28. Approximate exploitation rates on Yukon River summer chum salmon stocks, 1995 and 1997–2009. Data are unavailable for 1996.

## 5.2.5.2 Fall run

In response to guidelines established in the SSFP (5 AAC 39.222(f)(21)), the BOF classified Yukon River fall chum salmon as a stock of yield concern and classified Toklat and Fishing Branch rivers fall chum salmon as stocks of management concerns at its September 2000 work session. The determination for the entire Yukon River fall chum salmon as a stock of yield concern was based on substantial decrease in yields and harvestable surpluses during the period 1998–2000, and the anticipated very low run expected in 2001. The determination for Toklat and Fishing Branch rivers as stocks of management concern was based on escapements not meeting the OEG of 33,000 for Toklat River from 1996 to 2000, and not meeting the escapement objective of 50,000–120,000 salmon for Fishing Branch River from 1997 to 2000. An action plan was subsequently developed by ADF&G (ADF&G 2000) and acted upon by the BOF in January 2001.

Yukon River fall chum salmon classification as a yield concern was continued at the January 2004 BOF meeting because the combined commercial and subsistence harvests showed a substantial decrease in fall chum salmon yield from the 10-year period (1989–1998) to the more recent 5-year (1999–2003) average

(Bue et al. 2004). Toklat River stock was removed from management concern classification as a result of the BEG review presented at that BOF meeting. However, as a component of the Yukon River drainage, Toklat River fall chum salmon stock was included in the drainage-wide yield concern classification. Fishing Branch River stock was also removed from the management concern classification because management of that portion of the drainage is covered by the U.S./Canada Yukon River Salmon Agreement (Agreement), part of the Pacific Salmon Treaty, which is governed under the authority of the Yukon River Panel (Panel).

In January 2007, the BOF determined that Yukon River fall chum salmon stock no longer met the criteria for a yield concern. Run strength was poor from 1998 through 2002; however, steady improvement had been observed since 2003 (JTC 2006). The 2005 run was the largest in 30 years and 2006 was above average for an even-numbered year run; the drainagewide OEG of 300,000 fall chum salmon was exceeded in the preceding 5 years. The 5-year average (2002–2006) total reconstructed run of approximately 950,000 fish was greater than the 1989–1998 10-year average of approximately 818,000 fish, which indicated a return to historical run levels.

#### ***Stock Assessment Background***

### *Escapement*

Fall chum salmon spawn in fairly unique areas of the drainage where warmer upwelling waters can incubate eggs in a shorter time frame than summer chum salmon spawning habitats would allow (Figure 5-29). Analysis of biological escapement goals (BEGs) conducted by Eggers (2001) provided a drainagewide goal of 300,000 to 600,000 fall chum salmon, as well as tributary goals for main monitored systems in the upper Yukon River drainage, including Tanana River. Management of the fall season fishery is prescribed in 5 AAC 01.249. *Yukon River Drainage Fall Chum Salmon Management Plan* and describes recommended fishery actions based on estimates of run size (Table 5-15). The plan aligns the escapement goal threshold with the lower end of the established BEG range. This provides more subsistence fishing opportunity in years of poor runs while still attaining escapement goals. Drainagewide commercial fishing is allowed on the projected surplus above 600,000 fish which provides for subsistence use priority and bolsters escapement on strong runs. This report focuses on the recent 5-year period prior to the January 2010 Board of Fisheries cycle meeting.

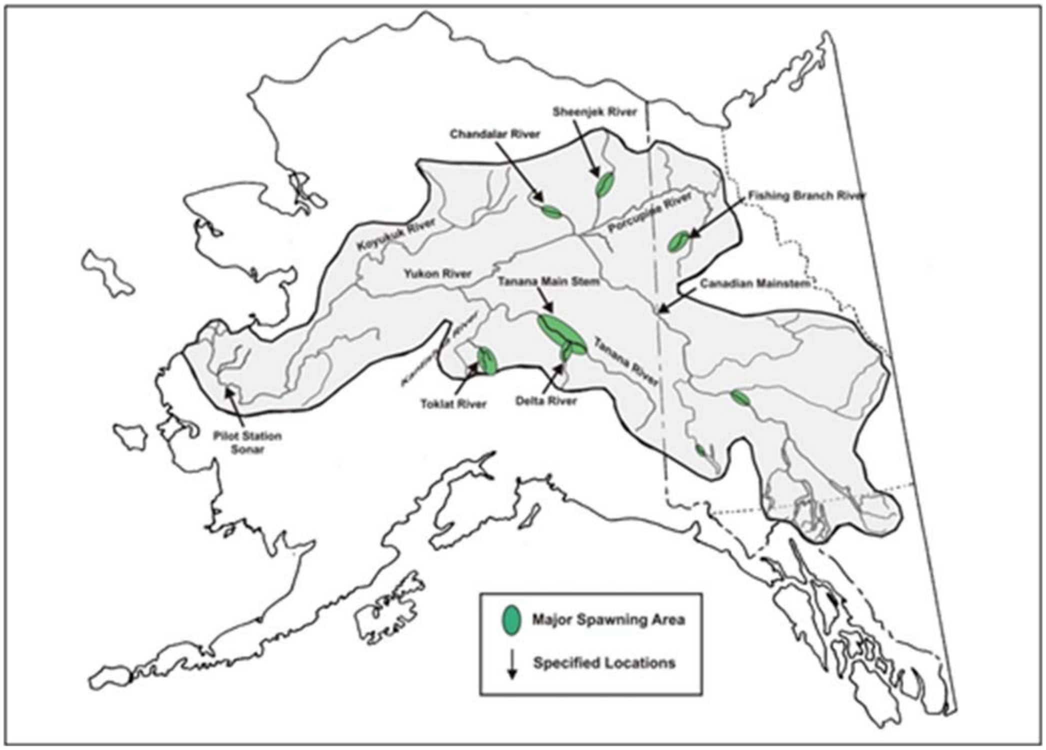



Figure 5-29. Map showing major spawning areas of fall chum salmon in Alaska and Canada.

Table 5-15. Yukon River drainage fall chum salmon management plan, 5AAC 01.249, 2009.

| Run Size Estimate [b] (Point Estimate) | Recommended Management Action Fall Chum Salmon Directed Fisheries [a] | | | | Targeted Drainagewide Escapement |
|---|---|---|---|---|---|
| | Commercial | Personal Use | Sport | Subsistence | |
| 300,000 or Less | Closure | Closure | Closure | Closure [c] | |
| 300,001 to 500,000 | Closure | Closure [c] | Closure [c] | Possible Restrictions [c, d] | 300,000 to 600,000 |
| 500,001 to 600,000 | Restrictions [c] | Open | Open | Pre-2001 Fishing Schedules | |
| Greater Than 600,000 | Open [e] | Open | Open | Pre-2001 Fishing Schedules | |

Note: This management plan was modified at the 2010 BOF cycle meeting.

[a] Considerations for the Toklat River and Canadian mainstem rebuilding plans may require more restrictive management actions.

[b] The department will use the best available data, including preseason projections, mainstem river sonar passage estimates, test fisheries indices, subsistence and commercial fishing reports, and passage estimates from escapement monitoring projects.

[c] The fisheries may be opened or less restrictive in areas where indicator(s) suggest the escapement goal(s) in that area will be achieved.

[d] Subsistence fishing will be managed to achieve a minimum drainagewide escapement goal of 300,000 fall chum salmon.

[e] Drainagewide commercial fisheries may be open and the harvestable surplus above 600,000 fall chum salmon will be distributed by district or subdistrict (in proportion to the guidelines harvest levels established in 5 AAC 05.365 and 5 AAC 05.367).

Fall chum salmon run abundance is assessed inseason using estimates provided by Pilot Station sonar whereas post-season run reconstruction uses the estimates of the individual escapement projects. One method of obtaining an estimate of total run of fall chum salmon in Yukon River consists of the following summation: (1) the sonar based estimates of fall chum salmon passage at Pilot Station, in the years 1995 and 1997–2009, (2) the total harvest of fall chum salmon in District 1 and that portion of District 2 below the Pilot Station sonar site, and (3) an estimate of fall chum salmon passage after the sonar operations ceased, typically around end of August (on average 7% of total passage, based on years when sonar was operated to mid-September or on run timing of Mt. Village test fishery that operates annually beyond the first week of September). The second method used for run reconstruction post-season includes adding the escapement projects together including: Chandalar (sonar), Sheenjek (sonar), Fishing Branch (weir), Mainstem Yukon at U.S./Canada Border (mark-recapture to sonar) and Tanana (mark-recapture) rivers as well as consideration of harvests where appropriate. The most complete Yukon River escapement coverage of fall chum salmon occurred between 1995 and 200. Brood tables were updated from Eggers (2001), which included 1974 to 1995, by Fleischman and Borba (2009) through the 2004 brood year. Note that the harvest estimates that were used in the run reconstruction (Table 5-16) are slightly different (not significant) than those presented in the JTC (2010) report because of maintaining Eggers (2001) dataset with recent updates to US and Canadian harvests.

The total reconstructed run of Yukon River fall chum salmon averages about 868,000 fish during the 36-year period (1974–2009), ranging from a low of about 239,000 fish in 2000 to over 2.2 million fish in 2005, about an 8-fold level of variation (Table 5-16, Figure 5-30). Historically estimated total returns indicated cycles in Yukon River fall chum salmon abundance from 1974 through 1992 even-odd numbered year cycles dominated and more recently a ten year pattern of high abundance also appears to be emerging (1975, 1985, 1995 and 2005). Generally, smaller run sizes occur during even-numbered years and larger returns in odd-numbered years fairly regularly between 1974 and 1992. From 1974 through 2009, estimated total run size in odd-numbered years averaged 1,000,000 fall chum salmon, ranging from approximately 382,000 fish (2001 – lowest odd-numbered year return on record) to 2,286,000 fish in 2005. Run size in even-numbered years averaged 687,000 fall chum salmon and ranges from approximately 239,000 fish (2000 – lowest return on record) to 1,144,000 fish in 2006. It is notable that 1996 and 2006 are the only even-numbered years that total fall chum salmon run size exceeded the average run size for odd-numbered years.

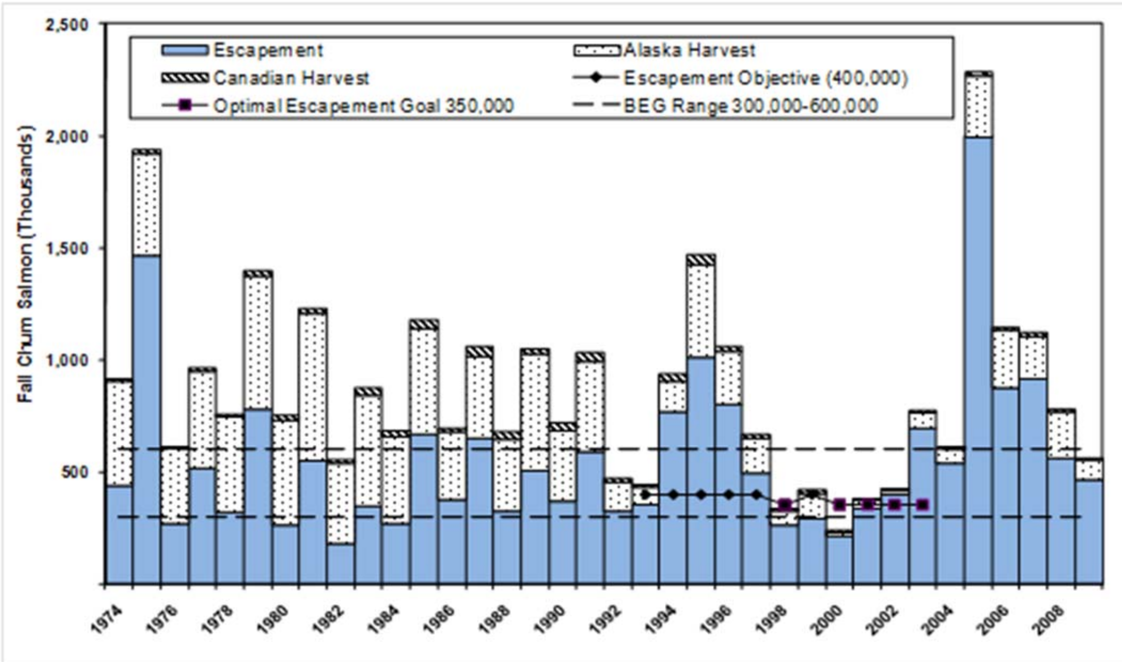



Figure 5-30. Total run reconstruction based on estimated harvest and escapement of fall chum salmon, Yukon River drainage, 1974–2008 with the 2009 run size estimate.

*Note*: The drainagewide escapement goal of 400,000 fall chum salmon was established in 1993. In 1996, an optimal escapement goal of 350,000 fall chum salmon was established in the *Yukon River Fall Chum Salmon Management Plan* and was utilized in 1998, 2000, and 2001. In 2004, a drainagewide escapement goal range of 300,000 to 600,000 fall chum salmon was established.

Table 5-16. Fall chum salmon estimated brood year production and return per spawner estimates, Yukon Area, 1974–2009.

| | (P) | | Estimated Brood Year Return | | | | | | | | | (R) | (R/P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Estimated Annual Totals | | | Number of Salmon [a] | | | | Percent | | | | | Total Brood | Return/ |
| Year | Escapement [b] | Catch | Return | Age 3 | Age 4 | Age 5 | Age 6 | Age 3 | Age 4 | Age 5 | Age 6 | Year Return[a] | Spawner |
| 1974 | 436,485 | 478,875 | 915,360 | 91,751 | 497,755 | 68,693 | 0 | 0.139 | 0.756 | 0.104 | 0.000 | 658,199 | 1.51 |
| 1975 | 1,465,213 | 473,062 | 1,938,275 | 150,451 | 1,225,440 | 61,401 | 123 | 0.105 | 0.853 | 0.043 | 0.000 | 1,437,415 | 0.98 |
| 1976 | 268,841 | 339,043 | 607,884 | 102,062 | 587,479 | 137,039 | 4,316 | 0.123 | 0.707 | 0.165 | 0.005 | 830,895 | 3.09 |
| 1977 | 514,843 | 447,918 | 962,761 | 102,660 | 1,075,198 | 175,688 | 4,189 | 0.076 | 0.792 | 0.129 | 0.003 | 1,357,735 | 2.64 |
| 1978 | 320,487 | 434,030 | 754,517 | 22,222 | 332,230 | 90,580 | 0 | 0.050 | 0.747 | 0.204 | 0.000 | 445,032 | 1.39 |
| 1979 | 780,818 | 615,377 | 1,396,195 | 41,114 | 769,496 | 274,311 | 3,894 | 0.038 | 0.707 | 0.252 | 0.004 | 1,088,814 | 1.39 |
| 1980 | 263,167 | 488,373 | 751,540 | 8,377 | 362,199 | 208,962 | 3,125 | 0.014 | 0.622 | 0.359 | 0.005 | 582,663 | 2.21 |
| 1981 | 551,192 | 683,391 | 1,234,583 | 45,855 | 955,725 | 278,386 | 8,888 | 0.036 | 0.742 | 0.216 | 0.007 | 1,288,853 | 2.34 |
| 1982 | 179,828 | 373,519 | 553,347 | 11,327 | 400,323 | 166,754 | 679 | 0.020 | 0.691 | 0.288 | 0.001 | 579,083 | 3.22 |
| 1983 | 347,157 | 525,485 | 872,642 | 12,569 | 875,355 | 223,468 | 2,313 | 0.011 | 0.786 | 0.201 | 0.002 | 1,113,704 | 3.21 |
| 1984 | 270,042 | 412,323 | 682,365 | 7,089 | 408,040 | 174,207 | 8,516 | 0.012 | 0.683 | 0.291 | 0.014 | 597,852 | 2.21 |
| 1985 | 664,426 | 515,481 | 1,179,907 | 46,635 | 874,819 | 270,984 | 3,194 | 0.039 | 0.732 | 0.227 | 0.003 | 1,195,632 | 1.80 |
| 1986 | 376,374 | 318,028 | 694,402 | 0 | 429,749 | 368,513 | 4,353 | 0.000 | 0.535 | 0.459 | 0.005 | 802,614 | 2.13 |
| 1987 | 651,943 | 406,143 | 1,058,086 | 12,413 | 617,519 | 290,767 | 7,720 | 0.013 | 0.665 | 0.313 | 0.008 | 928,418 | 1.42 |
| 1988 | 325,137 | 353,685 | 678,822 | 41,003 | 175,236 | 152,368 | 10,894 [c] | 0.108 | 0.462 | 0.401 | 0.029 | 379,501 | 1.17 |
| 1989 | 506,173 | 545,166 | 1,051,339 | 2,744 | 282,905 | 345,136 [c] | 20,290 | 0.004 | 0.435 | 0.530 | 0.031 | 651,075 | 1.29 |
| 1990 | 369,654 | 352,007 | 721,661 | 710 | 579,452 [c] | 418,448 | 30,449 | 0.001 | 0.563 | 0.407 | 0.030 | 1,029,059 | 2.78 |
| 1991 | 591,132 | 439,096 | 1,030,228 | 3,663 [c] | 1,024,800 | 369,103 | 12,167 | 0.003 | 0.727 | 0.262 | 0.009 | 1,409,733 | 2.38 |
| 1992 | 324,253 | 148,846 | 473,099 | 6,763 | 653,648 | 197,073 | 3,907 | 0.008 | 0.759 | 0.229 | 0.005 | 861,392 | 2.66 |
| 1993 | 352,688 | 91,015 | 443,703 | 7,745 | 451,327 | 102,420 | 3,235 | 0.014 | 0.799 | 0.181 | 0.006 | 564,727 | 1.60 |
| 1994 | 769,920 | 169,225 | 939,145 | 4,322 | 225,243 | 149,527 | 1,603 [c] | 0.011 | 0.592 | 0.393 | 0.004 | 380,695 | 0.49 |

-continued-

Table 5-16 continued

| | (P) | | | Estimated Brood Year Return | | | | | | | | (R) | (R/P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Estimated Annual Totals | | | | Number of Salmon | | | | Percent | | | | Total Brood | Return |
| Year | Escapement | Catch | Return | Age 3 | Age 4 | Age 5 | Age 6 | Age 3 | Age 4 | Age 5 | Age 6 | Year Return | Spawner |
| 1995 | 1,009,155 | 461,147 | 1,470,302 | 2,371 | 266,955 | 68,918 [c] | 383 | 0.007 | 0.788 | 0.204 | 0.001 | 338,627 | 0.34 |
| 1996 | 800,022 | 260,923 | 1,060,945 | 420 | 165,691 [c] | 136,906 | 8,295 | 0.001 | 0.532 | 0.440 | 0.027 | 311,312 | 0.39 |
| 1997 | 494,831 | 170,059 | 664,890 | 3,087 [c] | 244,801 | 118,343 | 3,332 | 0.008 | 0.662 | 0.320 | 0.009 | 369,563 | 0.75 |
| 1998 | 263,121 | 70,820 | 333,941 | 651 | 269,653 | 57,962 | 6,694 | 0.002 | 0.805 | 0.173 | 0.020 | 334,960 | 1.27 |
| 1999 | 288,962 | 131,175 | 420,137 | 29,097 | 705,152 | 174,424 | 13,720 | 0.032 | 0.764 | 0.189 | 0.015 | 922,392 | 3.19 |
| 2000 | 210,756 | 28,543 | 239,299 | 8,446 | 297,012 | 115,478 | 0 | 0.020 | 0.706 | 0.274 | 0.000 | 420,937 | 2.00 |
| 2001 | 337,765 | 44,976 | 382,741 | 136,038 | 2,157,498 | 675,688 | 33,955 | 0.045 | 0.718 | 0.225 | 0.011 | 3,003,179 | 8.89 |
| 2002 | 397,977 | 27,411 | 425,388 | 0 | 444,507 | 239,154 | 13,067 | 0.000 | 0.638 | 0.343 | 0.019 | 696,728 | 1.75 |
| 2003 | 695,363 | 79,529 | 774,892 | 24,263 | 858,714 | 434,639 | 16,010 | 0.018 | 0.644 | 0.326 | 0.012 | 1,333,626 | 1.92 |
| 2004 | 537,873 | 76,296 | 614,169 | 0 | 332,454 | 145,202 | 7,377 | 0.000 | 0.685 | 0.299 | | 485,033 [d] | >0.90 |
| 2005 | 1,996,513 | 290,183 | 2,286,696 | 2,269 | 370,342 | 150,844 | | | | | | 523,455 [e] | >0.26 |
| 2006 | 873,987 | 270,471 | 1,144,458 | 24,349 | | | | | | | | | |
| 2007 | 928,430 | 203,393 | 1,131,823 | | | | | | | | | | |
| 2008 | 564,482 | 217,947 | 782,429 | | | | | | | | | | |
| 2009 | 462,583 | 93,319 | 555,902 | | | | | | | | | | |
| 2009 Avg. | 560,878 | 306,563 | 867,441 | | | | | | | | | | |
| | 494,258 | All Brood Years (1974–2003) | | 30,862 | 607,131 | 218,178 | 7,644 | 0.0319 | 0.6870 | 0.2716 | 0.0095 | 863,814 | 2.08 |
| | 371,738 | Even Brood Years (1974–2003) | | 20,343 | 388,548 | 178,778 | 6,393 | 0.0340 | 0.6531 | 0.3020 | 0.0109 | 594,062 | 1.89 |
| | 616,777 | Odd Brood Years (1974–2003) | | 41,380 | 825,714 | 257,578 | 8,894 | 0.0299 | 0.7209 | 0.2412 | 0.0080 | 1,133,566 | 2.28 |

[a] The estimated number of salmon which returned are based upon annual age composition observed in lower Yukon test nets each year, weighted by test fish CPUE.

[b] Contrast in escapement data is 11.10.

[c] Based upon expanded test fish age composition estimates for years in which the test fishery terminated early (both in 1994 and 2000).

[d] Brood year return for 3, 4, and 5 year fish, indicate that production (R/P) from brood year 2004 was at least 0.90. Recruits estimated for incomplete brood year.

[e] Brood year return for 3 and 4 year fish, indicate that production (R/P) from brood year 2005 was at least 0.26. Recruits estimated for incomplete brood year.

### *Escapement goals*

Current BEGs and SEGs for Yukon River fall chum salmon are as follows:

| Stream (Project Type) | Current Goal | Type of Goal |
|---|---|---|
| Yukon Drainage (multiple) | 300,000–600,000 | SEG |
| Tanana River (mark-recapture) | 61,000–136,000 | BEG |
| Delta River (foot surveys) | 6,000–13,000 | BEG |
| Toklat River (foot survey) | 15,000–33,000 | Eliminated |
| Upper Yukon R. Tributaries (multiple) | 152,000–312,000 | BEG |
| Chandalar River (sonar) | 74,000–152,000 | BEG |
| Sheenjek River (sonar) | 50,000–104,000 | BEG |
| Canadian Upper Yukon River (sonar) | >80,000[a] | IMEG[b] |
| Fishing Branch River (weir) | 50,000–120,000[a] | IMEG[b] |

[a] U.S./Canada escapement goals based on Yukon Salmon Agreement.

[b] Interim Management Escapement Goals (IMEG) are set by the U.S./Canada Panel. The current IMEG for Fishing Branch River is 22,000 to 49,000 fall chum salmon through 2010.

Fall chum salmon run strength was poor to below average from 1998 through 2002 with 1998 and 2000 being the weakest runs on record. More recently, fall chum salmon runs have shown marked improvement with estimated drainagewide escapement exceeding the upper end of the OEG range of 600,000 fish in 2003 and 2005 through 2007, with approximately 2.0 million in 2005, the largest escapement on record. The low end of the drainagewide escapement goal of 300,000 fall chum salmon was not met in 1998 through 2000, but has been exceeded annually since that time (Figure 5-31).

Biological escapement goals in Chandalar and Delta rivers have been met or exceeded in each of the past 10 years, except for low escapements in 2000 (Table 5-17 and Figure 5-32). Sheenjek River BEG is based on estimated passage for only one bank and the goal has only been met 4 times since 1997. Escapement objectives for fall chum salmon stocks in Yukon River Canadian mainstem and Fishing Branch River were originally recommended by the U.S./Canada Joint Technical Committee (JTC) and specifically stipulated in the Agreement. Because of poor runs in the early 2000s, the Panel agreed to lower escapement targets through 2005 for Canadian mainstem fall chum salmon stock to allow for some U.S. subsistence and Canadian aboriginal harvest, while rebuilding the stock over 3 life cycles. However, the escapement objective of >80,000 for this stock had been exceeded since 2002 and since 2006 goals were again based on rebuilt status (Table 5-17 and Figure 5-32).

Table 5-17. Fall chum salmon passage estimates and escapement estimates for selected spawning areas, Yukon River drainage, 1971–2009.

| | Alaska | | | | | | | | Canada | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Yukon | Tanana River Drainage | | | | | Upper Yukon River Drainage | | | |
| Year | River Mainstem Sonar Estimate | Toklat River [a] | Kantishna / Toklat Rivers Tagging Estimate [b] | Delta River [c] | Bluff Cabin Slough [d] | Upper Tanana River Tagging Estimate [e] | Chandalar River [f] | Sheenjek River [g] | Fishing Branch River [h] | Mainstem Tagging Escapement Estimate [i] |
| 1971 | | | | | | | | | 312,800 [j] | |
| 1972 | | | | | | | | | 35,125 [k] | |
| 1973 | | | | | | | | | 15,989 | |
| 1974 | | 41,798 | | 5,915 [l] | | | | 89,966 [m] | 31,525 | |
| 1975 | | 92,265 | | 3,734 | | | | 173,371 [m] | 353,282 | |
| 1976 | | 52,891 | | 6,312 | | | | 26,354 [m] | 36,584 [j] | |
| 1977 | | 34,887 | | 16,876 | | | | 45,544 [m] | 88,400 [j] | |
| 1978 | | 37,001 | | 11,136 [l] | | | | 32,449 [m] | 40,800 [j] | |
| 1979 | | 158,336 | | 8,355 [l] | | | | 91,372 [m] | 119,898 [j] | |
| 1980 | | 26,346 | | 5,137 [l] | 3,190 [n] | | | 28,933 [m] | 55,268 [j] | 22,912 |
| 1981 | | 15,623 | | 23,508 [l] | 6,120 [n] | | | 74,560 | 57,386 [o] | 47,066 [p] |
| 1982 | | 3,624 | | 4,235 [l] | 1,156 | | | 31,421 | 15,901 [j] | 31,958 |
| 1983 | | 21,869 | | 7,705 [l] | 12,715 | | | 49,392 | 27,200 [j] | 90,875 |
| 1984 | | 16,758 | | 12,411 [l] | 4,017 | | | 27,130 | 15,150 [j] | 56,633 [p] |
| 1985 | | 22,750 | | 17,276 | 2,655 [n] | | | 152,768 [q] | 56,016 | 62,010 |
| 1986 | | 17,976 | | 6,703 | 3,458 | | 59,313 | 84,207 [q, r] | 31,723 | 87,940 |
| 1987 | | 22,117 | | 21,180 [l] | 9,395 | | 52,416 | 153,267 [q, r] | 48,956 | 80,776 |
| 1988 | | 13,436 | | 18,024 [l] | 4,481 [n] | | 33,619 | 45,206 [r] | 23,597 | 36,786 |
| 1989 | | 30,421 | | 21,342 | 5,386 [n] | | 69,161 | 99,116 [r] | 43,834 | 35,750 |
| 1990 | | 34,739 | | 8,992 | 1,632 | | 78,631 | 77,750 [r] | 35,000 [s] | 51,735 |
| 1991 | | 13,347 | | 32,905 | 7,198 | | | 86,496 | 37,733 | 78,461 |
| 1992 | | 14,070 | | 8,893 | 3,615 [n] | | | 78,808 | 22,517 | 49,082 |
| 1993 | 295,000 | 27,838 | | 19,857 [l] | 5,550 [n] | | | 42,922 | 28,707 | 29,743 |
| 1994 | 407,000 | 76,057 | | 23,777 | 2,277 [n] | | | 150,565 | 65,247 | 98,358 |
| 1995 | 1,053,245 | 54,513 [t] | | 20,587 [l] | 19,460 | 268,173 | 280,999 | 241,855 | 51,971 [u] | 158,092 |

**Table 5-17 continued.**

| Year | Alaska Yukon River Mainstem Sonar Estimate | Tanana River Drainage: Toklat River [a] | Tanana River Drainage: Kantishna / Toklat Rivers Tagging Estimate [b] | Tanana River Drainage: Delta River [c] | Tanana River Drainage: Bluff Cabin Slough [d] | Tanana River Drainage: Upper Tanana River Tagging Estimate [e] | Upper Yukon River Drainage: Chandalar River [f] | Upper Yukon River Drainage: Sheenjek River [g] | Canada: Fishing Branch River [h] | Canada: Mainstem Tagging Escapement Estimate [i] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1996 | | 18,264 | | 19,758 | 7,074 [d] | 134,563 | 208,170 | 246,889 | 77,278 | 122,429 |
| 1997 | 506,621 | 14,511 | | 7,705 | 5,707 [d] | 71,661 | 199,874 | 80,423 [v] | 26,959 | 85,439 |
| 1998 | 372,927 | 15,605 | | 7,804 | 3,549 [d] | 62,384 | 75,811 | 33,058 | 13,564 | 46,305 |
| 1999 | 379,493 | 4,551 | 27,199 | 16,534 | 7,037 [d] | 97,843 | 88,662 | 14,229 | 12,904 | 58,682 |
| 2000 | 247,935 | 8,911 | 21,450 | 3,001 | 1,595 | 34,844 | 65,894 | 30,084 [w] | 5,053 | 53,742 |
| 2001 | 376,182 | 6,007 [x] | 22,992 | 8,103 | 1,808 [n] | 96,556 [y] | 110,971 | 53,932 | 21,669 | 33,851 |
| 2002 | 326,858 | 28,519 | 56,665 | 11,992 | 3,116 | 109,961 | 89,850 | 31,642 | 13,563 | 98,695 |
| 2003 | 889,778 | 21,492 | 87,359 | 22,582 | 10,600 [n] | 193,418 | 214,416 | 44,047 [z] | 29,519 | 142,683 |
| 2004 | 594,060 | 35,480 | 76,163 | 25,073 | 10,270 [n] | 123,879 | 136,703 | 37,878 | 20,274 | 154,080 |
| 2005 | 1,813,589 | 17,779 [t] | 107,719 | 28,132 | 11,964 [n] | 377,755 | 496,484 | 438,253 [q] | 121,413 | 437,920 |
| 2006 | 790,563 | - | 71,135 | 14,055 | - | 202,669 | 245,090 | 160,178 [q] | 30,849 | 211,193 |
| 2007 | 684,011 | - | 81,843 | 18,610 | - | 320,811 | 228,056 | 65,435 [q] | 33,750 | 214,802 |
| 2008 | 615,127 | - | - | 23,055 | 1,198 [n] | - | 178,278 | 50,353 [q] | 20,055 [aa] | 174,424 |
| 2009 [ab] | 240,449 | - | - | 13,492 | | - | - | 54,126 [q] | 25,828 [aa] | 92,626 |
| Five Year Average | 828,748 | N/A | 86,899 | 19,469 | 6,581 | 300,412 | 286,977 | 153,669 | 46,379 | 226,193 |
| BEG Range | | 15,000 | N/A | 6,000 | N/A | 46,000 [ac] | 74,000 | 50,000 | 27,000 | 60,000 |
| | | 33,000 | | 13,000 | | 103,000 | 152,000 | 104,000 | 56,000 | 129,000 |

| | | |
|---|---|---|
| Drainagewide BEG 300,000-600,000 | Treaty Negotiated Interim Objectives: | 50,000-120,000 (Fishing Branch); >80,000 (Mainstem) |
| | Yukon River Panel Negotiated Objectives for 2008-2010: | 22,000-49,000 |

-continued-

**Table 5-17 continued.**

*Note*: Latest table revision September 9, 2010.

[a] Total abundance estimates for upper Toklat River drainage spawning index area using stream life curve method developed with 1987 to 1993 data.

[b] Fall chum salmon passage estimate for Kantishna and Toklat river drainages is based on tag deployment from a fish wheel located at the lower end of Kantishna River and recaptures from three fish wheels; two located on Toklat River (1999 to 2007) about eight miles upstream of the mouth and one fish wheel on Kantishna River (2000 and 2007) near Bear Paw River.

[c] Population estimate generated from replicate foot surveys and stream life data (area under the curve method), unless otherwise noted.

[d] Peak counts from foot surveys unless otherwise noted.

[e] Fall chum salmon passage estimate for upper Tanana River drainage based on tag deployment from a fish wheel (two fish wheels in 1995) located just upstream of Kantishna River and recaptures from one fish wheel (two fish wheels from 1995 to 1998) located downstream from the village of Nenana.

[f] Side-scan sonar estimate from 1986 through 1990. Split beam sonar estimate from 1995 through 2006. DIDSON sonar estimate in 2007 to present.

[g] Side-scan sonar estimate from 1986 through 1999, 2001, and 2002. Split-beam sonar estimate from 2003 through 2004. DIDSON sonar estimate since 2005. Counts prior to 1986 are considered conservative, approximating the period from the end of August through middle of the fourth week of September. Since 1991, total abundance estimates are for the approximate period second week in August through the middle of the fourth week of September.

[h] Total escapement estimated using weir count unless otherwise indicated. Counts for 1974, 1975, and 1998 revised from DFO, February 23, 2000.

[i] Estimated border passage minus Canadian mainstem harvest and excluding Canadian Porcupine River drainage escapement. Based on mark-recapture from 1980 to 2007 and sonar thereafter.

[j] Total escapement estimated using weir to aerial survey expansion factor of 2.72.

[k] Weir installed on September 22, 1972. Estimate consists of a weir count of 17,190 after September 22 and a tagging passage estimate of 17,935 prior to weir installation.

[l] Total escapement estimate generated from the migratory time density curve method.

[m] Total escapement estimate using sonar to aerial survey expansion factor of 2.22.

[n] Peak counts aerial surveys.

[o] In 1981, the initial aerial survey count was doubled before applying the weir to aerial expansion factor of 2.72 since only half of the spawning area was surveyed.

[p] In 1984, the escapement estimate based on mark-recapture program is unavailable. Estimate is based on assumed average exploitation rate.

[q] Sonar counts included both banks in 1985-1987 and 2005 to present.

[r] Expanded estimates, using Chandalar River fall chum salmon run timing data, for the approximate period from mid-August through the middle of the fourth week of September 1986-1990.

[s] Population of spawners was reported by DFO as between 30,000 to 40,000 fish considering aerial survey timing. For purpose of this table, an average of 35,000 fall chum salmon was estimated to pass by the weir. Note: A single survey flown October 26, 1990, counted 7,541 chum salmon. A population estimate of approximately 27,000 fish was made through date of survey, based upon historic average aerial to weir expansion of 28%.

[t] Minimal estimate because of late timing of ground surveys with respect to peak of spawning.

[u] Minimal count because weir was closed while submerged due to high water, during the period August 31 to September 8, 1995.

**Table 5-17 continued.**

[v] The passage estimate includes an additional 15,134 salmon that were estimated to have passed during 127 hours that the sonar was inoperable due to high water from August 29 until September 3, 1997.

[w] Project ended early; sonar passage estimate was 18,652 (62% of normal run timing). The total sonar passage estimate, 30,083, was expanded to reflect the 1986-1999 average run timing through September 24.

[x] Minimal estimate because Sushana River was breached by the main channel and uncountable.

[y] Due to low numbers of tags deployed and recovered on Tanana River the estimate has a large range in confidence interval (95% CI + 41,172).

[z] Project ended on peak daily passages due to late run timing; estimate was expanded based on run timing (87%) at Rapids.

[aa] Project estimated for late run timing through October 25 as project ended on October 10, 2008 and October 12, 2009.

[ab] Preliminary.

[ac] Upper Tanana River goal is Tanana River drainage BEG (61,000 to 136,000) minus the lower and upper ranges of Toklat River goal based on Eggers (2001), and is not an established BEG.

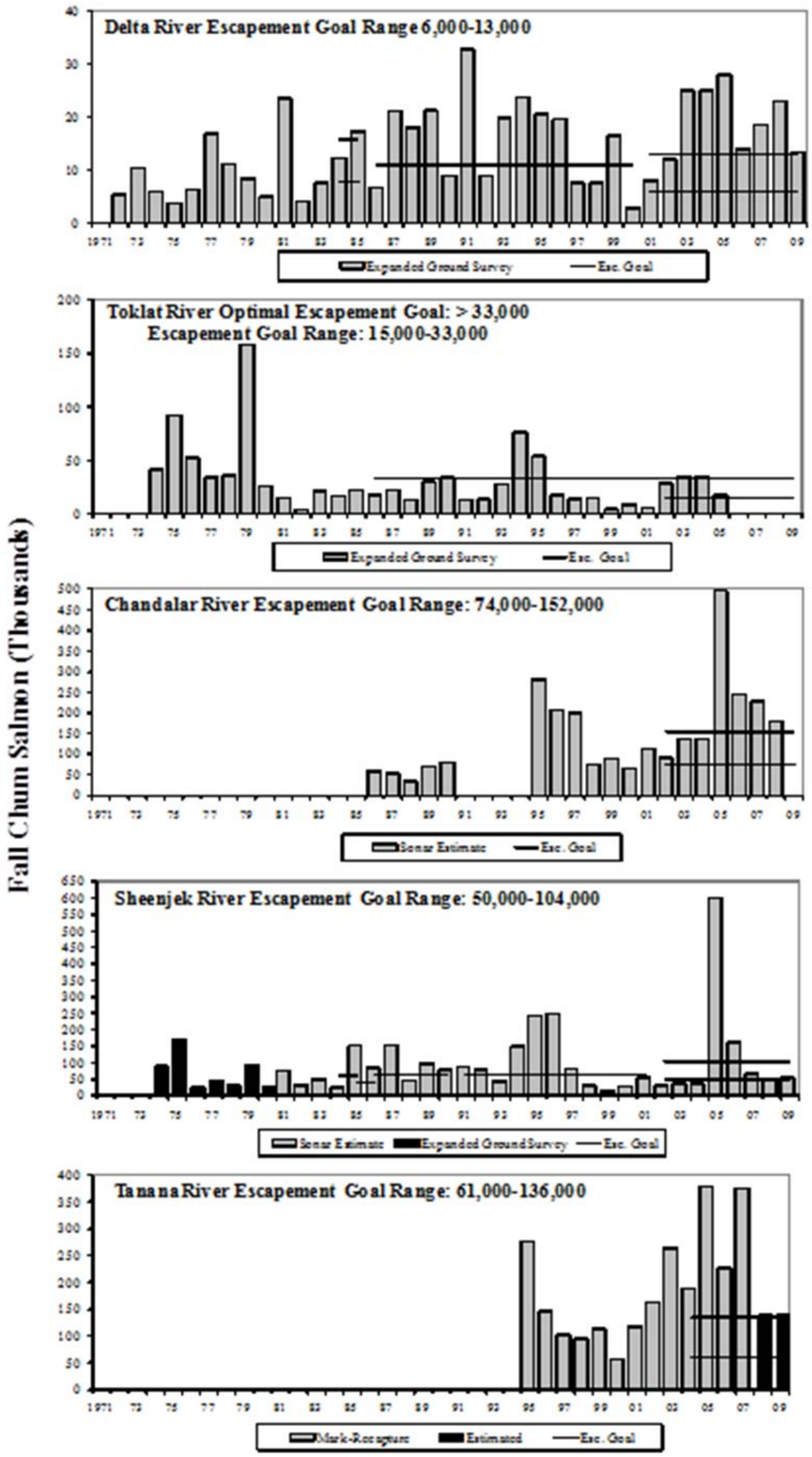



Figure 5-31 Fall chum salmon escapement estimates for selected spawning areas in the Alaskan portion of the Yukon River drainage, 1971-2009. Horizontal lines represent escapement goals or ranges. Note: vertical scale is variable

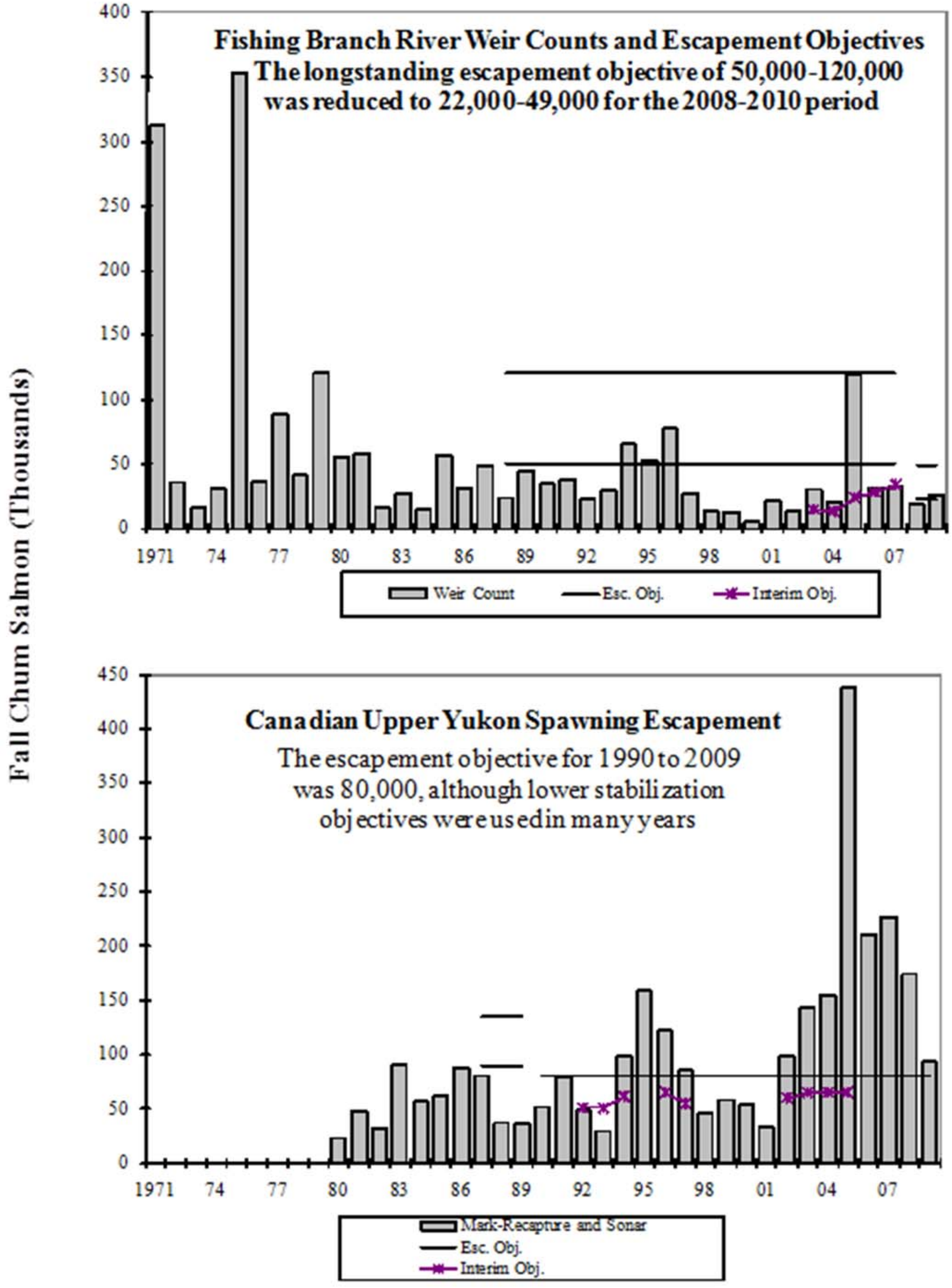



Figure 5-32 Chum salmon spawning escapement estimates for Canadian portion of the Yukon River drainage, 1971-2009. Sonar estimates were used in 2008 and 2009. Horizontal lines represent escapement goal objectives or ranges. The interim stabilization or rebuilding objectives are also shown.

Escapements in fishing Branch River, Canada have only met the escapement objective established in 1987 of 50,000 to 120,000 fall chum salmon once in the past 12 years, in 2005 (Figure 5-32). ADF&G developed a BEG for this stock of 27,000 to 56,000 in conjunction with total run reconstruction analysis in 2000 (Eggers 2001); however, this goal has only been met 4 times since 1997. Like the Canadian mainstem stock, the Fishing Branch River fall chum salmon stock is managed based on recommendations of the Panel that are addressed annually. The Panel agreed to an interim management goal of 28,000 fish for the 2006 season and 33,667 fish in 2007, which were both exceeded. For the years 2008–2010, JTC has recommended an Interim Management Escapement Goal (IMEG) range of 22,000–49,000 fall chum salmon for Fishing Branch River (JTC 2009). This recommendation was based on the Bue and Hasbrouck[36] percentile method of determining an SEG. The IMEG for Fishing Branch River was nearly achieved in 2008 and was met in 2009.

In 1993, the BOF established the Toklat River OEG of 33,000 fall chum salmon based on an average return for this system. As part of the total run reconstruction analysis conducted by Eggers (2001), a BEG range of 15,000 to 33,000 fall chum salmon was recommended and adopted by ADF&G. The BOF removed the OEG from regulation in 2004. Based on the BEG range, the goal has been met each year from 2002 to 2005; however, assessment of the area has been hampered by the later freeze ups and counts used for developing an annual population estimate have not been achieved since 2005 (Figure 5-31). At the 2010 BOF meeting this goal was discontinued. The results of mark–recapture projects on both Kantishna and Tanana rivers suggest that the index streams of Toklat and Delta rivers support relatively small proportions of fall chum salmon. A radiotelemetry study conducted in 2008 has confirmed major mainstem spawning in Tanana River between Fairbanks and Delta Junction.

### *Maturity*

Annual inseason estimates of fall chum salmon age composition since 1977 are derived by the following sources: Inseason estimates of age prior to 1981 are based on fish sampled at Emmonak from 6" commercial gillnet catches. Estimates of age from 1981 to 2000 are based on 6" set gillnet test fish catches at Big Eddy and Middle Mouth sites (LYTF), in 2001 fishing gear was changed to 6" drift gillnets. All test fishery age composition data were weighted by daily CPUE from 1981 through 2009. Because of low sample sizes obtained in the normal operations of LYTF in 2009 (due to difficulty catching fall chum salmon) samples were supplemented by an extra drift site in Big Eddy and from the Mountain Village test fishery. Estimates for 1994 and 2000 were obtained by apportioning daily CPUE among ages, fitting age specific run timing curves to each age, and extending the curves to the end of the season since the projects were terminated early due to the poor returns. Estimated annual age composition from 1977 through 2009 has averaged approximately 4% age-3, 68% age-4, 27% age-5, and less than 1% age-6.

Age composition from 1974 through 2003 is used to estimate age structure of brood year returns (Table 5-16). Additionally, recruits are estimated from 2004 (age-6) and 2005 (age-5) brood year returns. Although the overall proportion of age-4 and age-5 fish combined varies little among brood year returns, (averaging approximately 95% annually), there is a change in the proportion of these age groups between even and odd-numbered brood year returns. For example, age-4 fish averaged approximately 72% of returns from odd-numbered brood years between 1974 and 2003, whereas only 65% from even-numbered brood years. By comparison, returning age-5 fish averaged approximately 24% from odd-numbered brood year returns and 30% from even-numbered brood years. The 2001 brood year had extremely good marine survival as evidenced by the large return of each age class from age-3 returns in 2004 through age-6

[36] Bue, B. G., and J. J. Hasbrouck. *Unpublished*. Escapement goal review of salmon stocks of Upper Cook Inlet, Report to the Alaska Board of Fisheries, 2001. Alaska Department of Fish and Game, Anchorage.

returns in 2007. However, age-4 component that retuned from the 2005 brood year was much lower than would be expected if the return had actually produced a run commensurate with the large escapement.

### *Harvest*

Combined commercial and subsistence harvests of fall chum salmon in Alaska show a substantial decrease from the 1980s and 1990s compared to the recent 5-year (2005–2009) average of approximately 205,000 fish. The recent decline in subsistence harvest resulted from several extremely poor runs (1998 through 2002) where subsistence fishing was restricted and cultural changes reduced fishing activity, such as fishermen moving away from long-established fish camps and allowing fishing gear to fall into disrepair. During several years of poor returns, there was little to no commercial harvests, causing loss of markets as businesses shifted interest to other fisheries with more predictable run strength and lower operating costs than in remote Yukon River drainage communities. Commercial harvest of fall chum salmon averaged about 262,000 during the 1980s and 118,000 from 2005 through 2009. In 2004, a modest surplus was identified, whereas in 2005 and 2006, substantial surpluses were available for commercial harvest. However, there was little exploitation of these available surpluses due to poor commercial market conditions for fall chum salmon. Since 2007 there has been renewed market interest and directed fall chum salmon commercial opportunity has been provided in 2007 through 2009. Coho salmon runs overlap in timing with fall chum salmon and are typically taken as incidental harvest in the fisheries. Directed coho salmon fisheries are rare because of the tie between coho and fall chum salmon management plans. Coho salmon-directed fisheries were conducted on the Yukon in 2009 after the majority of the fall chum salmon had past.

### *2010 Summary*

The fall season began by regulation on July 16. At that time, fall chum salmon abundance was projected to be 600,000 fish based upon the abundance of the proceeding summer chum salmon run. That level of abundance would be adequate to meet escapement needs and provide for normal subsistence harvest. At the beginning of the fall season, subsistence fishing in Districts 1, 2, 3, and Subdistrict 5-D were open seven days a week, 24 hours a day while District 4 and Subdistricts 5-A, 5-B, and 5-C were open on a five days a week schedule. Due to high water levels and debris which hindered subsistence fishing efforts early in the season, District 4 and Subdistricts 5-A, 5-B, and 5-C were moved to a seven days a week schedule to provide more opportunity.

In mid-August, management of fall chum shifted from using the preseason projection to inseason assessment. The Pilot Station sonar indicated a weaker fall chum salmon run than anticipated with projections less than 400,000 fish. As a result, the department placed mainriver districts (excluding Subdistrict 5-D) on the regulatory windowed schedule and commercial fishing for chum salmon was not allowed. In March 2010, the Yukon River Panel agreed to a new Interim Management Escapement Goal range of 70,000 – 104,000 for the Canadian mainstem fall chum salmon stock. Concerns about meeting the lower end of the Canadian border objective (escapement goal plus a Canadian harvest share agreement) resulted in further subsistence restrictions until it became apparent in early September that the lower end of the Canadian border passage goal was going to be met. At that point, subsistence schedules in the mainriver districts were liberalized.

A limited late season coho salmon directed commercial fishery was prosecuted in Districts 1 and 2, and a limited salmon directed commercial fishery was prosecuted in District 6. There were two commercial periods in District 1, one period in District 2, and three periods in District 6. The 2010 total commercial harvest for the Yukon River fall season in the Alaskan portion of the drainage was 2,550 fall chum salmon, which is well below the most recent five and 10-year averages and among the lowest on record.

The preliminary 2010 fall chum salmon run size is estimated to be approximately 450,000 to 500,000, below the preseason forecast of 552,000 to 828,000 salmon. The distribution of tributary stock escapements was not uniform and some goals and management objectives were not achieved within the Porcupine River drainage including the Sheenjek and Fishing Branch river systems while goals for the Chandalar River, Canadian Mainstem, Delta and Tanana rivers, were achieved.

### *Exploitation Rates*

Annual total run estimates can be coupled with total inriver harvests to estimate exploitation rates exerted on fall chum salmon for 1974–2009 (Figure 5-30). Total exploitation rates exerted by Yukon River fisheries on fall chum salmon over 36 years averaged about 17.4%, ranging from as high as 67.5% in 1982 to as low as 6.4% in 2002. Exploitation rates on 2 of the lowest runs, approximately 239,000 fish, in 2000 and 383,000 fish in 2001 were 11.9% and 11.7%, respectively. Exploitation rates have been increasing slightly since 2002 with improvements in run size and reestablishment of market interest; however, current exploitation rates are much lower than historical rates (averaging 51% pre-1992 to an average of 20% post-1991), partly due to highly variable and unpredictable runs occurring in the last two decades.

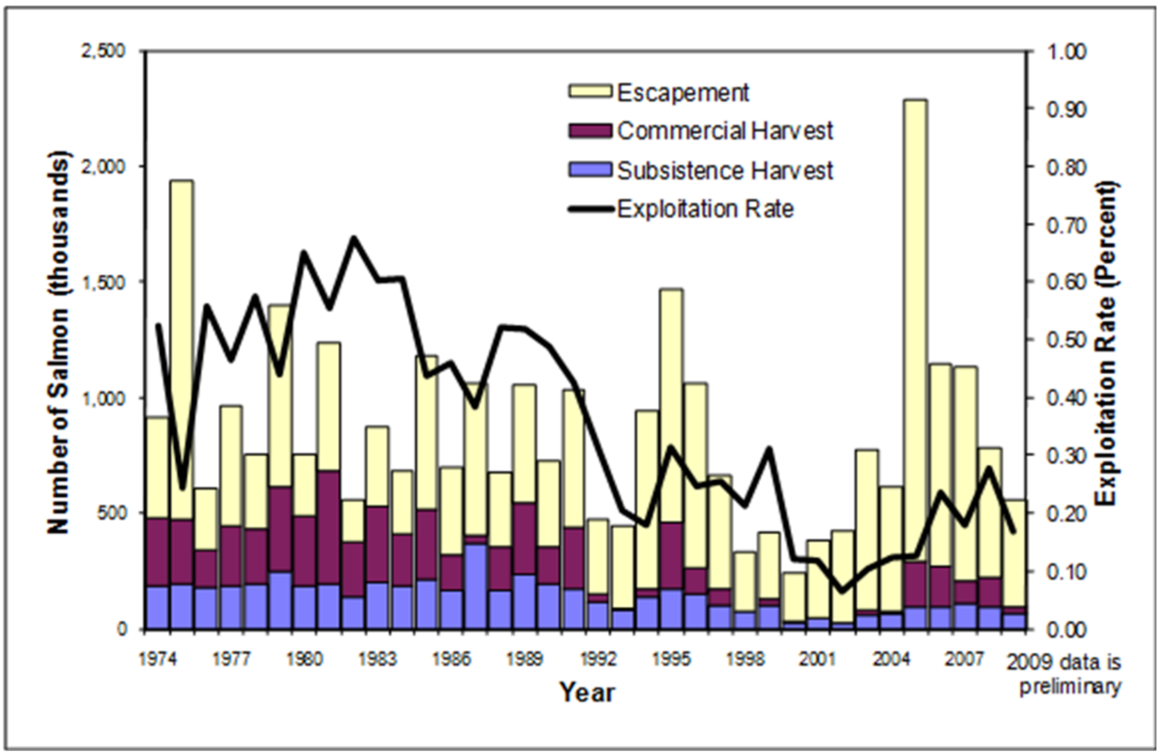



Figure 5-33 Estimated fall chum salmon harvest and escapement with exploitation rate, Yukon Area, 1974–2009.

Yields based on brood return from individual escapements have also become highly variable in the last two decades (Figure 5-34). Yields from brood years pre-1992 averaged 400,000 fish and ranged from 27,000 in 1975 to 840,000 in 1977, whereas yields after 1991 average 143,000 fall chum salmon, with 6 of the last 13 brood year returns (through 2005) resulting in negative yields representing substantially less production. Production levels for years 1974 through 1992 allowed for average harvests of 456,000 fish, whereas current production levels, conservative management actions, and weak market conditions through this period of high and low production extremes has reduced harvests to less than 200,000 fish. Harvests from 1999–2003 were at all time lows that averaged only 62,000 fall chum salmon drainagewide, whereas harvests from 2004–2008 average 211,000 fall chum salmon; this level of harvest is comparable to average harvest taken from 1994–1998 (Figure 5-33). As a result of previous poor fall chum salmon runs in the early 2000s and subsequent fishing restrictions and closures, it appears subsistence fishing effort and harvest has remained relatively low even in those years with much larger runs, as in 2003 and 2005 through 2008 (Figure 5-33). With the exception of 1995, fall chum salmon commercial harvests (Figure 5-33) have been low since 1992, partly due to weak market conditions, but also because of uncertainty in predicting run strength. Most recently this has resulted in underutilization of the stock in commercial fisheries in 2003, and 2005 through 2007. Fall chum salmon runs in 2008 and 2009 were fully utilized, with most escapement objectives attained and below average harvests due to below average available surpluses.

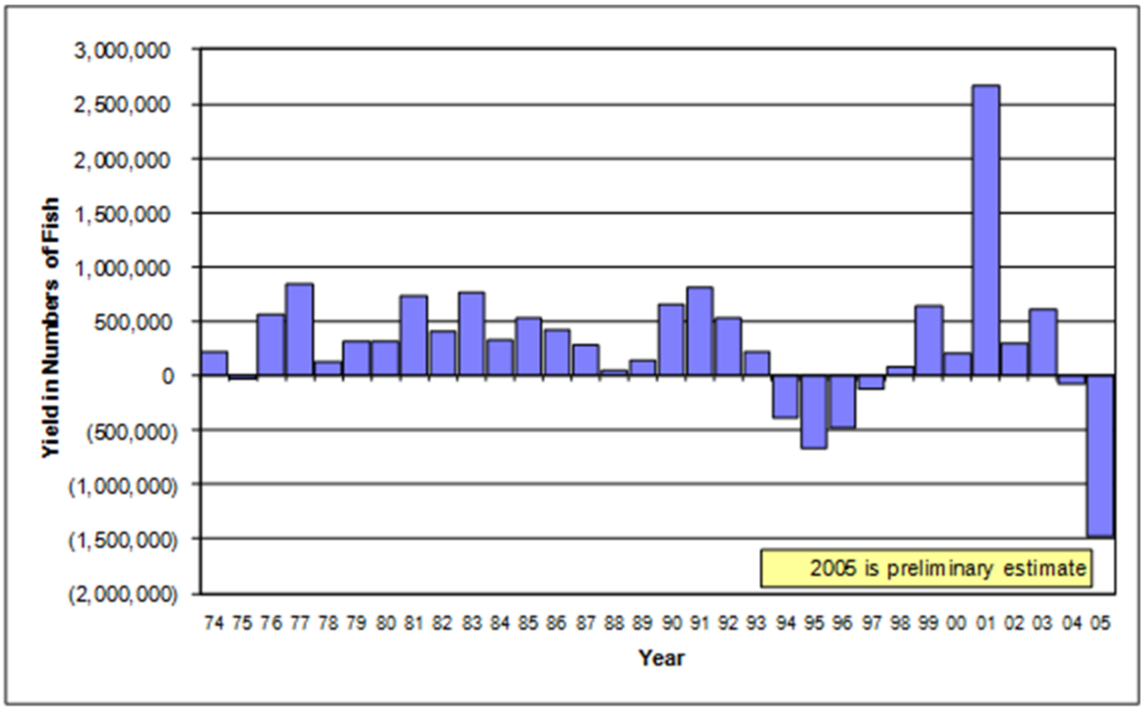



Figure 5-34. Yields of fall chum salmon based on parent year escapements and resulting brood year returns, 1974-2005.

### 5.2.6 Norton Sound

Norton Sound Salmon District consists of all waters between Cape Douglas in the north and Point Romanof in the south. The district is divided into six subdistricts: Subdistrict 1, Nome; Subdistrict 2, Golovin; Subdistrict 3, Moses Point; Subdistrict 4, Norton Bay; Subdistrict 5, Shaktoolik; and Subdistrict 6, Unalakleet (Figure 5-35). The subdistrict and statistical area boundaries were established to facilitate management of individual salmon stocks, and each subdistrict contains at least one major salmon-producing stream.

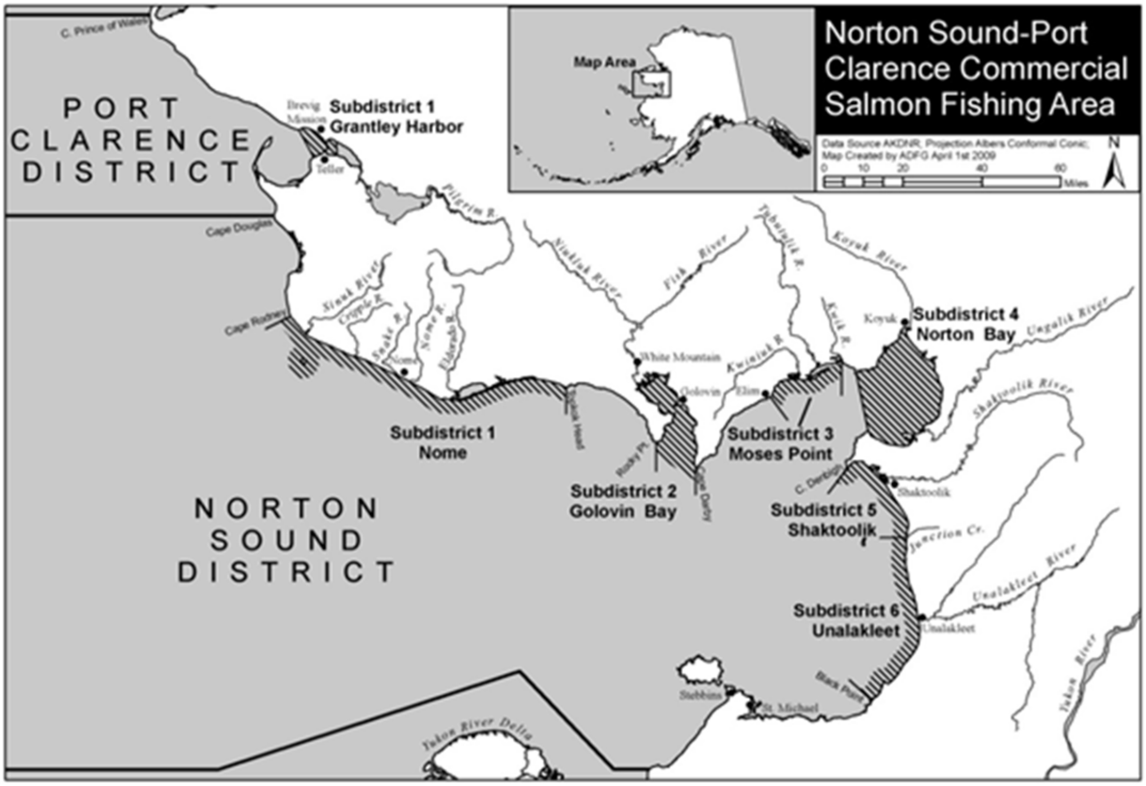



Figure 5-35. Norton Sound commercial salmon fishing districts and subdistricts.

Chinook *Oncorhynchus tshawytscha,* chum *O. keta,* pink *O. gorbuscha*, and coho *O. kisutch* salmon are harvested in Norton Sound commercial, subsistence, and sport fisheries all managed by ADF&G. All commercial salmon fishing in the district is by set gillnets in marine waters and fishing effort is usually concentrated near river mouths. Commercial fishing typically begins in June and targets Chinook salmon if sufficient run strength exists. Emphasis switches to chum salmon in late June and then to coho salmon at the end of July. Most commercial fishing is completed by early September. Pink salmon returns are much more abundant in even numbered years. A pink salmon directed fishery may coincide with or be scheduled to alternate periods with the historical chum directed fishery. Subsistence fishermen operate gillnets or seines in the main rivers, and to a lesser extent in coastal marine waters, capturing salmon, whitefish, Dolly Varden, and inconnu (sheefish). Beach seines are used to catch schooling or spawning salmon and other species of fish. The major portion of fish taken during summer months is air dried or smoked for later consumption by residents or occasionally their dogs.

### 5.2.6.1 Northern Norton Sound chum salmon

#### *5.2.6.1.1 Introduction*

Northern Norton Sound includes Subdistricts 1, 2, and 3 (Figure 5-35). In response to guidelines established in the SSFP (5 AAC 39.222(f)(21)), the BOF classified Subdistrict 1 chum salmon stock as a management concern in 2000 (Bue 2000a). The classification was upheld at the 2004 BOF meeting (Menard and Bergstrom 2003a). In 2007, based on definitions provided in SSFP (5 AAC 39.222(f)(21) and (42)), only the most recent 5-year yield and escapement information (2002–2006), and the historical level of yield or harvestable surpluses were considered. Accordingly, ADF&G recommended a change in status of the Subdistrict 1 chum salmon stock from a management concern to a yield concern at the

October 2006 BOF work session because in the preceding 5 years (2002–2006) a majority of chum salmon escapement goals had been achieved in Subdistrict 1. The BOF accepted ADF&G's recommendation and the Subdistrict 1 chum salmon stock was reclassified at its 2007 meeting (Menard and Bergstrom 2006a). At the 2010 BOF meeting, ADF&G recommended continuation of Norton Sound Subdistrict 1 chum salmon as a stock of yield concern (Menard and Bergstrom 2009a): ADF&G's recommendation was based on low yields from the recent 5-year period (2005 – 2009) compared to historical yields iin the 1980s, but a majority of chum salmon escapement goals being achieved in Subdistrict 1 in the most recent five years (2005 – 2009). Since the 2006 fishing season, Subdistrict 1 reverted back to Tier I subsistence fishing regulations because projected runs of chum salmon exceeded the Amount Necessary for Subsistence (ANS).

In response to the guidelines established in the SSFP (5 AAC 39.222(f)(42)), the BOF classified Norton Sound Subdistricts 2 and 3 chum salmon as a stock of yield concern at its September 2000 work session. This determination as a yield concern was based on low harvest levels for the previous 5-year period (1995–1999). An action plan was subsequently developed by ADF&G (Bue 2000b) and acted upon by the BOF in January 2001. The classification as a yield concern was continued at the January 2004 BOF meeting (Menard and Bergstrom 2003b) and at the January 2007 BOF meeting (Menard and Bergstrom 2006b). ADF&G recommended continuation of the Norton Sound Subdistrict 2 and Subdistrict 3 chum salmon as a stock of yield concern at the 2010 BOF meeting (Menard and Bergstrom 2009b). From 2005 to 2009, low yields of chum salmon have continued in Norton Sound Subdistrict 2 and in Subdistrict 3; yields have been inconsistent, but often low.

#### *5.2.6.1.2 Stock Assessment Background*

***Escapement***

The Subdistrict 1 BEG was achieved or exceeded from 2005–2008 and fell short of the goal in 2009 (Figure 5-33). During this same time period (2005–2009), the SEG was achieved or exceeded for 3 of 5 years at Nome and Snake Rivers (Table 5-18, Figure 5-36, Figure 5-37, and Figure 5-38), and 4 of 5 years at Eldorado River (Table 5-16, Figure 5-39). Comparing escapements during 2005–2009 to the escapement goals established in 2001 shows there has not been a chronic inability to meet escapement goals.

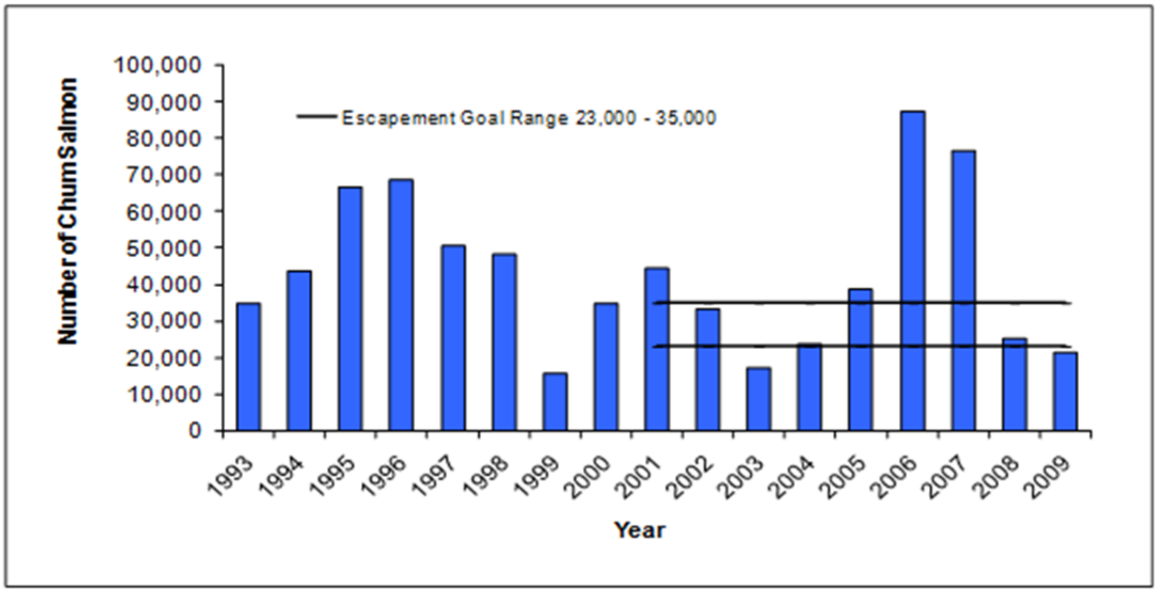



Figure 5-36. Subdistrict 1estimated chum salmon escapement, 1993–2009, and in relation to the biological escapement goal range, 2001–2009.

Table 5-18. Subdistrict 1 chum salmon escapement, 1993–2009.

| Year | Solomon River [a] | Bonanza River [a] | Flambeau River [a] | Sinuk River [a] | Eldorado River [b] | Snake River [c] | Nome River [d] | Subdistrict Total |
|---|---|---|---|---|---|---|---|---|
| 1993 | 2,525 | 3,007 | 6,103 | 6,052 | 9,048 | 2,115 | 5,925 | 34,775 |
| 1994 | 1,066 | 5,178 | 12,889 | 4,905 | 13,202 | 3,519 | 2,893 | 43,652 |
| 1995 | 2,106 | 11,182 | 16,474 | 9,464 | 18,955 | 4,395 | 5,093 | 67,669 |
| 1996 | 2,141 | 7,049 | 13,613 | 6,658 | 32,970 | 2,772 | 3,339 | 68,542 |
| 1997 | 2,111 | 4,140 | 9,455 | 9,212 | 14,302 | 6,184 | 5,147 | 50,551 |
| 1998 | 925 | 4,552 | 9,129 | 6,720 | 13,808 | 11,067 | 1,930 | 48,131 |
| 1999 | 637 | 2,304 | 637 | 6,370 | 4,218 | 484 | 1,048 | 15,698 |
| 2000 | 1,294 | 4,876 | 3,947 | 7,198 | 11,617 | 1,911 | 4,056 | 34,899 |
| 2001 | 1,949 | 4,745 | 10,465 | 10,718 | 11,635 | 2,182 | 2,859 | 44,553 |
| 2002 | 2,150 | 3,199 | 6,804 | 6,333 | 10,243 | 2,776 | 1,720 | 33,225 |
| 2003 | 806 | 1,664 | 3,380 | 3,482 | 3,591 | 2,201 | 1,957 | 17,081 |
| 2004 | 1,436 | 2,166 | 7,667 | 3,197 | 3,273 | 2,145 | 3,903 | 23,787 |
| 2005 | 1,914 | 5,534 | 7,692 | 4,710 | 10,426 | 2,948 | 5,584 | 38,808 |
| 2006 | 2,062 | 708 | 27,828 | 4,834 | 41,985 | 4,128 | 5,677 | 87,222 |
| 2007 | 3,469 | 8,491 | 12,006 | 16,481 | 21,312 | 8,147 | 7,084 | 76,990 |
| 2008 [e] | 1,000 | 1,000 | 11,618 | 1,000 | 6,746 | 1,244 | 2,607 | 25,215 |
| 2009 | 918 | 6,744 | 4,075 | 2,232 | 4,943 | 891 | 1,565 | 21,368 |
| 2005-2009 avg. | 1,873 | 4,495 | 12,644 | 5,851 | 17,082 | 3,472 | 4,503 | 49,921 |
| 2000-2009 avg. | 1,700 | 3,913 | 9,548 | 6,019 | 12,577 | 2,857 | 3,701 | 40,315 |

[a] The Bonanza, Flambeau, Sinuk and Solomon Rivers escapement estimate is obtained by expanded aerial survey counts and expanding by calculation from Clark, J.H. 2001.
[b] The Eldorado River escapement estimate is the same method as in Clark, J.H. 2001 for 1993-1996. From 1997 - 2002 escapement estimates are from counting tower and from 2003-2009 by weir.
[c] The Snake River escapement estimate is the same method as in Clark, J.H. 2001 for 1993-1994. From 1995 - 2002 escapement estimates are from counting tower and from 2003-2009 by weir.
[d] The Nome River escapement estimate is the same method as in Clark, J.H. 2001 for 1993. From 1994-1995 escapement estimates are from counting tower and from 1996 – 2009 by weir.
[e] A huge pink salmon run prevented surveyors from estimating chum salmon in the Solomon, Bonanza and Sinuk rivers; escapement was conservatively listed at 1,000 chum salmon for each river, but based

on historical data was likely higher.

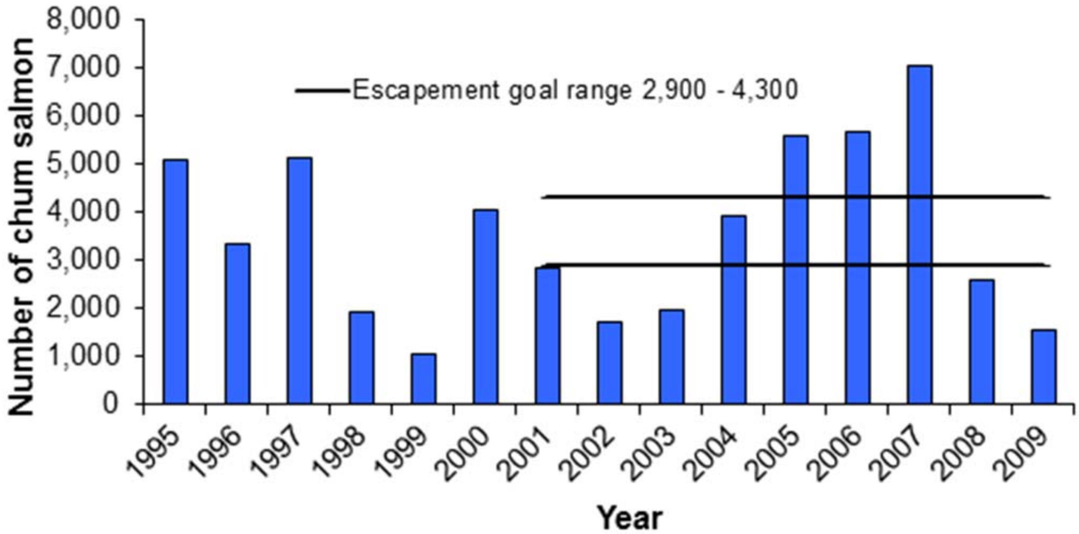



Figure 5-37. Nome River estimated chum salmon escapement, 1995–2009, and in relation to the sustainable escapement goal, 2001–2009.

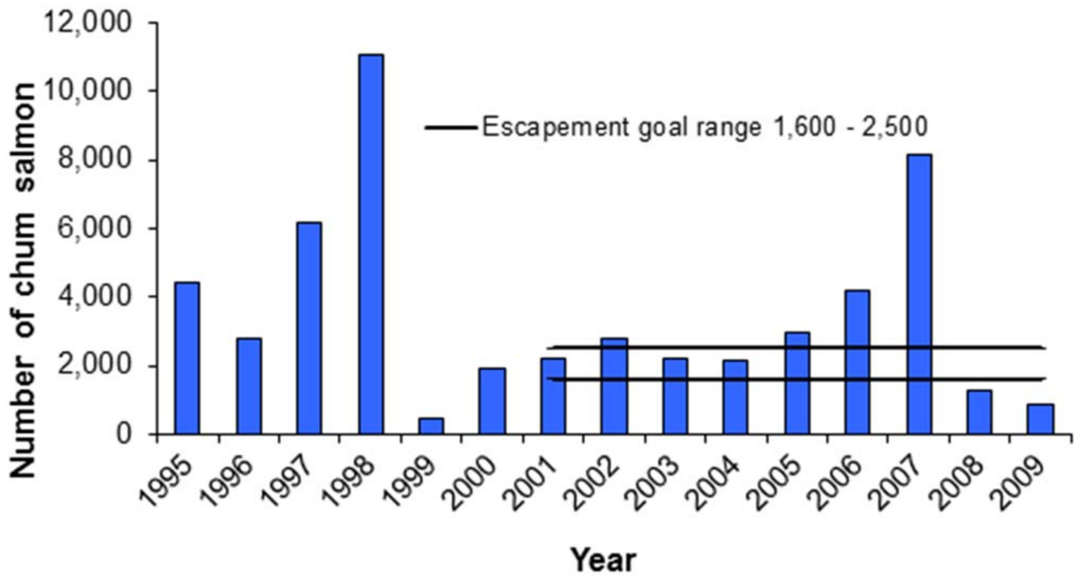



Figure 5-38. Snake River estimated chum salmon escapement,1995–2009, and in relation to the sustainable escapement goal, 2001–2009.

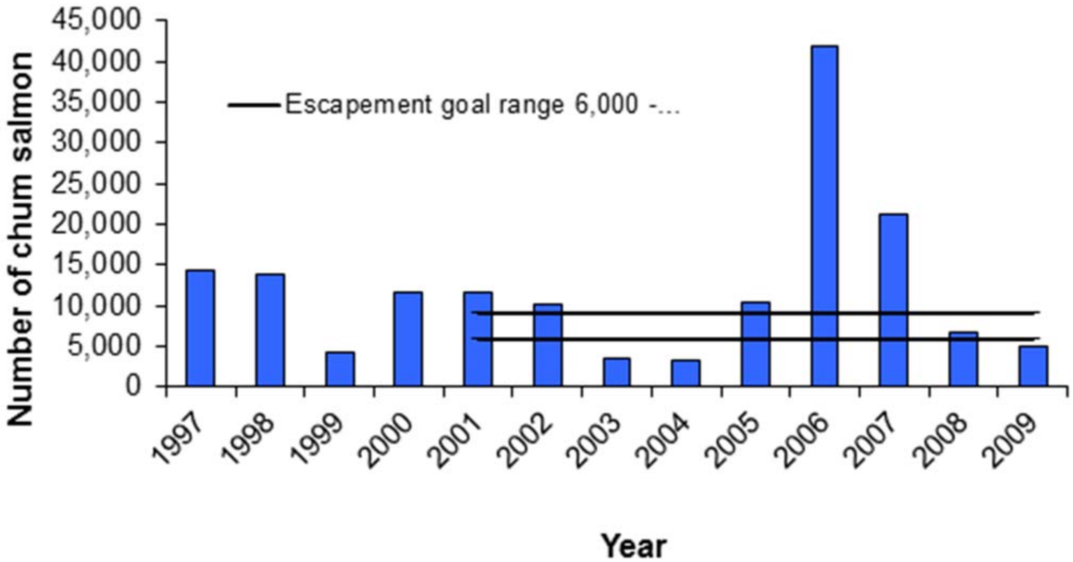



Figure 5-39. Eldorado River estimated chum salmon escapement, 1997–2009, and in relation to the sustainable escapement goal, 2001–2009.

Niukluk River in Subdistrict 2 exceeded the SEG in 2007, and was close to the goal in 2006. There has been a decreasing trend in escapement since the project was established in 1995 (Table 5-17, Figure 5-37).

Table 5-19. Historical salmon migration passed Niukluk River counting tower, 1995–2009.

| Year | Operating period | Chum | Pink | Chinook | Coho |
|---|---|---|---|---|---|
| 1995 | June 29 - Sept 12 | 86,332 | 17,088 | 123 | 4,713 |
| 1996 | June 23 - Sept 12 | 80,178 | 1,154,922 | 243 | 12,781 |
| 1997 | June 28 - Sept 09 | 57,305 | 10,468 | 259 | 3,994 |
| 1998 | July 04 - Aug 09 | 45,588 | 1,624,438 | 260 | 840 |
| 1999 | June 04 - Sept 04 | 35,239 | 20,351 | 40 | 4,260 |
| 2000 | July 04 - Aug 27 | 29,573 | 961,603 | 48 | 11,382 |
| 2001 | July 10 - Sept 08 | 30,662 | 41,625 | 30 | 3,468 |
| 2002 | June 25 - Sept 10 | 35,307 | 645,141 | 621 | 7,391 |
| 2003 | June 25 - Sept 10 | 20,018 | 75,855 | 179 | 1,282 |
| 2004 | June 25 - Sept 08 | 10,770 | 975,895 | 141 | 2,064 |
| 2005 | June 28 - Sept 09 | 25,598 | 270,424 | 41 | 2,727 |
| 2006 | June 26 - Sept 08 | 29,199 | 1,371,919 | 39 | 11,169 |
| 2007 | July 01 - Sept 04 | 50,994 | 43,617 | 30 | 3,498 |
| 2008 | July 01 - Sept 06 | 12,078 | 669,234 | 33 | 13,779 |
| 2009 | July 03 - Sept 02 | 15,879 | 24,204 | 204 | 6,861 |
| 2005-2009 avg. | | 26,750 | 475,880 | 69 | 7,607 |

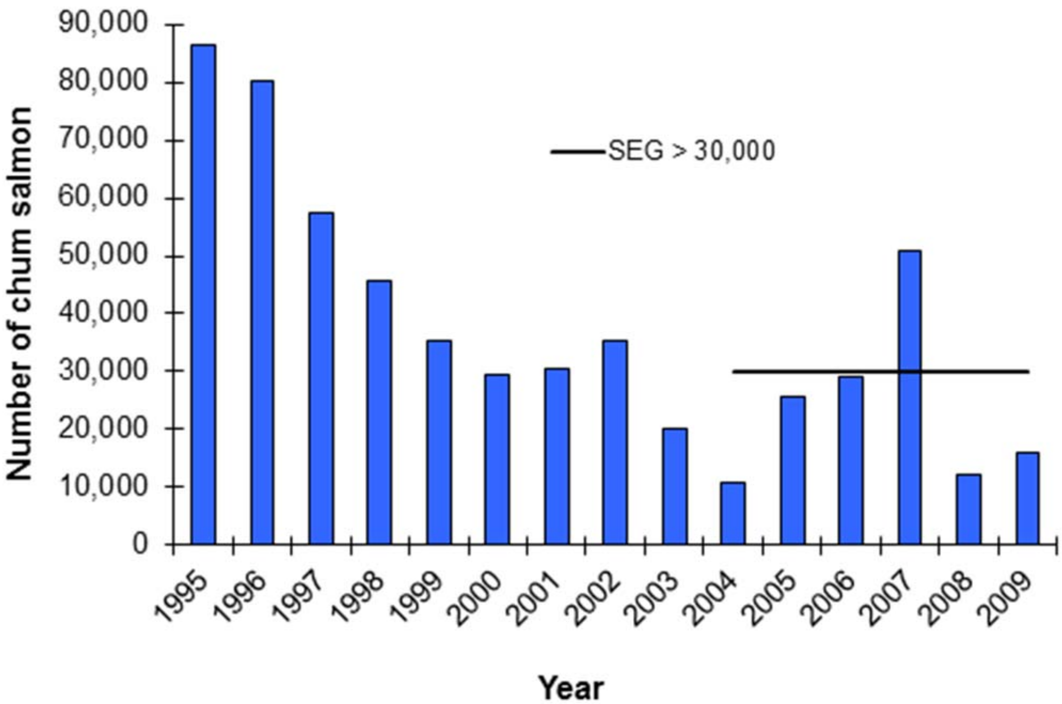



Figure 5-40. Niukluk River estimated chum slamon escapement, 1995–2009, and in relation to the sustainable escapement goal, 2004–2009.

Based on escapement counts from the Kwiniuk River counting tower project, the OEG for Subdistrict 3 of 11,500 to 23,000 chum salmon has been achieved or exceeded in 3 of the 5 recent years (2005–2009) (Table 5-20, Figure 5-41). The SEG for the Tubutulik chum salmon stock is 9,200 to 18,400 chum salmon as assessed by aerial surveys. It is difficult to determine if the SEG was achieved in most years because aerial surveys were often incomplete due to poor weather conditions or lack of aircraft. Another difficulty in surveying Tubutulik River beginning in 2004 was the huge numbers of pink salmon with the same run timing as chum salmon. Pink salmon prevented accurate enumeration of chum salmon in 2004–2006 and in 2008. An aerial survey in 2009 counted 3,161 chum salmon on Tubutulik River. Overall, chum salmon runs in Subdistrict 3 have been lower in the 1990s and 2000s than in the 1980s based on Kwiniuk River escapements and reported harvests.

Table 5-20. Historical salmon migration passed Kwiniuk counting tower, 1965–2009.

| Year | Chum | Pink | Chinook | Coho |
|---|---|---|---|---|
| 1965 | 32,861 | 8,668 | 19 | |
| 1966 | 32,786 | 10,629 | 7 | |
| 1967 | 26,661 | 3,587 | 13 | |
| 1968 | 19,976 | 129,052 | 27 | |
| 1969 | 19,687 | 56,683 | 12 | |
| 1970 | 66,604 | 226,831 | | |
| 1971 | 38,679 | 16,634 | | |
| 1972 | 30,686 | 62,461 | 65 | |
| 1973 | 28,029 | 37,070 | 57 | |
| 1974 | 35,161 | 39,375 | 62 | |
| 1975 | 14,049 | 55,293 | 44 | |
| 1976 | 8,508 | 35,226 | 12 | |
| 1977 | 21,798 | 47,934 | | |
| 1978 | 11,049 | 70,148 | | |
| 1979 | 12,355 | 167,492 | 107 | |
| 1980 | 19,374 | 319,363 | 177 | |
| 1981 | 34,565 | 566,534 | 136 | |
| 1982 | 44,099 | 469,674 | 138 | |
| 1983 | 56,907 | 251,965 | 267 | |
| 1984 | 54,043 | 736,544 | 736 [a] | |
| 1985 | 9,013 | 18,237 | 955 | |
| 1986 | 24,700 | 241,446 | 654 | |
| 1987 | 16,133 | 5,566 | 317 | |
| 1988 | 13,303 | 187,907 | 321 | |
| 1989 | 14,529 | 27,488 | 248 | |
| 1990 | 13,957 | 416,512 | 900 | |
| 1991 | 19,801 | 53,499 | 708 | |
| 1992 | 12,077 | 1,464,716 | 479 | |
| 1993 | 15,824 | 43,063 | 600 | |
| 1994 | 33,012 | 2,303,114 | 625 | 2,547 |
| 1995 | 42,500 | 17,511 | 498 | 114 |
| 1996 | 28,493 | 907,893 | 577 | 461 |
| 1997 | 20,119 | 9,535 | 974 | |
| 1998 | 24,247 | 655,934 | 303 | |
| 1999 | 8,763 | 607 | 116 | |
| 2000 | 12,879 | 750,173 | 144 | 41 |
| 2001 | 16,598 | 8,423 | 261 | 9,532 |
| 2002 | 37,995 | 1,114,410 | 778 | 6,459 |
| 2003 | 12,123 | 22,329 | 744 | 5,490 |
| 2004 | 10,362 | 3,054,684 | 663 | 11,240 |
| 2005 | 12,083 | 341,048 | 342 | 12,950 |
| 2006 | 39,519 | 1,347,090 | 195 | 22,341 |
| 2007 | 27,756 | 54,255 | 258 | 9,429 |
| 2008 | 9,462 | 1,442,246 | 237 | 10,461 |
| 2009 | 8,733 | 42,957 | 444 | 8,563 |
| 2005-2009 avg. | 19,511 | 645,519 | 295 | 12,749 |

[a] Chinook salmon counts from 1965-1984 were not expanded; counts in 1985 and after were expanded

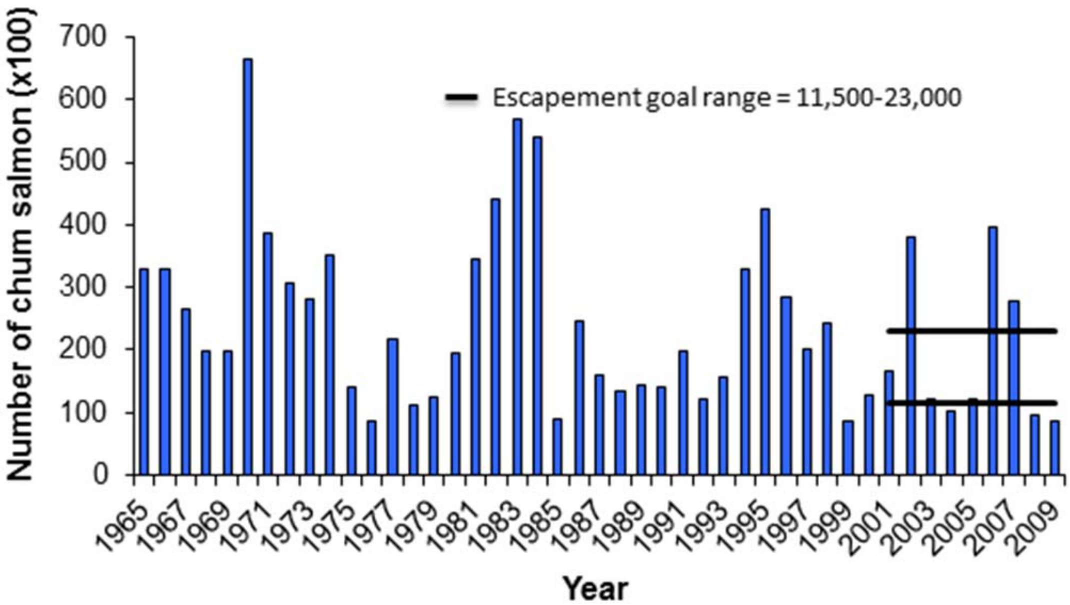



Figure 5-41. Kwiniuk River estimated chum salmon escapement, 1965–2009, and in relation to the optimal escapement goal range, 2001–2009.

***Escapement Goals***

Current Subdistrict 1 SEGs and district-wide BEG are as follows:

| River | Enumeration Method | Goal | Type |
|---|---|---|---|
| Eldorado River | Weir | 6,000-9,200 | SEG |
| Nome River | Weir | 2,900-4,300 | SEG |
| Snake River | Weir | 1,600-2,500 | SEG |
| Subdistrict 1 | Multiple | 23,000-35,000 | BEG |

In 2001, ADF&G established a BEG for Subdistrict 1 chum salmon of 23,000–35,000 fish (Clark 2001). At this time, SEGs were also established for the major rivers within the subdistrict. Nome, Snake, and Eldorado rivers used weirs and towers to assess escapement while the other 4 river systems relied on expanded aerial surveys to obtain escapement estimates. In 2010, ADF&G eliminated the SEGs on those rivers using expanded aerial surveys yet maintained aerial surveys to help obtain information to assess the overall escapement to Subdistrict 1 in relation to the BEG.

There is no district-wide escapement goal for Subdistrict 2 (Volk et al 2009). However, in 2005, an SEG of >30,000 chum salmon passed the Niukluk River counting tower was established; in 2010 ADF&G lowered the SEG threshold to > 23,000 chum salmon passed the counting tower.

In Subdistrict 3, there are two major river drainages, Kwiniuk and Tubutulik Rivers with biological escapement goals (BEG) of 10,000–20,000 and 8,000–16,000 chum salmon, respectively. In January 2001, the BOF established optimal escapement goal (OEG) ranges for chum salmon in Kwiniuk River and Tubutulik River by adding an additional 15% to the BEG range to account for subsistence harvests that may occur above the tower site.

### *Maturity*

In Subdistrict 1, the Nome, Snake, and Eldorado rivers have had age, sex, and length (ASL) data collected consistently from escapements since 2001. The 9-year average (2001–2009) age composition of escapement is dominated by 4 and 5-year old chum salmon.

| River | Age 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
|---|---|---|---|---|---|
| Nome River | 0.026 | 0.530 | 0.412 | 0.031 | 5.56E-04 |
| Snake River | 0.016 | 0.537 | 0.410 | 0.037 | 0.00E+00 |
| Eldorado River | 0.027 | 0.520 | 0.424 | 0.029 | 4.44E-04 |

In Subdistrict 2, the Niukluk River escapement has been monitored since 1995. The 10-year (2000–2009) average age composition of escapement is dominated by 4 and 5-year old chum salmon.

| | Age 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
|---|---|---|---|---|---|
| Niukluk River | 0.024 | 0.521 | 0.428 | 0.026 | 2.510E-04 |

In Subdistrict 3, the Kwiniuk River escapement has been monitored since 1965. The 10-year (2000–2009) average age composition is dominated by 4 and 5-year old chum salmon.

| | Age 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
|---|---|---|---|---|---|
| Kwiniuk River | 0.051 | 0.490 | 0.441 | 0.019 | 0.000 |

### *Harvest*

There has been no commercial harvest of chum salmon in Subdistrict 1 since 1996 and subsistence harvest has been diminishing since the 1980s (Figure 5-42). The average subsistence harvest of 1,636 chum salmon for 1990–2009 was less than one half the average subsistence harvests of 4,645 chum salmon for the previous twenty years (1970–1989). Contributing to this decrease were low runs and increasing subsistence restrictions. However, even with fishing closures, escapements did not increase in the late 1990s and early 2000s in response to less fishing pressure. In recent years, chum salmon runs have started increasing, yet subsistence harvests remain low in large part due to a preference for pink and coho salmon by subsistence users.

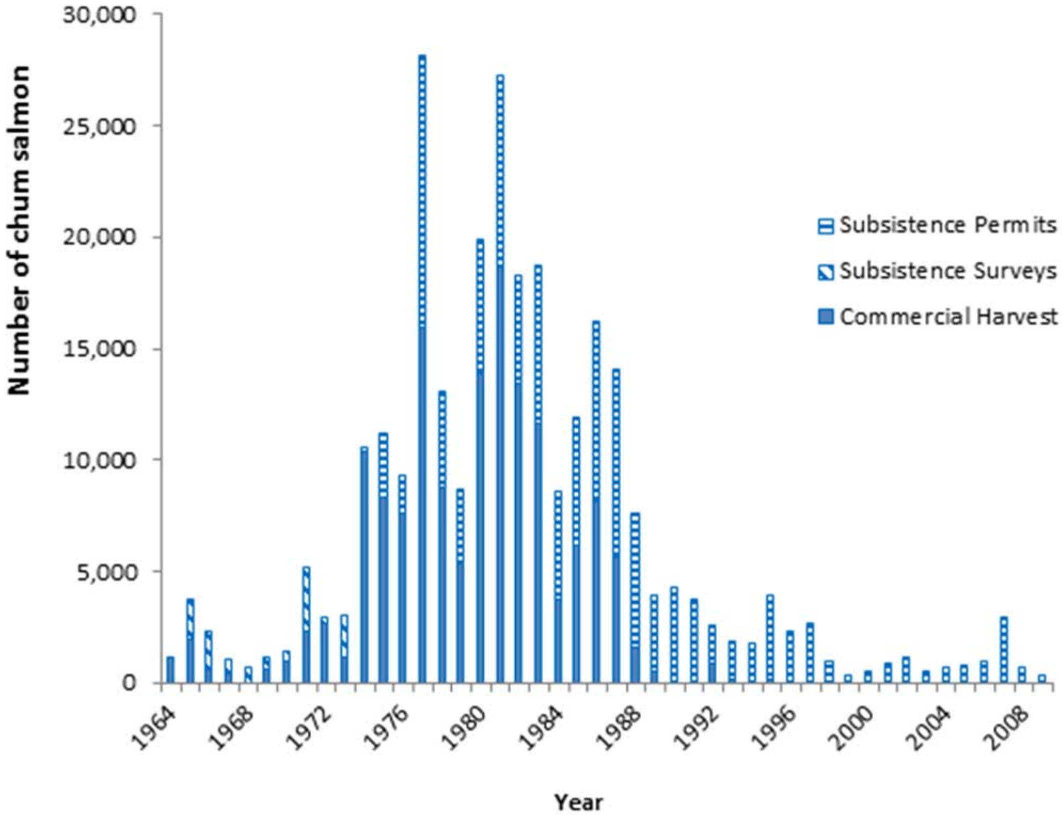



Figure 5-42. Subdistrict 1 commercial and subsistence chum salmon harvest, 1964–2009.

In Subdistricts 2 and 3, chum salmon subsistence harvests in the 2000s have been very minimal. In Subdistrict 2, chum salmon harvests averaged 1,767 fish from 2005 through 2009, only slightly more than one half the previous 10-year (1995–2004) average subsistence harvest of 3,237 chum salmon (Figure 5-43). In Subdistrict 3, an average of 1,216 chum salmon were harvested for subsistence from 2005 through 2009, slightly less than the previous 10-year (1995–2004) average subsistence harvest of 1,617 chum salmon (Figure 5-41). In most years since 2003, chum salmon runs have been insufficient to allow for a commercial harvest in Subdistricts 2 and 3. However, in 2007 there was a large surplus of chum salmon, but the buyer was only able to purchase fish in Subdistrict 3.

### *2010 Summary*

Commercial chum salmon catches in Northern Norton Sound totaled 40,665 fish harvested in 2010. Subdistricts 2 and 3 had the highest chum salmon harvest in each subdistrict in over 20 years. The department's longest operational salmon escapement monitoring project in Norton Sound at Kwiniuk River had the highest chum salmon escapement (71,388) in the 46-year history of the counting tower project.

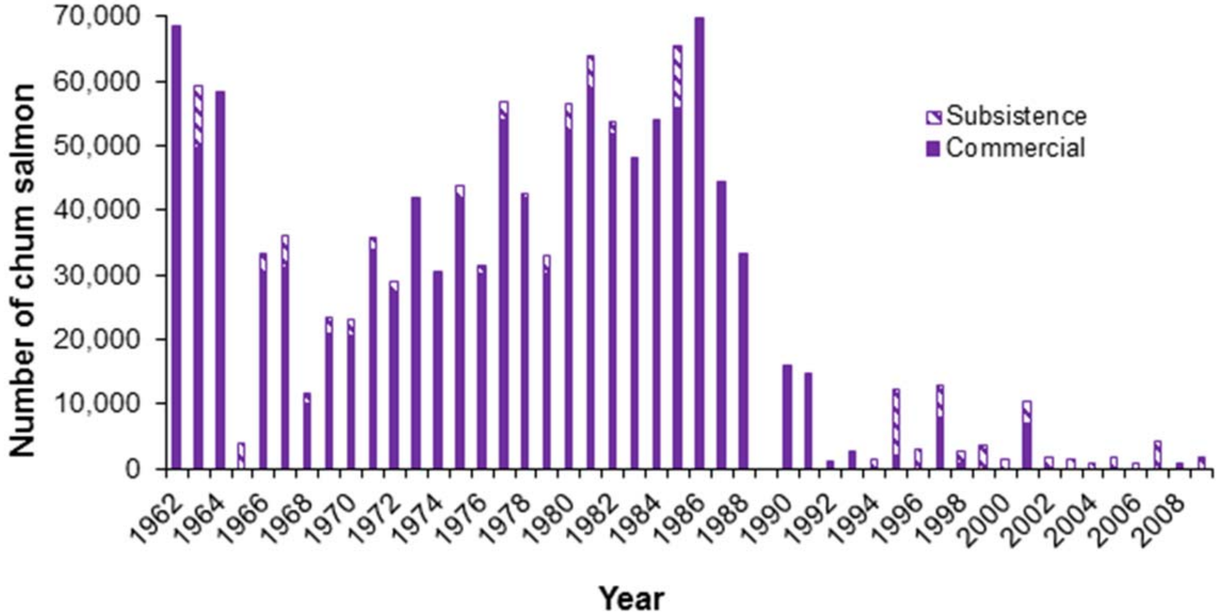



Figure 5-43. Subdistrict 2 commercial and subsistence chum salmon harvest, 1961–2009.

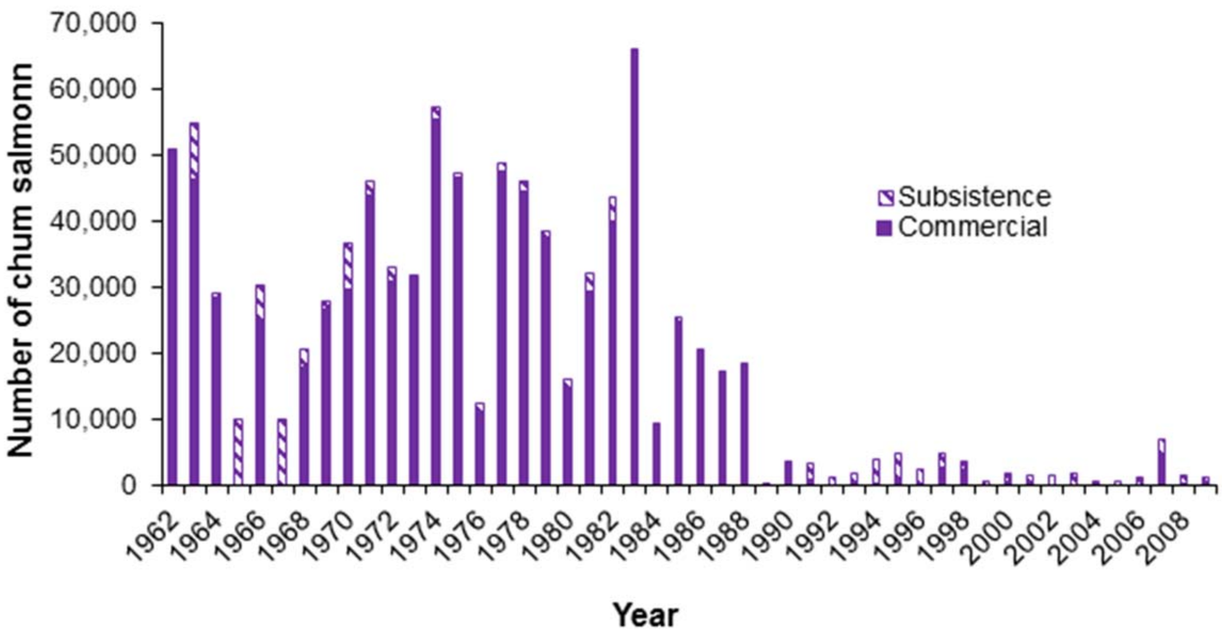



Figure 5-44. Subdistrict 3 commercial and subsistence chum salmon harvest, 1962–2009.

### *Exploitation Rates*

Exploitation rates in Subdistrict 1 have declined since the early 1990s (Figure 5-42) and dropped from an average of 3.5% (1993–2004) to an average of 2.3% in the last 5 years (2005–2009). In Subdistrict 2, the exploitation rate has been more consistent in the 2000s then earlier years and has been trending up since 2007 (Figure 5-43) yet it has dropped from an average of 3.1% (1995–2004) to an average of 2.1% (2004–2009). The exploitation rate in Subdistrict 3 peaked in the late 1990s and has been decreasing since (Figure 5-44) with an average exploitation rate of 2.5% (2005–2009) down from 3.8% (1994–2004). These harvest rates are low in comparison to exploitation rates exerted on most Alaska salmon populations and primarily reflect low runs and lack of commercial markets during larger runs.

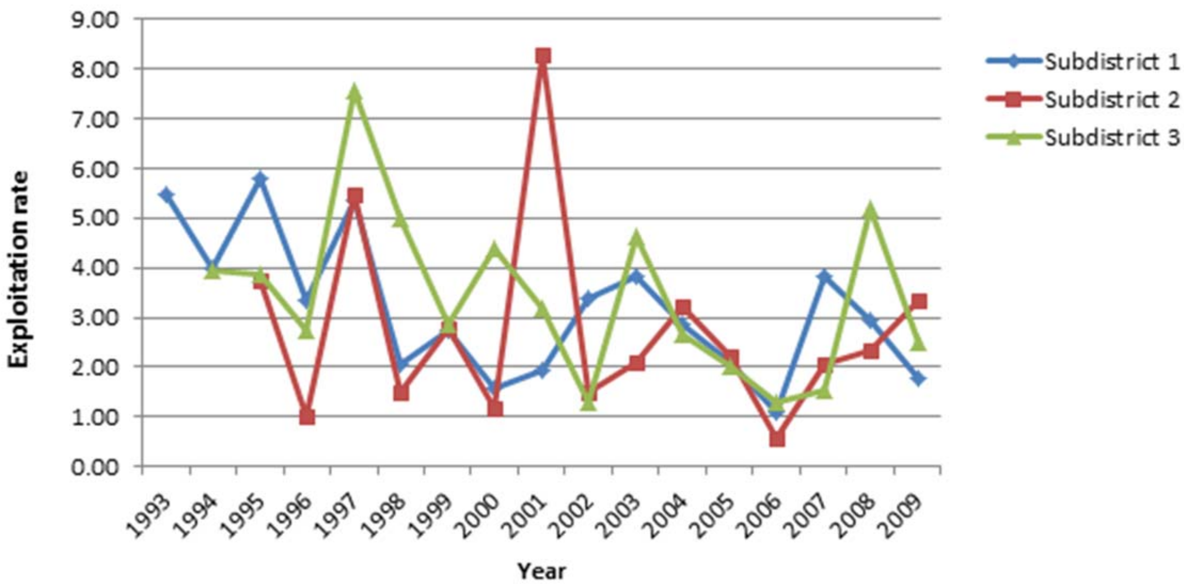



Figure 5-45. Exploitation rates in Subdistrict 1, 1993–2009; Subdistrict 2, 1995–2009; and Subdistrict 3, 1994–2009.

***Outlook***

Norton Sound Subdistricts 1–3 have no formal forecast for salmon returns. Broad expectations are developed based on parent-year escapements and recent year trends.

Processing capacity and management for anticipated low Chinook salmon abundance may result in chum salmon harvests that are lower than the outlook projections. Currently, Northern Norton Sound chum salmon stocks are classified as stocks of yield concern under the Sustainable Salmon Fisheries Policy. The estimated projected commercial harvest in 2011 is 90,000–120,000 fish for all subdistricts (1–6) combined in Norton Sound..

### 5.2.6.2 Eastern Norton Sound chum salmon

Eastern Norton Sound includes Subdistricts 4, 5, and 6 (Figure 5-35) and the majority of the chum salmon run comes from the Koyuk, Inglutalik, and Ungalik Rivers in Subdistrict 4, Shaktoolik River in subdistrict 5 and Unalakleet River in Subdistrict 6. Aerial surveys are used to assess chum salmon escapements in Subdistricts 4 and 5. In Subdistrict 6, chum salmon escapement is assessed using a test fishery on the Unalakleet River and a counting tower on the North River, a tributary of the Unalakleet River. Commercial fisheries in Subdistricts 5 and 6 are managed concurrently according to test fishery and escapement indices in Subdistrict 6 because tagging studies conducted in the late 1970s showed an intermingling in near-shore waters of chum salmon bound for both subdistricts. Subdistrict 4 is typically managed similar to Subdistricts 5 and 6 because they are believed to have similar trends in salmon run strength and timing; however there have been limited commercial fishing opportunities in Subdistrict 4.

### *Stock Assessment Background*

#### *Escapement*

There are no escapement monitoring programs in Subdistricts 4 and 5. The historical average escapement as enumerated at the North River counting tower is 6,232 chum salmon and this has been exceeded 5 times in the last ten years (Table 5-21). Area managers estimate drainagewide chum salmon escapement in the Unalakleet River by expanding North River tower chum salmon passage estimates using proportional abundance estimates determined from radiotelemetry investigations. The recent 5-year average (2005–2009) drainage-wide chum salmon escapement estimate of 69,591 chum salmon was 41% above the previous 9-year average (1996–2004) escapement estimate of 49,328 chum salmon (Table 5-23). Additionally, the number of chum salmon caught in 2008 and 2009 in the Unalakleet River test fishery was higher than in any other years over the 25 years the project has been operating (Table 5-22).

Table 5-21. Historical salmon migration passed North River counting tower, 1972–2009.

| Year | Operating Period | Chum | Pink | Chinook | Coho |
|---|---|---|---|---|---|
| 1972 | July 07-July 28 | 2,332 | 54,934 | 561 | |
| 1973 | June 29-July 23 | 4,334 | 26,542 | 298 | |
| 1974 | June 25-July 17 | 826 | 143,789 | 196 | |
| 1984 | June 25-July 28 | 2,915 | 458,387 | 2,844 | |
| 1985 | June 27-Aug 31 | 4,567 | 4,360 | 1,426 | 2,045 |
| 1986 | June 25-July 18 | 3,738 | 236,487 | 1,613 | |
| 1996 | June 16-July 25 | 9,789 | 332,539 | 1,197 | 1,229 |
| 1997 | June 16-Aug 21 | 6,904 | 127,926 | 4,185 | 5,768 |
| 1998 | June 15-Aug 12 | 1,526 | 74,045 | 2,100 | 3,361 |
| 1999 | June 30-Aug 31 | 5,600 | 48,993 | 1,639 | 4,792 |
| 2000 | June 17-Aug 12 | 4,971 | 69,703 | 1,046 | 6,959 |
| 2001 | July 05-Sept 15 | 6,515 | 24,737 | 1,337 | 12,383 |
| 2002 | June 19-Aug 29 | 5,918 | 321,756 | 1,484 | 2,966 |
| 2003 | June 15-Sept 13 | 9,859 | 280,212 | 1,452 | 5,837 |
| 2004 | June 15-Sept 14 | 10,036 | 1,162,978 | 1,125 | 11,187 |
| 2005 | June 15-Sept 15 | 11,984 | 1,670,934 | 1,015 | 19,189 |
| 2006 | June 18-Sept 11 | 5,385 | 2,169,890 | 906 | 9,835 |
| 2007 | June 16-Sept 05 | 8,151 | 580,929 | 1,948 | 19,965 |
| 2008 | June 19-Sept 13 | 9,502 | 240,286 | 903 | 15,648 |
| 2009 | June 19-Sept 11 | 9,783 | 189,939 | 2,352 | 22,266 |

Table 5-22. Historical salmon catches in the Unalakleet set gillnet test fishery, 1985–2009

| | | Chinook | | Chum | | Coho | |
|---|---|---|---|---|---|---|---|
| Year | Dates of Operation | Total Catch | Midpoint Date | Total Catch | Midpoint Date | Total Catch | Midpoint Date |
| 1985 | 6/05-9/21 | 193 | 7/08 | 916 | 7/10 | 206 | 8/21 |
| 1986 | 6/17-9/10 | 52 | 6/26 | 1,063 | 7/23 | 163 | 8/18 |
| 1987 | 6/20-9/08 | 52 | 7/07 | 707 | 7/22 | 149 | 8/27 |
| 1988 | 6/20-9/12 | 15 | 6/27 | 662 | 7/25 | 216 | 8/12 |
| 1989 | 6/13-9/12 | 50 | 6/19 | 856 | 7/11 | 232 | 8/16 |
| 1990 | 6/15-9/13 | 43 | 6/20 | 383 | 7/14 | 284 | 8/21 |
| 1991 | 6/10-9/10 | 36 | 6/24 | 834 | 7/27 | 177 | 8/26 |
| 1992 | 6/27-9/08 | 25 | 7/12 | 976 | 7/12 | 455 | 8/12 |
| 1993 | 6/08-9/08 | 94 | 6/26 | 700 | 7/29 | 156 | 8/24 |
| 1994 | 6/16-9/07 | 35 | 6/22 | 949 | 7/02 | 297 | 8/22 |
| 1995 | 6/05-9/11 | 99 | 6/20 | 1,212 | 7/11 | 213 | 8/14 |
| 1996 | 6/05-9/11 | 138 | 6/14 | 1,635 | 7/06 | 717 | 8/06 |
| 1997 | 6/05-9/10 | 202 | 6/27 | 832 | 7/16 | 197 | 8/12 |
| 1998 | 6/05-9/09 | 110 | 7/07 | 535 | 7/18 | 220 | 8/17 |
| 1999 | 6/05-9/08 | 63 | 7/08 | 1,022 | 7/27 | 206 | 8/23 |
| 2000 | 6/05-9/08 | 61 | 6/28 | 1,075 | 7/18 | 257 | 8/16 |
| 2001 | 6/15-9/07 | 79 | 7/04 | 645 | 7/09 | 219 | 8/15 |
| 2002 | 6/05-9/08 | 44 | 6/26 | 852 | 7/08 | 394 | 8/25 |
| 2003 | 6/02-9/08 | 25 | 7/02 | 458 | 7/30 | 267 | 8/24 |
| 2004 | 6/02-9/10 | 29 | 7/01 | 976 | 7/17 | 829 | 8/15 |
| 2005 | 6/04-9/08 | 78 | 6/23 | 1,209 | 7/10 | 1,080 | 8/19 |
| 2006 | 6/08-9/14 | 79 | 6/30 | 1,482 | 7/01 | 1,738 | 8/16 |
| 2007 | 6/04-9/09 | 96 | 6/29 | 978 | 7/15 | 1,087 | 8/06 |
| 2008 | 6/09-9/13 | 123 | 7/07 | 1,932 | 7/18 | 1,988 | 8/15 |
| 2009 | 6/08-9/11 | 135 | 6/28 | 1,687 | 7/18 | 2,104 | 8/18 |

Table 5-23. Estimated chum salmon escapement, total harvest, and total run compared to exploitation rates, Unalakleet River, 1984–1986, 1996–2009.

| | Escapement | | Total | | |
|---|---|---|---|---|---|
| Year | North River | Unalakleet R. Drainage[a] | Harvest [b] | Estimated Run Size | Exploitation Rate Percent |
| 1984 | 2,915 | 21,123 | 46,665 | 67,788 | 68.8 |
| 1985 | 4,567 | 33,094 | 27,079 | 60,173 | 45.0 |
| 1986 | 3,738 | 27,087 | 30,239 [c] | 57,326 | 52.7 |
| 1996 [d] | 9,789 | 70,935 | 11,596 | 89,677 | 12.9 |
| 1997 | 6,904 | 50,029 | 18,742 | 59,277 | 31.6 |
| 1998 | 1,526 | 11,058 | 9,248 | 20,450 | 45.2 |
| 1999 | 5,600 | 40,580 | 9,392 | 46,280 | 20.3 |
| 2000 | 4,971 | 36,022 | 5,700 | 40,452 | 14.1 |
| 2001 | 6,515 | 47,210 | 4,430 | 51,426 | 8.6 |
| 2002 | 5,918 | 42,884 | 4,216 | 47,744 | 8.8 |
| 2003 | 9,859 | 71,442 | 4,860 | 78,520 | 6.2 |
| 2004 | 10,036 | 73,794 | 7,078 | 79,646 | 8.9 |
| 2005 | 11,984 | 118,653 | 5,852 | 128,086 | 4.6 |
| 2006 | 5,397 | 30,492 | 9,433 | 44,337 | 21.3 |
| 2007 | 8,151 | 59,066 | 13,845 | 79,519 | 17.4 |
| 2008 | 9,502 | 68,855 | 20,453 | 68,855 | 29.7 |
| 2009 | 9,783 | 70,891 | 23,614 | 94,505 | 25.0 |
| Previous 9-yr Avg. | 6,791 | 49,328 | 8,362 | 57,052 | 17.4 |
| 2005-2009 Avg. | 8,963 | 69,591 | 14,639 | 83,060 | 19.6 |

[a] Drainage-wide escapement estimates for the 2004-2006 seasons calculated by expanding tower counts by North River proportional abundance estimates determined from radiotelemetry (0.136, 0.101, and 0.177, respectively). Drainage-wide escapements estimated for all other years by expanding tower counts by the average proportion (0.138) of chum salmon migrating into the North River, 2004-2006 (Estensen & Balland, *in prep*).

[b] Harvest includes commercial, subsistence, sport and Unalakleet River test fishery catches from 1984-1986 and 1996-2009.

[c] Subsistence harvest data unavailable in 1986 and was estimated by averaging subsistence harvest from 1981-1985.

[d] North River Tower not operational from 1987-1995.

### *Escapement Goals*

There are no chum salmon escapement goals for Subdistricts 4 and 5. In Subdistrict 6, an aerial survey SEG of 2,400–4,800 chum salmon for Old Women River, in the upper Unalakleet River is the only established escapement goal. Additionally, drainage-wide escapement is estimated using North River chum salmon proportional abundance estimates determined by radiotelemetry during the 2004–2006 seasons. Drainage-wide chum salmon escapement estimates for the 2004–2006 seasons were calculated by dividing the North River tower chum salmon passage by the actual proportional abundance estimates for those years. The average North River abundance proportion (0.138) was used to expand North River tower chum salmon passage for years radiotelemetry work was not conducted.

***Maturity***

The age composition of chum salmon in Subdistrict 5 was calculated from commercial fisheries in 2002, 2004, 2006, and 2007–2009. The commercial fisheries are dominated by age-4 chum salmon.

| | Age | | | | |
|---|---|---|---|---|---|
| | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
| Commercial | 0.064 | 0.463 | 0.437 | 0.045 | 0.000 |

In Subdistrict 6, age composition is determined by age, sex, and length data collected during the test fishery and the commercial fisheries. The test fishery is dominated by 5-year old chum salmon while the commercial fishery is predominantly 4-year old chum salmon. The disparity of age between the test fishery and the commercial catch may highlight a bias in fishing gear; the 5 7/8-inch mesh deployed in the test fishery preferentially selects large male chum salmon in the 5 and 6-year old age classes.

| | Age | | | | |
|---|---|---|---|---|---|
| | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
| Test Fish | 0.022 | 0.445 | 0.499 | 0.034 | 0.001 |
| Commercial | 0.024 | 0.535 | 0.415 | 0.027 | 0.000 |

***Harvest***

Subdistrict 4 typically has difficulty attracting a buyer due to its remoteness and its reputation for watermarked fish. Improving market conditions allowed for commercial chum salmon fishing in Norton Bay in 2008 and 2009. Commercial chum salmon fishing has only occurred 6 times since 1987 and the harvest of 1,850 chum salmon in 2009 was the highest since 1988 (Table 5-24). A total of 7 permits holders participated at some time during the 2009 season compared to 4 permit holders in 2008. Subsistence harvest in Subdistrict 4 was not assessed from 2004–2007 but shows a slight decreasing trend with an average harvest of 4,826 chum salmon in the 1990s to an average harvest of 3,840 chum salmon in the 2000s (Table 5-22).

Table 5-24. Commercial and subsistence salmon catch by species, by year in Subdistrict 4, Norton Sound District, 1962-2009.

| Year | Commercial | Subsistence |
|---|---|---|
| 1962 | 24380 | - |
| 1963 | 12469 | - |
| 1964 | 5916 | - |
| 1965 | - | 3032 |
| 1966 | - | 3612 |
| 1967 | - | 2945 |
| 1968 | - | 1872 |
| 1969 | 3974 | 3855 |
| 1970 | | 3500 |
| 1971 | - | 2619 |
| 1972 | 7799 | 2022 |
| 1973 | 4672 | 130 |
| 1974 | 3826 | 900 |
| 1975 | 17385 | 361 |
| 1976 | 7161 | 236 |
| 1977 | 13563 | 2055 |
| 1978 | 21973 | 1060 |
| 1979 | 15599 | 1400 |
| 1980 | 7855 | 1132 |
| 1981 | 3111 | 3515 |
| 1982 | 7128 | 2485 |
| 1983 | 17157 | [a] |
| 1984 | 3442 | [a] |
| 1985 | 9948 | [a] |
| 1986 | 1994 | [a] |
| 1987 | 3586 | [a] |
| 1988 | 7521 | [a] |
| 1989 | - | [a] |
| 1990 | 0 | [a] |
| 1991 | 0 | [a] |
| 1992 | 1787 | [a] |
| 1993 | 1378 | [a] |
| 1994 [b] | 0 | 4581 |
| 1995 [b] | 0 | 5828 |
| 1996 [b] | 0 | 4161 |
| 1997 [b] | 531 | 4040 |
| 1998 [b] | 0 | 6192 |
| 1999 [b] | 0 | 4153 |
| 2000 [b] | 0 | 4714 |
| 2001 [b] | 0 | 4445 |
| 2002 [b] | 0 | 3971 |
| 2003 [b] | 0 | 3397 |
| 2004 | 0 | [a] |
| 2005 | 0 | [a] |
| 2006 | 0 | [a] |
| 2007 | 0 | [a] |
| 2008 | 507 | 3330 |
| 2009 | 1850 | 3183 |

[a] Subsistence surveys were not conducted.

[b] Subsistence harvests were estimated from Division of Subsistence surveys.

In Subdistrict 5, the majority of chum salmon are taken in the commercial fishery; there is little subsistence harvest. There has been a trend of increasing commercial harvest since 2006. The 2009 commercial harvest was 10,915 chum salmon, well above the recent 5-year (2004–2008) average of 3,520 fish (Figure 5-46).

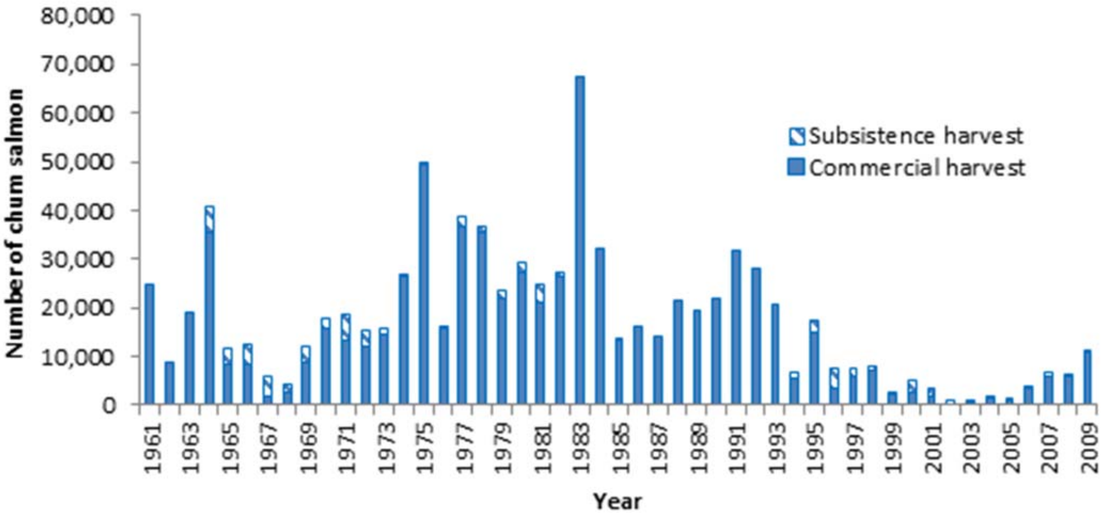



Figure 5-46. Commercial and subsistence chum salmon harvest in Subdistrict 5, 1961–2009.

In Subdistrict 6, commercial harvest is also showing an increase since 2006. The commercial harvest in 2009 of 20,647 chum salmon was well above the most recent 5-year (2004–2008) average of 8,855 fish. Subsistence harvest has remained relatively consistent since 2004 but has decreased slightly with an average harvest of 2,668 chum salmon in the 2000s down from an average of 3,557 chum salmon harvested in the 1990s (Figure 5-44).

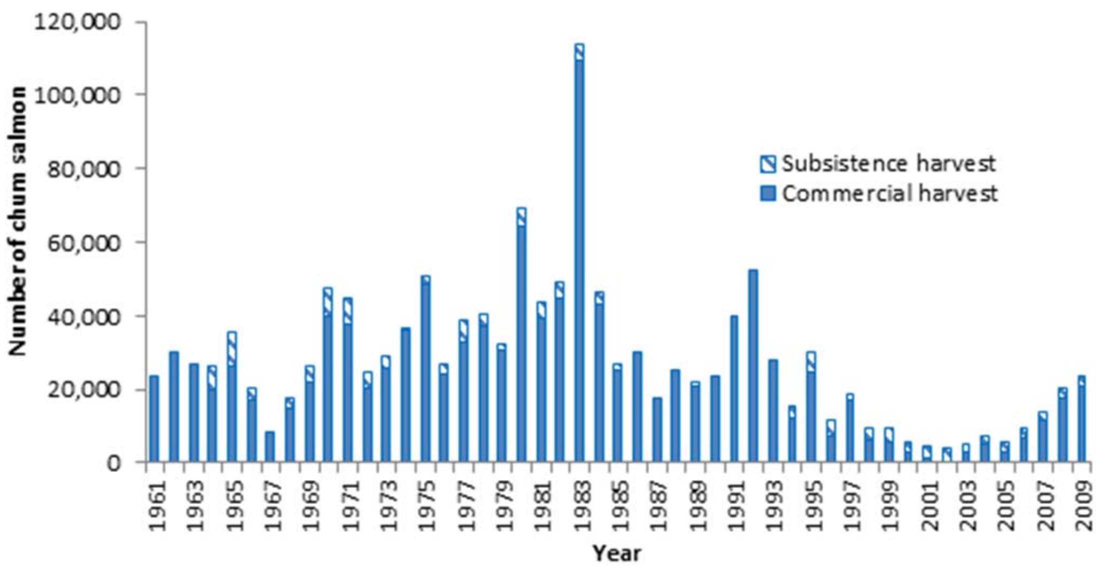



Figure 5-47. Commercial and subsistence chum salmon harvest in Subdistrict 6, 1961–2009.

***Exploitation Rates***

There are no complete escapement estimates for Subdistricts 4 and 5, hence it is not possible to calculate exploitation rates for these subdistricts. The exploitation rate of chum salmon in Subdistrict 6 is calculated using the drainage-wide escapement estimate and harvest. There is an increasing trend in exploitation since the early 2000s yet it is still well below the 1998 exploitation rate of 45% (Figure 5-48).

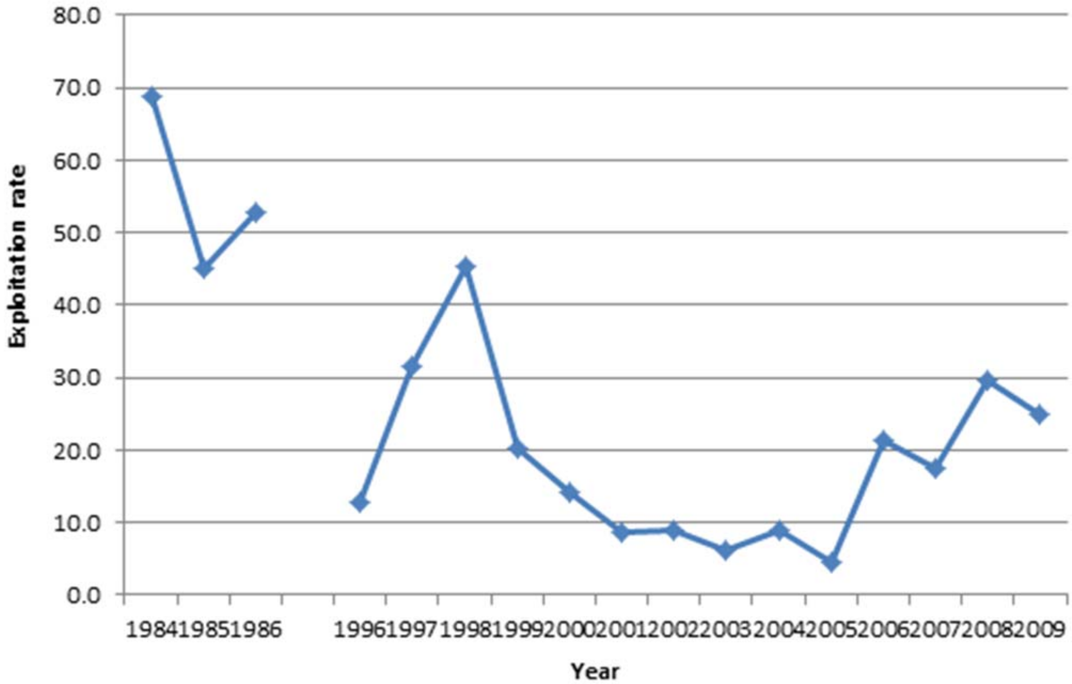



Figure 5-48. Exploitation rate of chum salmon in Subdistrict 6, Norton Sound, 1984–2009. Note: No data are available for 1987–1995.

***2010 Summary***

Commercial chum salmon catches in Eastern Norton Sound totaled 77,078 fish in 2010, well above the long-term average of 49,259 fish. Subdistricts 4 and 5 had the highest chum salmon harvest in each subdistrict in over 20 years, and Subdistrict 6 had the highest chum salmon harvest in 18 years. Additionally, the department's Unalakleet River test fishery had the highest chum salmon catch index in its 26-year project history.

***Outlook***

ADF&G does not produce formal run forecasts for most salmon runs in the AYK Region. Processing capacity and management for anticipated low Chinook salmon abundance may result in chum salmon harvests that are lower than the outlook projections. Currently, the estimated projected chum salmon commercial harvest for all subdistricts (1-6) in Norton Sound is 90,000 – 120,000 fish.

### 5.2.7 Kotzebue

Kotzebue Sound District encompasses all waters from Point Hope to Cape Prince of Wales, including those waters draining into the Chukchi Sea (Figure 5-49). Salmon, saffron cod, whitefish, and herring are the major subsistence species. There are two rivers in the Kotzebue area providing the majority of chum salmon, the Kobuk River and Noatak River.

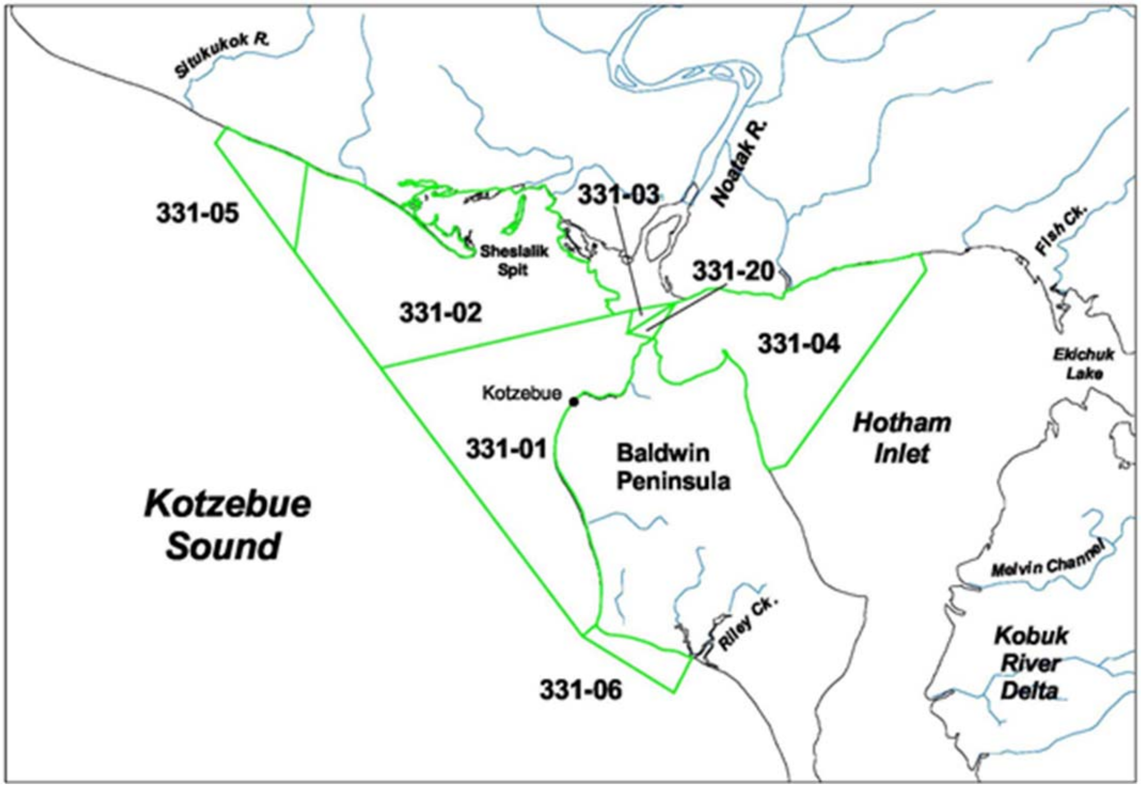



Figure 5-49. Kotzebue Sound commercial fishing subdistricts.

Kotzebue Sound District supports the northernmost commercial salmon fishery in Alaska and is divided into three subdistricts; commercial salmon fishing may occur in subdistrict 1 (Figure 5-46). Commercial fishing began in 1962 primarily harvesting chum salmon, and in recent years has been limited by processing capacity

Subsistence salmon fishing in Kotzebue Sound District is important, but fish abundance and fishing activities vary between communities. Along the Noatak and Kobuk Rivers where chum salmon runs are strong, household subsistence activities in middle and late summer revolve around catching, drying, and storing salmon. In southern Kotzebue Sound other fish species may be taken for subsistence because salmon are not abundant.

***Stock Assessment Background***

*Escapement*

Escapement for the Kotzebue Sound District is determined with aerial survey SEGs within the two major river drainages and a district-wide BEG. Aerial surveys are infrequent on the Kobuk and Noatak Rivers because of poor weather conditions (Figure 5-49).

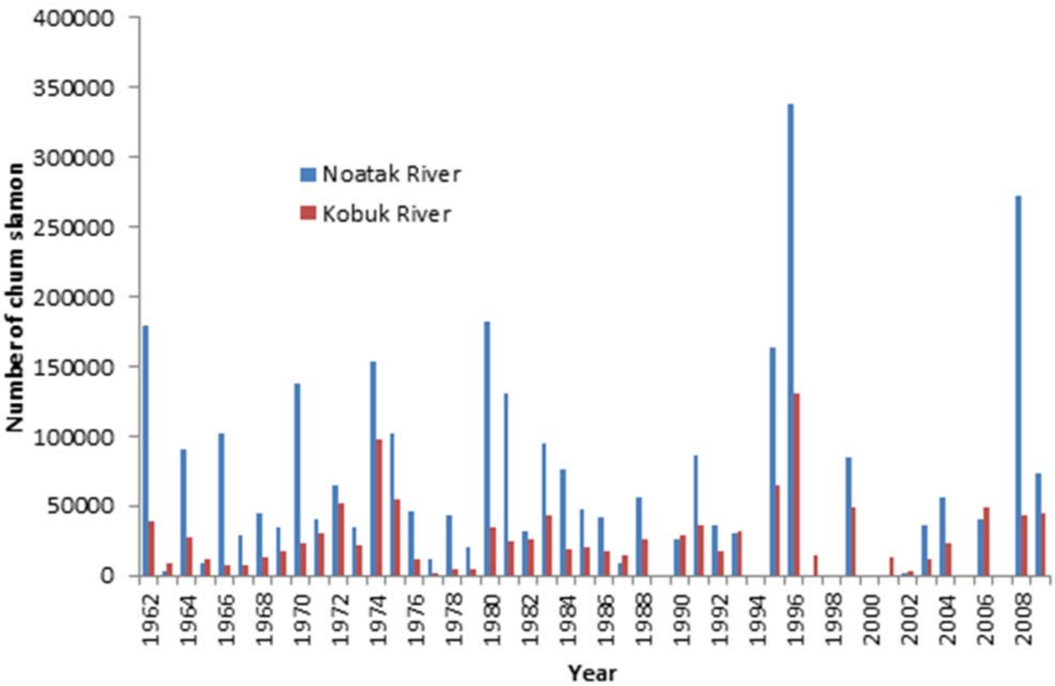



Figure 5-50. Chum salmon escapement in to the Noatak and Kobuk River drainages in Kotzebue Sound District determined by aerial surveys, 1962–2009. Note: Foot surveys were conducted in 1962 and 1968; blanks represent years with no surveys or poor survey conditions.

### *Escapement Goals*

Chum salmon escapement goals were established in 2007 for the Kotzebue area. All goals are determined from aerial surveys.

| River | Enumeration method | Goal | Type |
|---|---|---|---|
| Noatak/Eli Rivers | Aerial Survey | 42,000-91,000 | SEG |
| Kobuk River drainage | | | |
| Salmon River | Aerial Survey | 3,300-7,200 | SEG |
| Squirrel River | Aerial Survey | 4,900-10,500 | SEG |
| Tutuksuk River | Aerial Survey | 1,400-3,000 | SEG |
| Upper Kobuk/Selby River | Aerial Survey | 9,700-21,000 | SEG |
| Kotzebue (all areas) | Expanded aerial survey | 196,000-421,000 | BEG |

### *Maturity*

The age composition of chum salmon from the Noatak River is obtained from a yearly test fishery. The average age composition (2001-2009) is dominated by 4-year old chum salmon.

| | Age | | | | |
|---|---|---|---|---|---|
| | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
| Noatak River | 0.064 | 0.605 | 0.290 | 0.035 | 0.006 |

The age composition for the Kobuk River is obtained from a test fishery conducted about 75 miles from the mouth. The 2002-2009 average age composition is predominantly ag-3 chum salmon.

| | Age | | | | |
|---|---|---|---|---|---|
| | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
| Kobuk River | 0.099 | 0.476 | 0.369 | 0.054 | 0.002 |

Age composition is also determined for the commercial chum fishery in Kotzebue Sound District. The 2003-2009 average age composition for the commercial fishery is dominated by 4-year old chum salmon.

| | Age | | | | | |
|---|---|---|---|---|---|---|
| | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 |
| Commercial | 0.051 | 0.544 | 0.357 | 0.045 | 0.002 | 0.001 |

### *Harvest*

Commercial harvest in Kotzebue Sound District has been limited because of processor capacity and lacked a local buyer in 2002–2003. The 2009 harvest of 187,000 chum salmon was well above the average harvest of 119,000 for the 2000–2008 time period, but is still well below harvests in the 1980s, which averaged close to 300,000 fish. The number of fishing permits is also rebounding slightly with 62, the highest number since 2001 (Figure 5-51). Subsistence harvest is not available beyond 2004.

2010 Summary

The overall chum salmon run to Kotzebue Sound in 2010 was estimated to be above average to well above average based on commercial harvest rates, subsistence fishermen reports, and the Kobuk test fish index being the fifth best in the 18-year project history. The commercial harvest of 270,343 chum salmon was the highest since 1995.

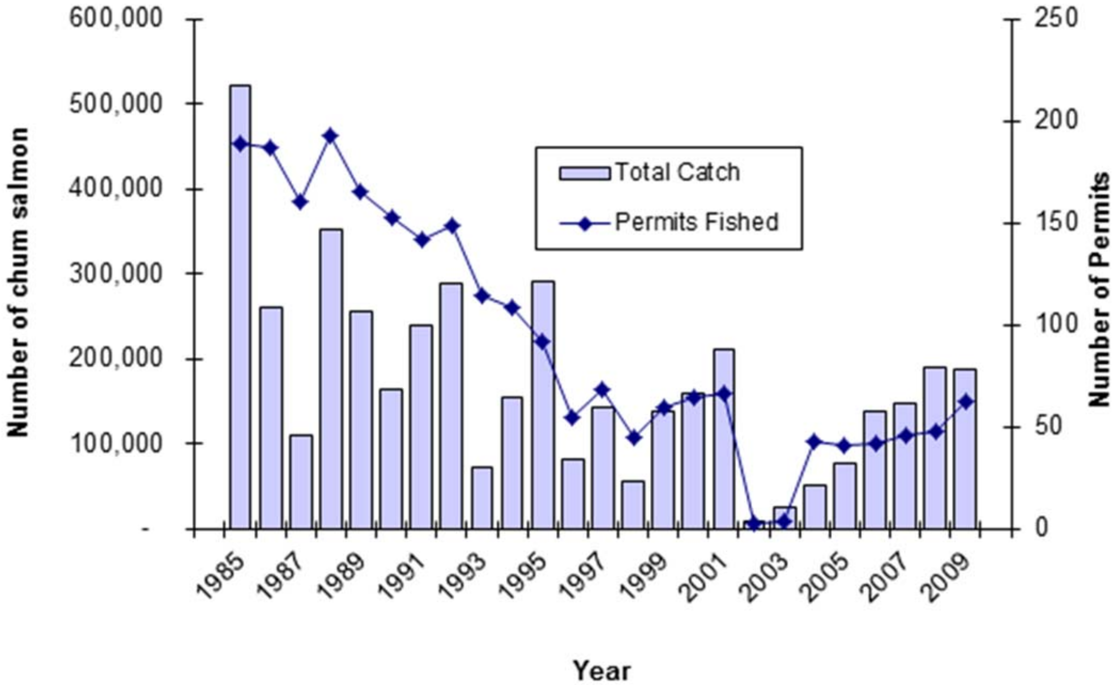



Figure 5-51. Kotzebue Sound commercial chum salmon harvest and permit fished, 1985–2009.

### *Exploitation Rates*

There are no complete escapement estimates for the Kotzebue Sounds District; hence, it is not possible to calculate exploitation rates.

### *Outlook*

Kotzebue Sound chum salmon fisheries have no formal forecast for salmon returns. Broad expectations are developed based on parent-year escapements and recent year trends.

ADF&G does not produce formal run forecasts for most salmon runs in the AYK Region. In general, processing capacity and management for anticipated low Chinook salmon abundance may result in chum salmon harvests that are lower than the outlook projections, in the AYK region. The estimated projected run size for chum salmon in Kotzebue Sound is 230,000–260,000 fish.

## 5.2.8 Alaska Peninsula/Area M

The Alaska Peninsula Area (Area M) includes the waters of Alaska on the north side of the Alaska Peninsula, southwest of a line from Cape Menshikof (57º 28.34' N. lat., 157º 55.84' W. long.) to Cape Newenham (58º 39.00' N. lat., 162º W. long.) and east of the longitude of Cape Sarichef Light (164º 55.70' W. long.) and on the south side of the Alaska Peninsula, from a line extending from Scotch Cap through the easternmost tip of Ugamak Island to a line extending 135º southeast from Kupreanof Point (55º 33.98' N. lat., 159 º 35.88' W. long.; Figure 5-52). Area M is further divided into two management areas, the North Alaska management area and the South Alaska management area. The two management areas will be summarized separately.

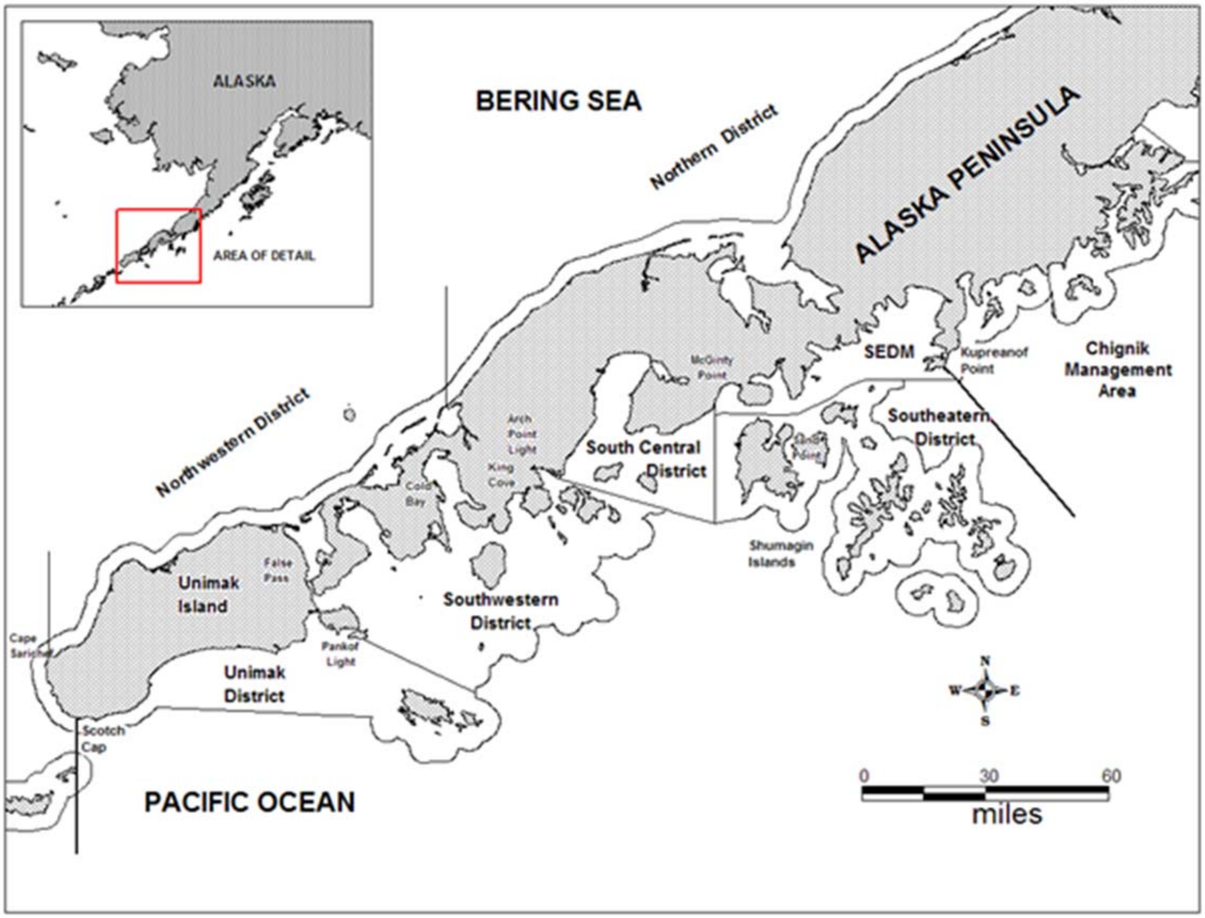



Figure 5-52. Alaska Peninsula/Area M identifying commercial salmon fishing districts.

### *Area M Escapement*

Salmon migration or spawning has been documented in approximately 307 Area M streams. The South Peninsula has approximately 136 systems with chum salmon spawning populations while the North Peninsula has approximately73 systems with chum salmon spawning populations. A total of six stock-aggregate escapement goals have been established for chum salmon in Area M (Table 5-25). These stock-aggregate goals comprise the respective sums of aerial survey escapement objectives for 136 individual index streams (Honnold et al. 2007; Nelson and Lloyd 2001). Sixty-seven of these index streams are located along the South Peninsula and 69 are found along the North Peninsula.

Table 5-25. Area M chum salmon escapements by year and district, 1979-2009.

| | Area M Salmon Management Districts | | | | | | |
|---|---|---|---|---|---|---|---|
| Year | Northern | Northwestern | Unimak | Southwestern | Southeastern | South Central | Total |
| 1979 | 114,900 | 190,400 | 500 | 107,900 | 134,100 | 168,600 | 716,400 |
| 1980 | 364,200 | 405,300 | 1,000 | 119,800 | 118,800 | 122,800 | 1,131,900 |
| 1981 | 276,400 | 264,600 | 100 | 146,700 | 118,400 | 116,100 | 922,300 |
| 1982 | 267,500 | 190,200 | 0 | 183,900 | 73,900 | 129,100 | 844,600 |
| 1983 | 199,100 | 193,500 | 0 | 117,600 | 160,400 | 168,500 | 839,100 |
| 1984 | 409,300 | 460,900 | 0 | 253,700 | 251,000 | 195,000 | 1,569,900 |
| 1985 | 123,900 | 220,400 | 0 | 218,800 | 112,300 | 172,400 | 847,800 |
| 1986 | 77,900 | 165,700 | 400 | 331,477 | 130,816 | 105,774 | 812,067 |
| 1987 | 161,400 | 341,500 | 493 | 327,910 | 154,207 | 169,267 | 1,154,777 |
| 1988 | 144,100 | 356,200 | 1,313 | 271,446 | 90,397 | 225,623 | 1,089,079 |
| 1989 | 102,300 | 110,000 | 321 | 144,034 | 103,997 | 94,107 | 554,759 |
| 1990 | 115,600 | 110,900 | 710 | 181,897 | 125,813 | 137,082 | 672,002 |
| 1991 | 81,500 | 221,800 | 540 | 278,929 | 276,545 | 170,262 | 1,029,576 |
| 1992 | 136,400 | 215,300 | 170 | 162,923 | 224,399 | 138,482 | 877,674 |
| 1993 | 183,400 | 219,000 | 1,070 | 300,251 | 40,632 | 211,293 | 955,646 |
| 1994 | 230,800 | 249,400 | 1,190 | 403,233 | 69,291 | 216,690 | 1,170,604 |
| 1995 | 347,800 | 408,300 | 736 | 556,707 | 127,150 | 295,161 | 1,735,854 |
| 1996 | 436,400 | 386,700 | 800 | 302,100 | 133,600 | 173,800 | 1,433,400 |
| 1997 | 161,000 | 227,200 | 3,300 | 263,700 | 267,650 | 274,400 | 1,197,250 |
| 1998 | 380,400 | 349,100 | 500 | 351,410 | 246,025 | 1,444,300 | 2,771,735 |
| 1999 | 299,500 | 366,800 | 1,000 | 388,130 | 82,550 | 253,500 | 1,391,480 |
| 2000 | 338,900 | 249,200 | 800 | 257,225 | 179,950 | 84,100 | 1,110,175 |
| 2001 | 285,900 | 520,026 | 400 | 277,021 | 318,300 | 155,500 | 1,557,147 |
| 2002 | 262,800 | 438,939 | 1,200 | 268,000 | 204,150 | 129,400 | 1,304,489 |
| 2003 | 214,660 | 252,577 | 200 | 193,030 | 218,810 | 79,000 | 958,277 |
| 2004 | 139,350 | 302,078 | 400 | 180,000 | 367,200 | 184,800 | 1,173,828 |
| 2005 | 103,675 | 226,582 | 4,200 | 317,910 | 412,500 | 235,700 | 1,300,567 |
| 2006 | 382,583 | 232,848 | 7,915 | 231,935 | 405,300 | 119,600 | 1,380,181 |
| 2007 | 243,334 | 431,456 | 1,200 | 398,010 | 201,451 | 126,000 | 1,401,451 |
| 2008 | 228,537 | 176,550 | 2,800 | 171,250 | 277,450 | 140,450 | 997,037 |
| 2009 | 154,131 | 84,460 | 1,400 | 385,730 | 106,500 | 18,600 | 750,821 |
| 1999-2008 Average | 249,924 | 319,706 | 2,012 | 268,251 | 266,766 | 150,805 | 1,257,463 |

### *North Peninsula Chum salmon Escapement*

The North Alaska Peninsula has two chum salmon escapement goals, one for the entire Northern District and one for the entire Northwestern District (Figure 5-53). In 2009, the Northern District chum salmon escapement goal (119,600 to 239,200 fish; Honnold et al. 2007) was met when 154,131 fish were documented in Northern District streams (Table 5-25; Figure 5-53). The Northwestern District chum salmon escapement of 84,460 fish did not meet the goal of 100,000 to 215,000 fish, and was below the previous ten year average of 319,706 fish (Table 5-25; Figure 5-54; Honnold et al. 2007). The total North Alaska Peninsula estimated chum salmon escapement of 238,591 was below the previous ten year average of 569,630 fish.

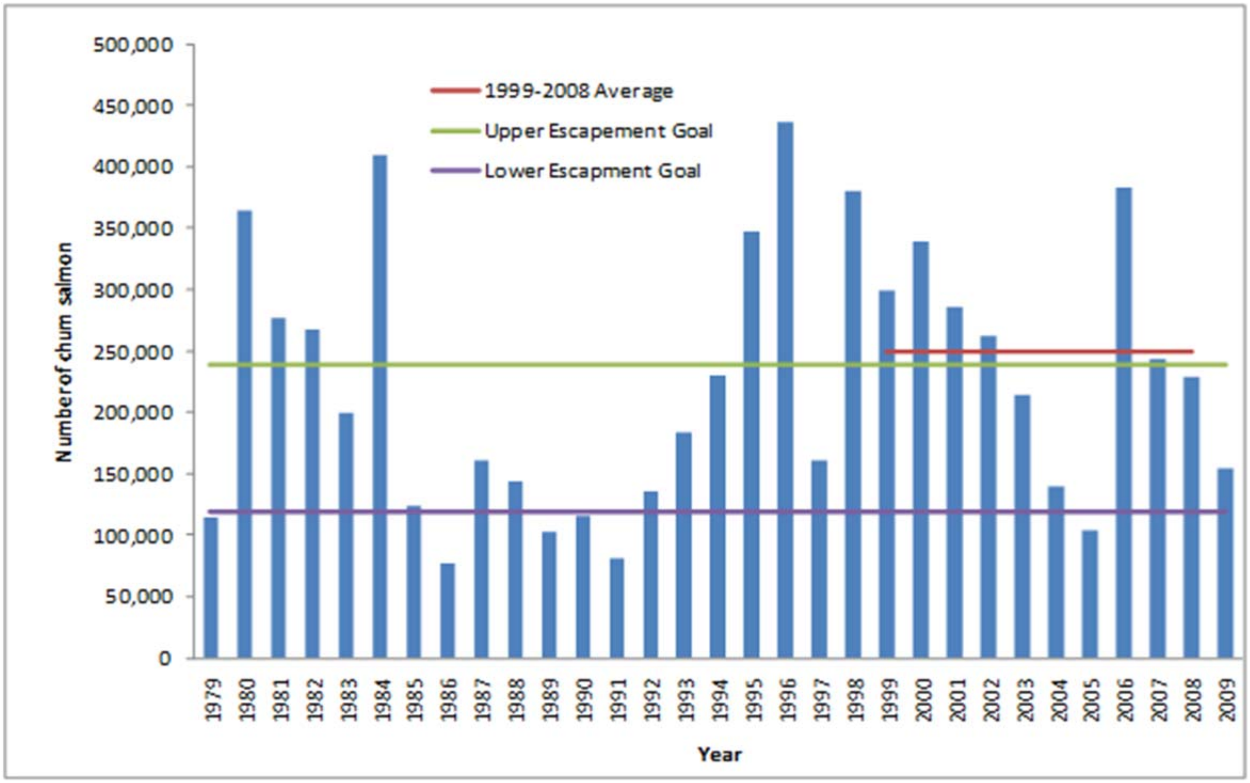



Figure 5-53. Northern District chum salmon escapement with comparison of upper and lower escapement goal and 10 year average, 1979-2009.

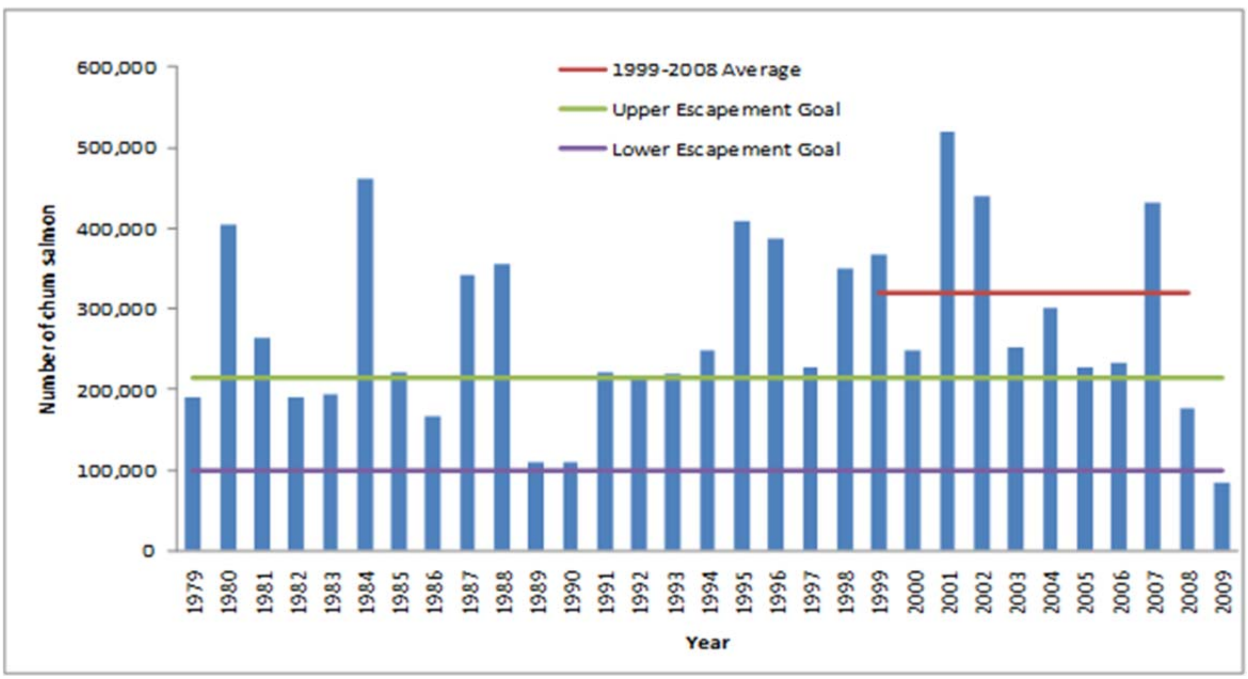



Figure 5-54. Northwestern District chum salmon escapement with comparison of upper and lower escapement goal and 10 year average, 1979-2009.

### *South Peninsula Chum salmon Escapement*

Chum salmon are managed on district-wide SEGs of 106,400 to 212,800 fish for Southeastern District; 89,800-179,600 fish in the South Central District; 133,400 to 266,800 fish in the Southwestern District; and a lower bound SEG of 800 fish for the Unimak District (Honnold et al. 2007).

In 2009, chum salmon escapement in the Unimak District was 1,400 fish and was the only district to exceed its SEG (Figure 5-55). Chum salmon escapement was within the established SEG for the Southeastern District (106,500; Figure 5-56) and the Southwestern District of (385,730 fish; Figure 5-57). The South Central District chum salmon escapement of 18,600 fish was below the SEG (Figure 5-58). South Peninsula total indexed chum salmon escapement of 512,230 fish was within the combined escapement goal range of 330,400 to 659,200 fish.

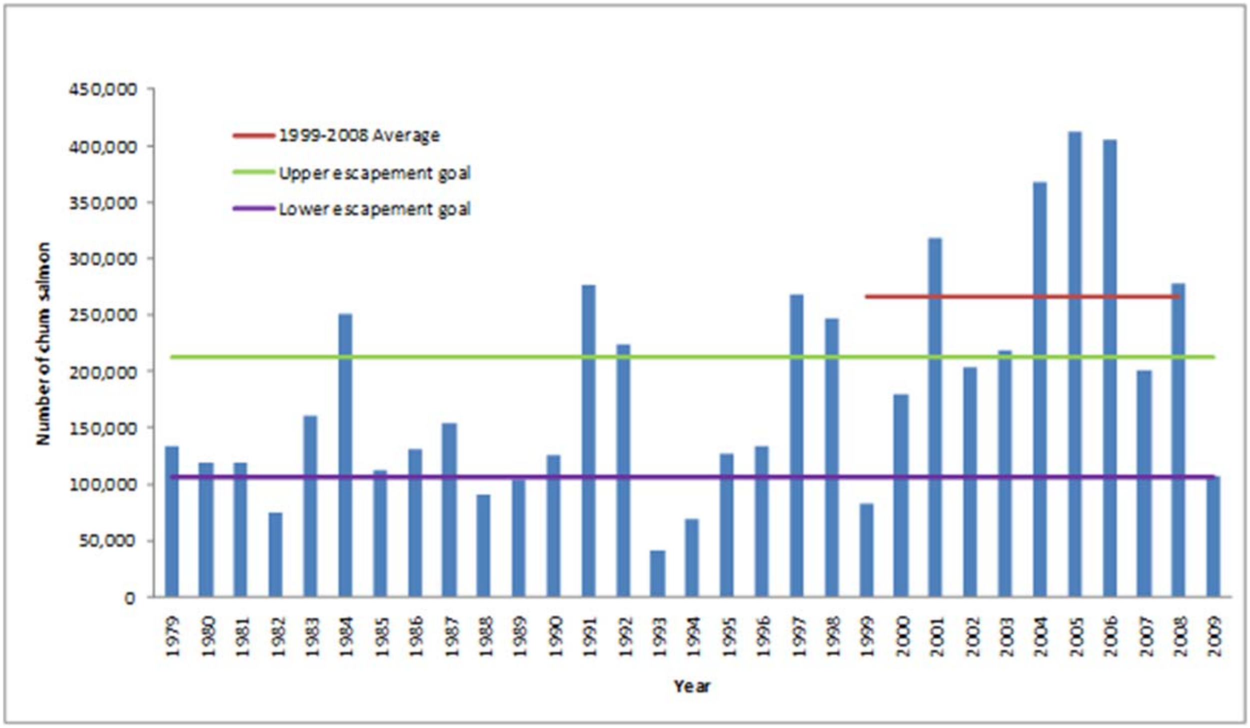



Figure 5-55. Unimak District chum salmon escapement including the lower escapement goal and 10-year average, 1979-2009.

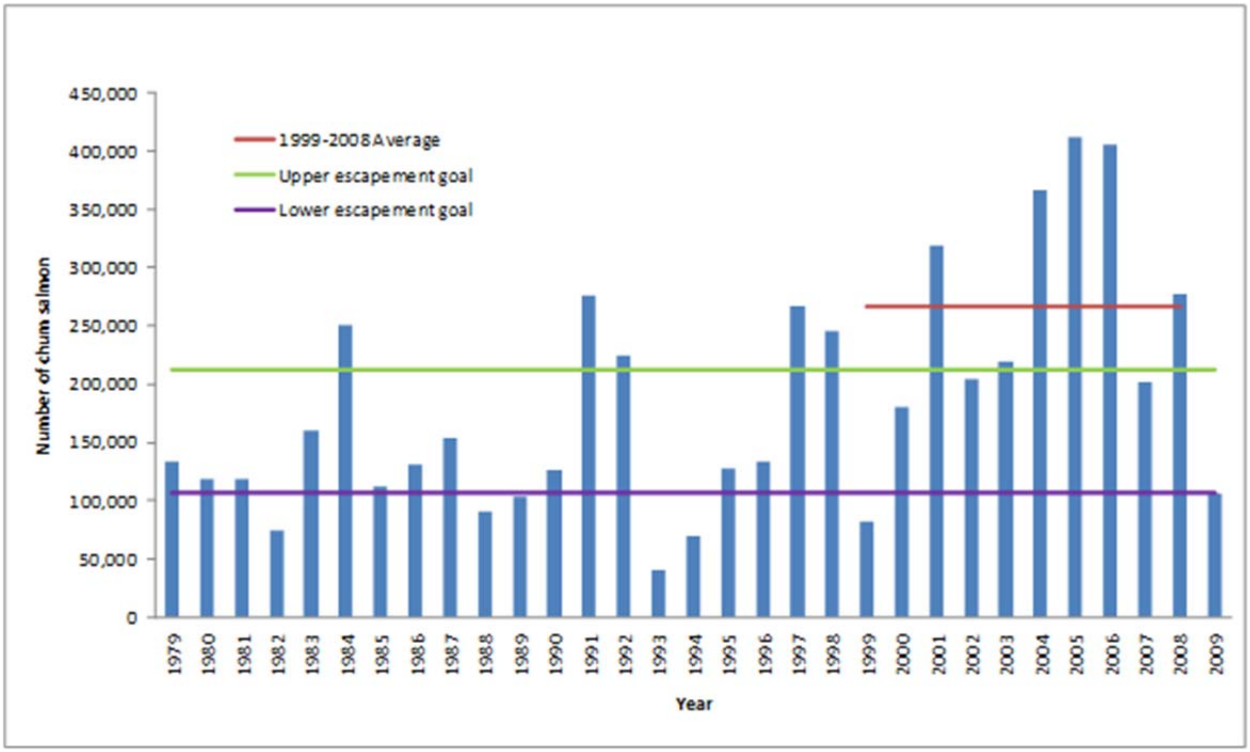



Figure 5-56. Southeastern District chum salmon escapement including the lower and upper escapement goal and 10-year average, 1979-2009.

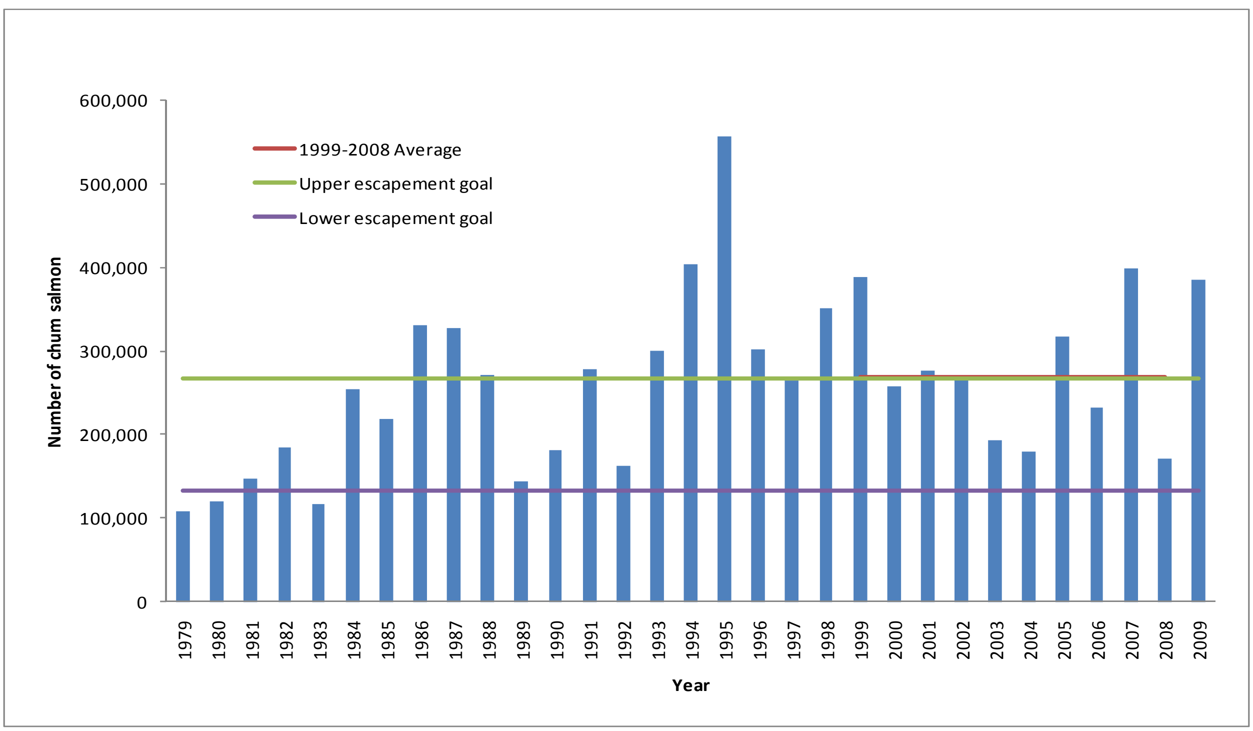



Figure 5-57. Southwestern District chum salmon escapement including the lower and upper escapement goal and 10-year average, 1979-2009.

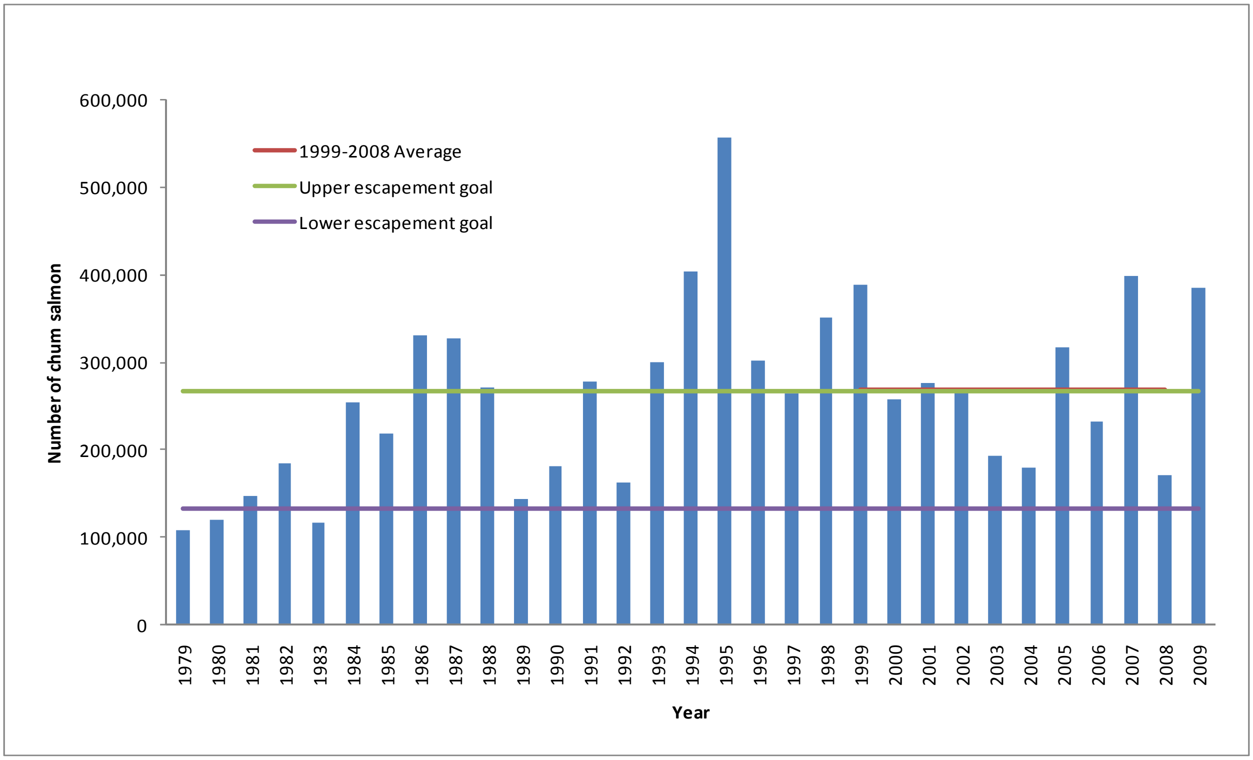



Figure 5-58. South Central District chum salmon escapement including the lower and upper escapement goal and 10 year average, 1979-2009.

### *Area M Commercial Chum Salmon Fishery*

In 2009, 54 of the 119 available seine, 143 of 162 available drift gillnet, and 91 of 113 available set gillnet Area M permits were fished. Overall effort by the different gear groups was similar to the most recent ten year average. In 2009, the Alaska Peninsula Area commercial chum salmon harvest totaled 1,786,713 fish which was higher than the 1999-2008 average harvest of 939,588 (Table 5-26; Hartill and Keyes 2010).

The 2010 total Area M chum salmon harvest was approximately 1.05 million which was slightly above the recent 10-year average.

Table 5-26. Area M chum salmon harvest by year and district, 1979-2009.

| | Area M Salmon Management Districts | | | | | | |
|---|---|---|---|---|---|---|---|
| Year | North | Northwest | Southeastern | South Central | Southwestern | Unimak | Total |
| 1979 | 35,371 | 30,340 | 215,955 | 105,650 | 128,431 | 33,145 | 548,892 |
| 1980 | 332,685 | 367,511 | 534,752 | 191,080 | 223,100 | 404,540 | 2,053,668 |
| 1981 | 351,322 | 355,496 | 781,060 | 240,631 | 273,239 | 475,770 | 2,477,518 |
| 1982 | 236,014 | 95,119 | 845,086 | 240,172 | 643,885 | 545,504 | 2,605,780 |
| 1983 | 178,681 | 169,626 | 637,701 | 128,906 | 207,956 | 728,824 | 2,051,694 |
| 1984 | 614,268 | 182,455 | 630,929 | 311,193 | 430,211 | 282,332 | 2,451,388 |
| 1985 | 423,489 | 243,127 | 482,176 | 165,893 | 428,201 | 272,181 | 2,015,067 |
| 1986 | 157,653 | 113,563 | 825,398 | 254,835 | 467,475 | 201,943 | 2,020,867 |
| 1987 | 155,446 | 213,250 | 591,960 | 198,350 | 230,802 | 354,775 | 1,744,583 |
| 1988 | 214,790 | 178,285 | 736,086 | 155,378 | 514,960 | 502,083 | 2,301,582 |
| 1989 | 131,250 | 25,742 | 418,334 | 49,861 | 129,786 | 419,792 | 1,174,765 |
| 1990 | 95,541 | 30,572 | 564,118 | 60,370 | 208,090 | 445,430 | 1,404,121 |
| 1991 | 128,538 | 62,740 | 509,423 | 156,552 | 322,742 | 585,056 | 1,765,051 |
| 1992 | 236,884 | 104,732 | 441,023 | 253,811 | 358,237 | 257,266 | 1,651,953 |
| 1993 | 86,563 | 48,394 | 337,403 | 143,660 | 232,895 | 332,449 | 1,181,364 |
| 1994 | 43,658 | 40,239 | 581,256 | 317,664 | 962,369 | 317,621 | 2,262,807 |
| 1995 | 72,588 | 26,705 | 684,643 | 176,827 | 551,587 | 302,010 | 1,814,360 |
| 1996 | 60,225 | 7,731 | 446,435 | 70,607 | 170,952 | 87,063 | 843,013 |
| 1997 | 51,169 | 46,211 | 172,629 | 55,050 | 240,914 | 137,661 | 703,634 |
| 1998 | 37,487 | 32,029 | 252,947 | 90,080 | 217,498 | 151,001 | 781,042 |
| 1999 | 42,220 | 7,900 | 385,200 | 69,651 | 235,981 | 126,134 | 867,086 |
| 2000 | 63,087 | 30,609 | 390,120 | 118,854 | 424,916 | 121,426 | 1,149,012 |
| 2001 | 61,297 | 113,226 | 331,095 | 122,593 | 451,313 | 16,985 | 1,096,509 |
| 2002 | 29,201 | 21,839 | 342,590 | 44,283 | 320,902 | 111,255 | 870,070 |
| 2003 | 22,178 | 16,577 | 271,634 | 15,376 | 271,316 | 78,979 | 676,060 |
| 2004 | 8,480 | 6,478 | 557,336 | 40,423 | 100,116 | 92,234 | 805,067 |
| 2005 | 8,915 | 33,617 | 459,546 | 51,248 | 148,139 | 80,527 | 781,992 |
| 2006 | 92,330 | 39,388 | 664,189 | 110,116 | 326,023 | 77,478 | 1,309,524 |
| 2007 | 85,003 | 96,006 | 352,448 | 42,511 | 170,809 | 114,019 | 860,796 |
| 2008 | 73,224 | 104,140 | 337,605 | 71,108 | 121,331 | 272,360 | 979,768 |
| 2009 | 51,825 | 54,169 | 866,938 | 77,233 | 605,457 | 131,091 | 1,786,713 |
| 1999-2008 Average | 48,594 | 46,978 | 409,176 | 68,616 | 257,085 | 109,140 | 939,588 |

### *North Alaska Peninsula*

The 2009 North Alaska Peninsula chum salmon harvest of 105,994 fish was above the 1999-2008 average harvest of 95,572 fish. In the Northern District, the chum salmon harvest of 51,825 fish was just above the 1999-2008 average of 48,594 fish (Figure 5-59). The remaining 54,169 chum salmon were harvested in the Northwestern District, which was also above the previous ten-year average of 46,978 fish (Figure 5-57). In 2009, the chum salmon harvested in the Northern District were caught incidentally during sockeye salmon fisheries, while in the Northwestern District the majority of the chum salmon harvest was from directed fisheries (Hartill and Murphy 2010).

***2010 summary***

The total commercial harvest for the North Alaska Peninsula fishery was 259,063 chum salmon. The North Alaska Peninsula fishery is predominantly a sockeye salmon fishery, although depending on market conditions, directed Chinook, coho, and chum salmon fisheries occur in some locations. In 2010, the North Alaska Peninsula harvest of chum salmon was above the previous 10-year (2000–2009) average.

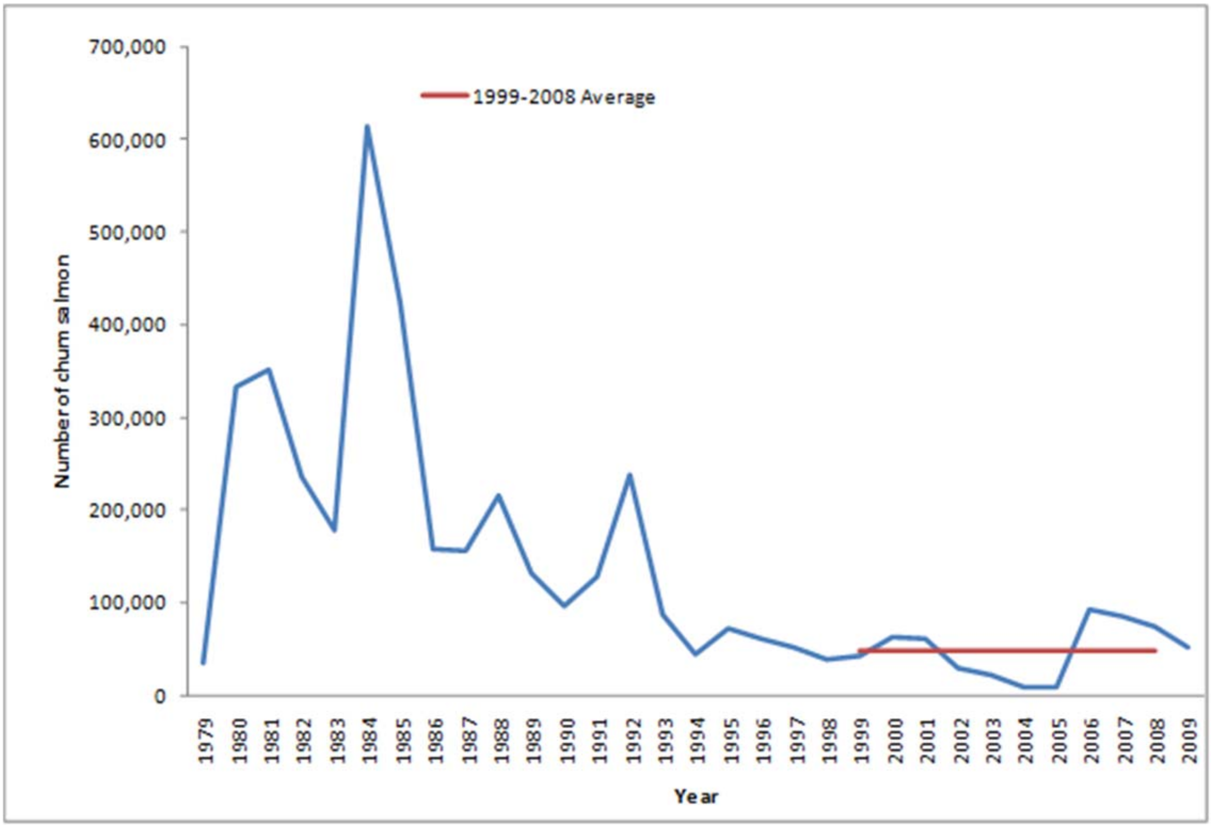



Figure 5-59. Northern District chum salmon harvest and 10-year average, 1979-2009.

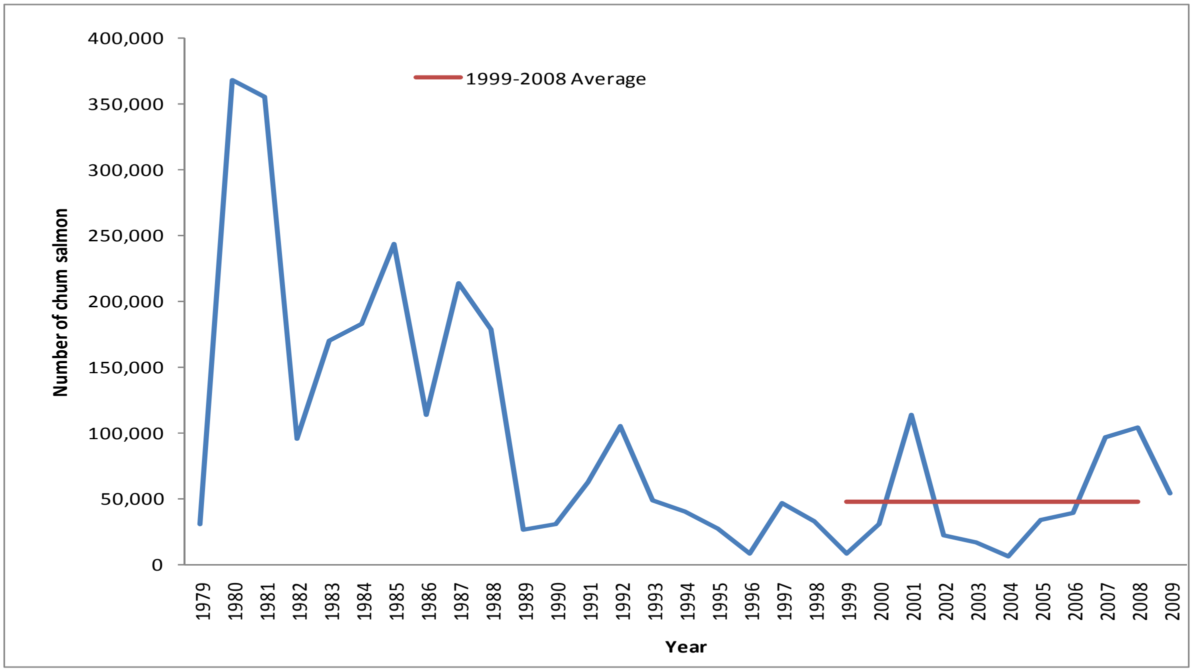



Figure 5-60. Northwestern District chum salmon harvest and 10-year average, 1979-2009

### *South Alaska Peninsula*

The 2009 South Alaska Peninsula chum salmon harvest of 1,680,719 fish was well above the 1999-2008 average harvest of 844,017 fish. In the Southeastern District, the chum salmon harvest of 866,938 fish was above the 1999-2008 average of 409,176 fish (Table 5-26). For the South Central District a total of 77,233 chum salmon were harvested which was slightly above the previous ten year average of 68,616 fish (Table 5-26). Fishermen in the Southwest District harvested 605,457 chum salmon which was higher than the 1999-2008 average harvest of 257,085 fish (Table 5-26). A total of 131,091 chum salmon were harvest in the Unimak District, which was also above the previous ten-year average of 109,140 fish (Figure 5-61; Poetter et al).

### *2010 Summary*

The South Unimak and Shumagin Islands fishing season began at 6:00 a.m. on June 7 with an 88-hour fishing period for all gear types (purse seine, drift gillnet, and set gillnet gear). During the June fishery, there were four 88-hour periods and one 64-hour fishing period. The commercial chum salmon harvest for the June fishery was 271,700 fish. The total commercial harvest for the South Peninsula post-June fishery (excluding the Southeastern District mainland) was 444,245 chum salmon. The Southeastern District Mainland section had a total harvest after June 18 of 74,186 chum salmon. Commercial salmon fishing did not take place from August 4-6 through September 14 in the South Alaska Peninsula due to low escapements of both pink and chum salmon. Chum salmon indexed total escapement (291,912) was below the escapement goal range (330,400–660,800).

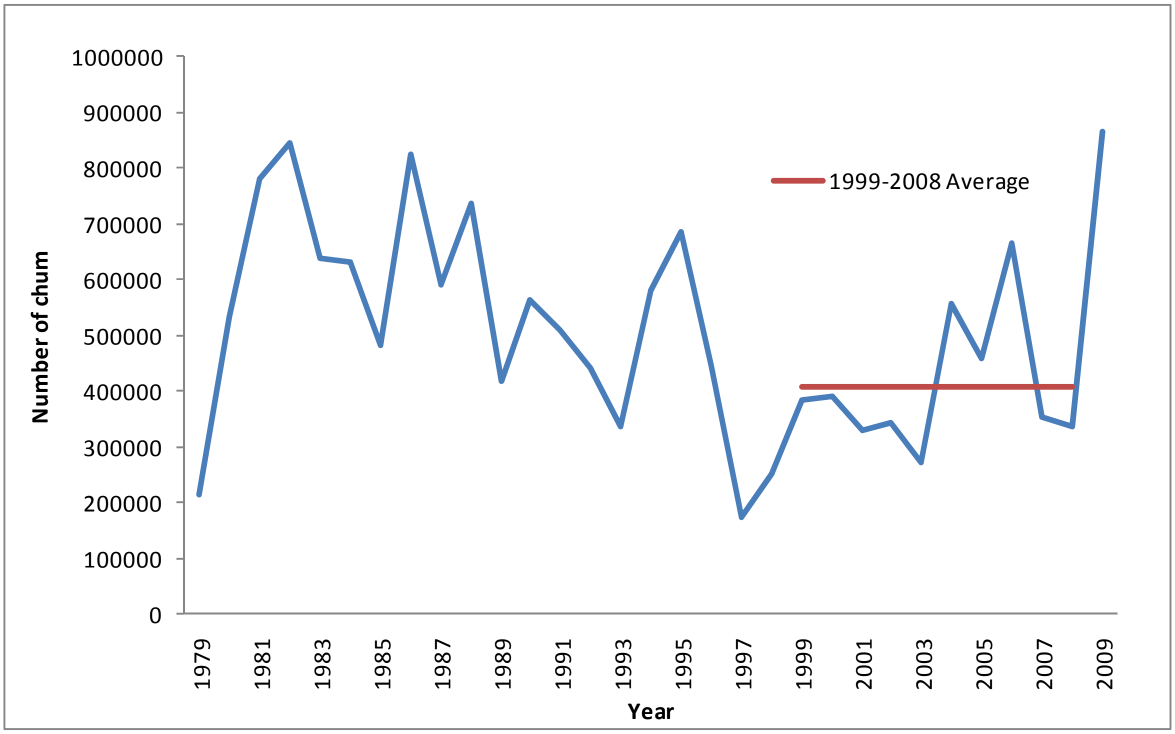



Figure 5-61. Southeastern District chum salmon harvest and 10-year average, 1979-2009

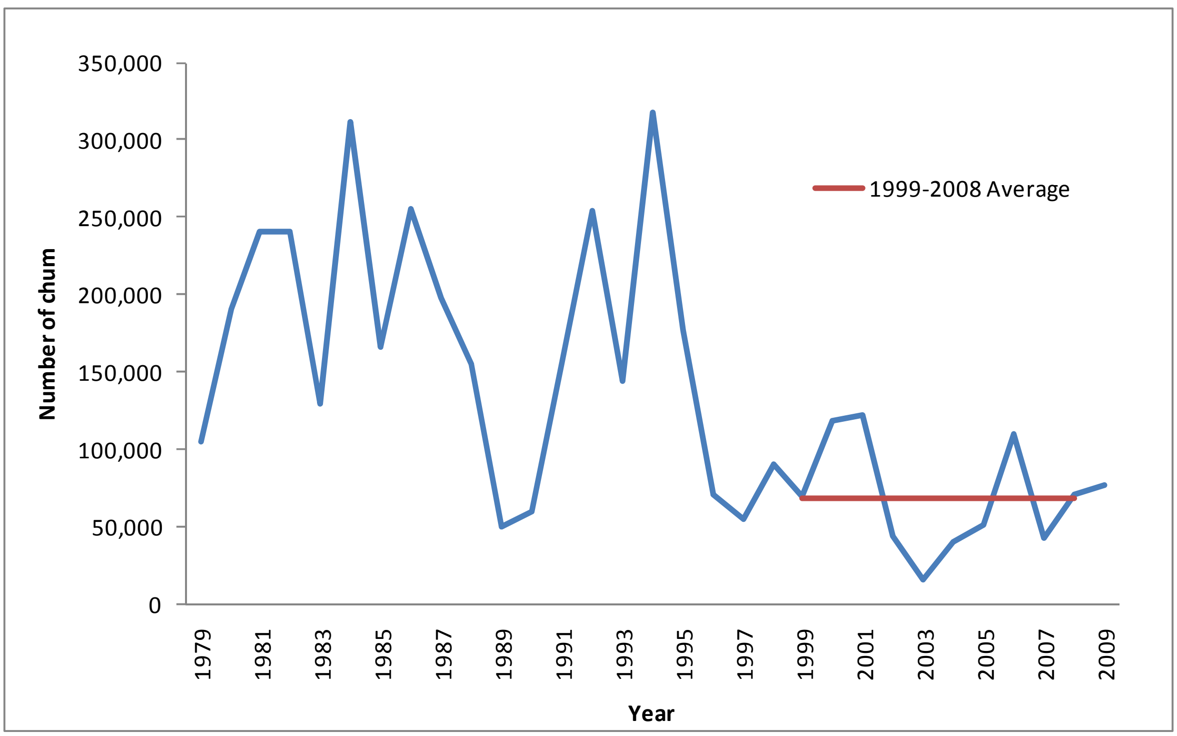



Figure 5-62. South Central District chum salmon harvest and 10-year average, 1979-2009

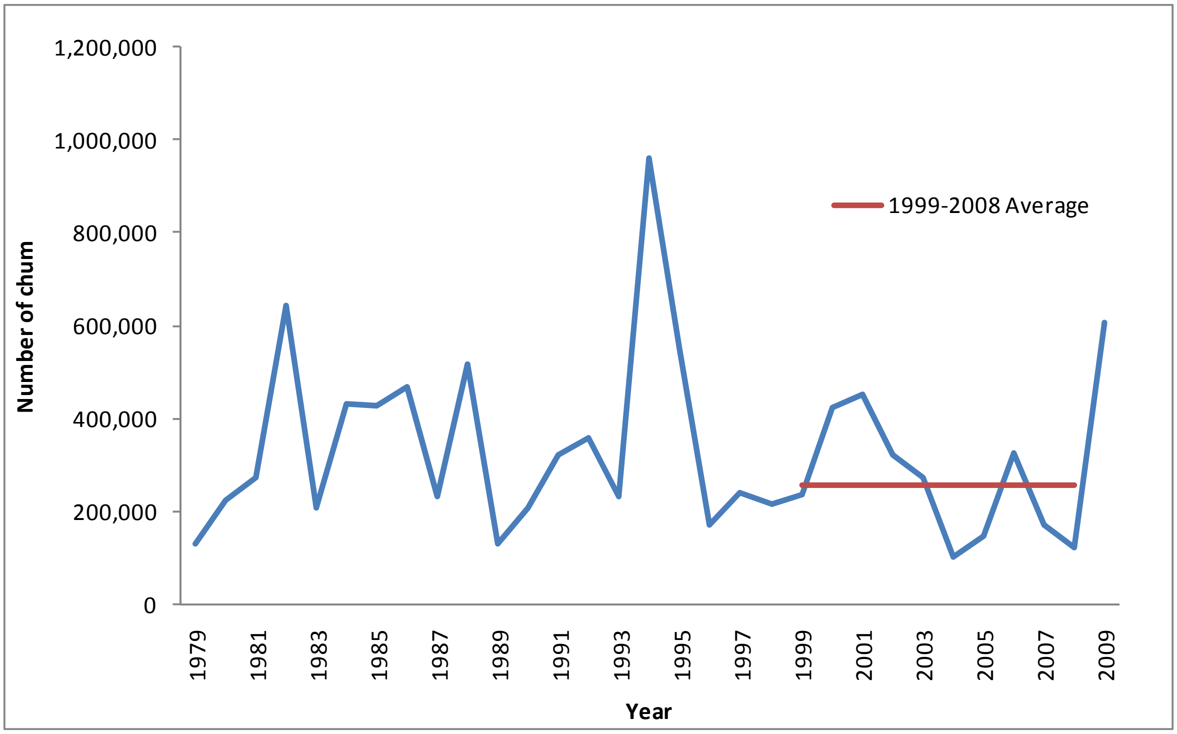



Figure 5-63. Southwestern District chum salmon harvest and 10-year average, 1979-2009

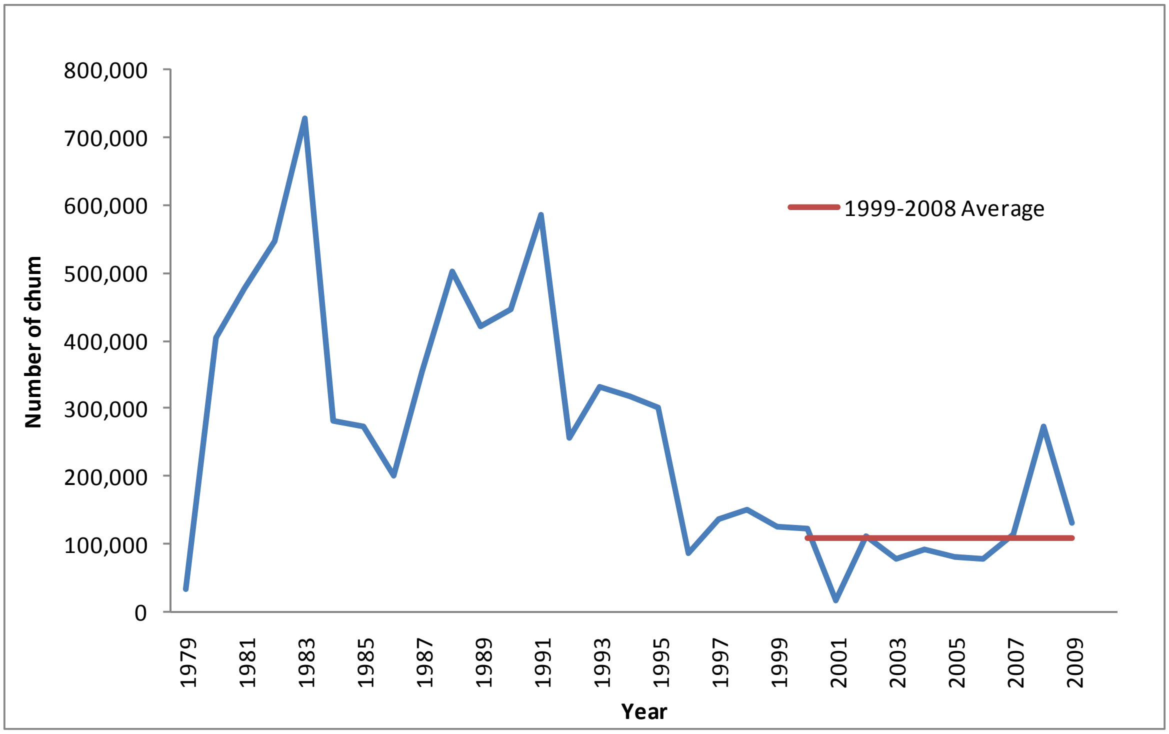



Figure 5-64. Unimak District chum salmon harvest and 10-year average, 1979-2009

*Outlook*

The Area M districts have no formal forecast for salmon returns. Broad expectations are developed based on parent-year escapements and recent year trends.

### 5.2.9 Chum salmon assessment overview for stock groupings outside western Alaska

#### 5.2.9.1 Cook Inlet

##### *5.2.9.1.1 Upper Cook Inlet*

###### *5.2.9.1.1.1 Description of Management Area*

The Upper Cook Inlet (UCI) commercial fisheries management area consists of that portion of Cook Inlet north of the latitude of the Anchor Point Light and is divided into the Central and Northern Districts (Figure 5-65). The Central District is approximately 75 miles long, averages 32 miles in width, and is divided into six subdistricts. The Northern District is 50 miles long, averages 20 miles in width and is divided into two subdistricts. At present, all five species of Pacific salmon are subject to commercial harvest in Upper Cook Inlet.


Figure 5-65. Upper Cook Inlet Management Area showing Northern and Central commercial fishing districts.

### *5.2.9.1.1.2 Commercial Chum Salmon Harvest*

Currently, set (fixed) gillnets are the only gear permitted in the Northern District while both set and drift gillnets are used in the Central District. The use of seine gear is restricted to the Chinitna Bay subdistrict. Drift gillnets have accounted for approximately 88% of the annual chum salmon harvest since 1966. Set gillnets have harvested virtually all of the remainder; however, in the last 10 years (2001-2010), the proportion of the total annual chum salmon harvest taken by drift gillnets has increased. Run-timing and migration routes utilized by all species of salmon overlap to such a large extent that the commercial fishery is largely mixed-stock and mixed-species in nature.

In 2010, approximately 229,000 chum salmon were harvested by UCI commercial fishermen, which represented the second largest catch in the past 15 years. This harvest was nearly 116% more than the previous 10-year average annual harvest of 106,000 fish, yet more than 50% less than the average annual harvest of 458,000 fish taken from 1966-2009 (Figure 5-66). Assessing chum salmon stocks based on recent harvest trends is suspect, at best. For example, the drift gillnet fleet is the primary harvester of chum salmon. Drift gillnet fishing time in the Central District has been significantly altered, primarily to conserve Susitna River sockeye salmon. These restrictions have resulted in a marked reduction of chum salmon harvest (Shields 2010).

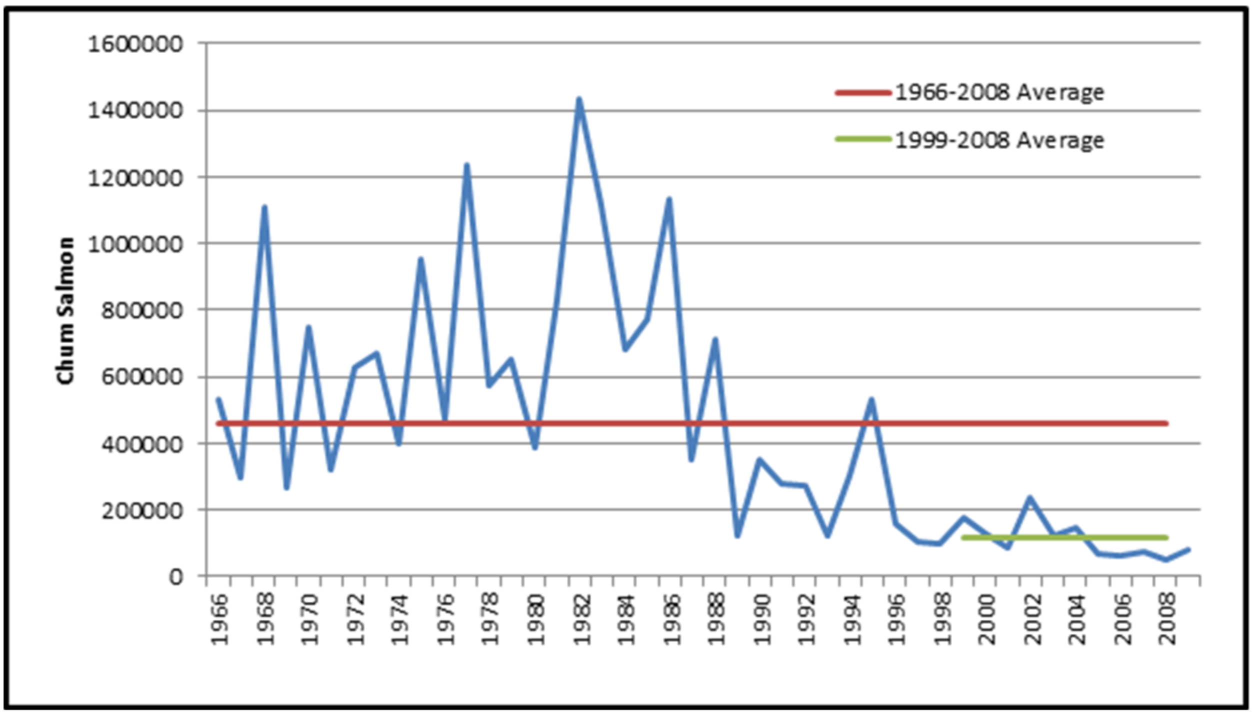



Figure 5-66. Upper Cook Inlet commercial chum salmon harvest, 1966-2009.

As shown in Table 5-25, chum salmon returns to UCI are concentrated predominately in the western and northern watersheds, with the most significant harvest coming from the Central District drift gillnet fleet.

Table 5-27. Upper Cook Inlet commercial chum salmon harvest by district and gear type, 2010

| Gear | District | Subdistrict | Permits | Chum Salmon |
|---|---|---|---|---|
| Drift | Central | All | 378 | 216,985 |
| Setnet | Central | Upper | 329 | 3,035 |
| | | Kalgin Is. | 29 | 1,525 |
| | | Chinitna | <4 | 272 |

| | | | | |
|---|---|---|---|---|
| | | Western | 26 | 3,148 |
| | | Kustatan | 10 | 2 |
| | | All | 380 | 7,982 |
| | Northern | General | 60 | 3,179 |
| | | Eastern | 31 | 524 |
| | | All | 86 | 3,703 |
| Seine | All | | - | - |
| Total | | | 846 | 228,670 |

### *5.2.9.1.1.3 Chum Salmon Escapement*

Evaluation of chum salmon runs in UCI is made difficult because of the lack of information other than commercial harvest data. The only chum salmon escapement goal in all of UCI is an aerial SEG survey in Chinitna Bay (Clearwater Creek) set at 3,800-8,400 fish. This SEG has been met or exceeded every year since it was established in 2002 (Table 5-28).

While ADF&G lacks long-term quantitative chum salmon escapement information, escapements to streams throughout UCI have benefited by management actions or regulatory changes aimed principally at other species. These actions have included: (1) significant reductions in the offshore drift gillnet and Northern District set gillnet fisheries to conserve Yentna River sockeye salmon; (2) adoption of the Northern District Salmon Management Plan (5 AAC 21.358), which states that its primary purpose is to minimize the harvest of coho salmon bound for the Northern District; (3) the lack of a directed chum salmon fishery in Chinitna Bay; and (4) harvest avoidance by the drift fishery as a result of lower prices being paid for chum salmon than for sockeye salmon. Other than the aerial census counts in Chinitna Bay, most of the sporadic chum salmon data available to assess annual runs can at best be used to make very general conclusions (i.e., the run was below average, average, or above average). The commercial chum salmon harvest in 2009 was better than the previous few years, but the UCI chum salmon run was still considered below average. It appears the 2010 chum salmon run, however, was above average. This characterization was corroborated by commercial harvest data, as well as catches in the offshore test fish (OTF) project, and aerial census escapement counts from Chinitna Bay. The 2010 OTF cumulative chum salmon CPUE of 737 was the second largest CPUE in the OTF project history. The peak aerial chum salmon census in Chinitna Bay of nearly 16,000 fish was the third largest estimate of escapement there since 1971. Based on a 2002 marine tagging study, which estimated the UCI commercial fishing exploitation rate on chum salmon at only 6%, and considering the escapement objective in Chinitna Bay has been consistently achieved, these limited data reveal no immediate concerns for UCI chum salmon stocks.

### *5.2.9.1.1.4 Subsistence, Educational, and Personal Use Chum Salmon Harvest*

The only subsistence fishery that has occurred consistently in Cook Inlet is the Tyonek Subsistence fishery; however, there is also a subsistence salmon fishery allowed in the Yentna River drainage. Subsistence permits for both areas allows for the harvest of 25 salmon per permit holder plus 10 salmon (except Chinook salmon, which must be released) for each additional member. The preliminary subsistence harvest for 2009 from Tyonek was two chum salmon and for the Yentna River drainage was six chum salmon (Table 5-28).

Educational fisheries in UCI first began in 1989. The total harvest from all salmon species educational fisheries in 2009 was 9,397 fish, which was the largest harvest ever recorded since the educational fisheries began. The average annual educational harvest from 1994 through 2009 has been approximately 6,008 fish. The 2009 education chum salmon harvest in UCI was 36 fish (Table 5-28).

As with the subsistence fishery, permit holders in the personal use fishery are allowed to harvest 25 salmon with an additional 10 salmon (except Chinook) for each household member. Personal use fishing takes places primarily with dip nets in the Kenai, Kasilof, and Beluga (senior citizens only) rivers and in some years at Fish Creek. A personal use fishery with set gillnets also takes place in salt water at the mouth of the Kasilof River (Table 5-28).

Table 5-28. Upper Cook Inlet subsistence, educational, and personal use chum salmon harvest, 1998-2010.

| | Chum Salmon | | | |
|---|---|---|---|---|
| Year | Subsistence | | Educational | Personal |
| | Tyonek | Yentna | | |
| 1998 | 2 | 20 | 137 | 220 |
| 1999 | 11 | 11 | 75 | 168 |
| 2000 | 0 | 7 | 69 | 290 |
| 2001 | 6 | 4 | 34 | 276 |
| 2002 | 4 | 28 | 112 | 757 |
| 2003 | 10 | 13 | 66 | 371 |
| 2004 | 0 | 2 | 100 | 52 |
| 2005 | 2 | 25 | 79 | 428 |
| 2006 | 1 | 27 | 38 | 746 |
| 2007 | 2 | 18 | 20 | 614 |
| 2008 | 10 | 7 | 23 | 728 |
| 2009 | 2 | 6 | 36 | 559 |
| 2010 | 4 | 18 | 78 | 1,095 |

#### *5.2.9.1.1.5 2011 Upper Cook Inlet Chum Salmon Forecast*

Very little information is available on which to base outlooks for the commercial harvests of chum salmon in UCI. Using recent harvest trends and factoring in the expected intensity of the sockeye-based fishery, ADF&G forecasted a 2011 chum salmon harvest of approximately 101,000 fish.

### *5.2.9.1.2 Lower Cook Inlet*

#### *5.2.9.1.2.1 Description of Management Area*

The Lower Cook Inlet (LCI) management area, comprised of all waters west of the longitude of Cape Fairfield, north of the latitude of Cape Douglas, and south of the latitude of Anchor Point, is divided into five commercial salmon fishing districts (Figure 5-67). Barren Islands District is the only fishing district where no salmon fishing occurs, with the remaining four districts (Southern, Outer, Eastern, and Kamishak Bay) separated into approximately 40 subdistricts and sections to facilitate management of discrete stocks of salmon.

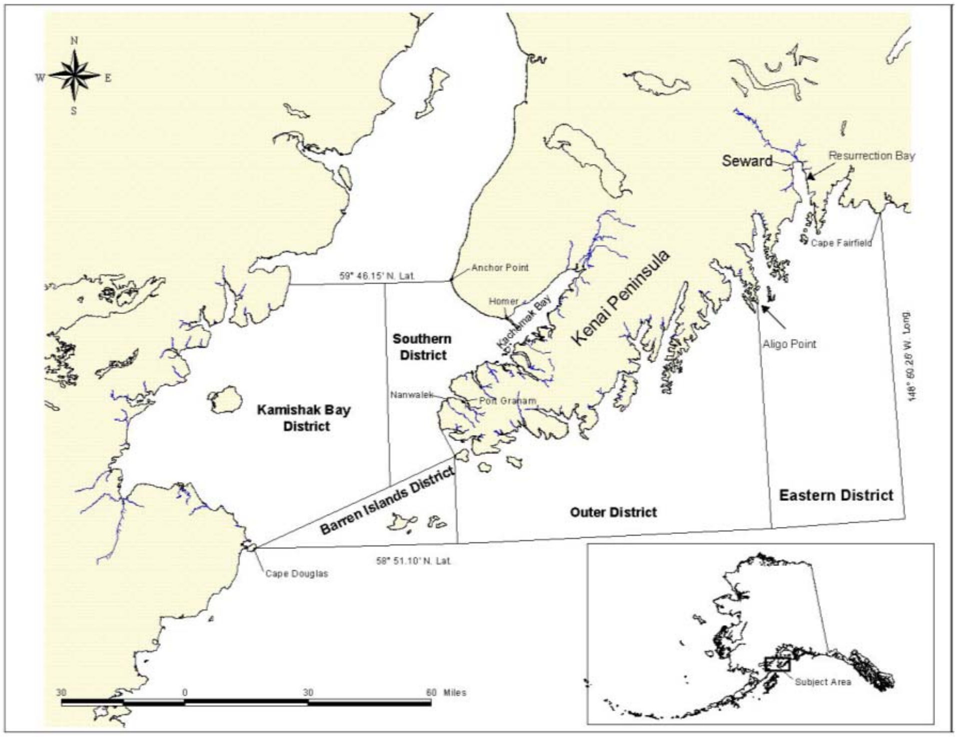



Figure 5-67. Lower Cook Inlet Management Area showing the five management districts.

Several hatchery facilities occur in Lower Cook Inlet and while salmon fisheries enhancement continues to play a major role in LCI salmon production as it has over the past three decades, chum salmon in this region consists exclusively of natural production fish. At the Tutka Bay Lagoon Hatchery, pink salmon were the primary species produced with chum salmon as a secondary species during the early years of this facility before these efforts were discontinued in favor of experimental efforts directed towards sockeye salmon production.

### *Commercial Chum Salmon Harvest*

The cumulative 2010 LCI all-species commercial salmon harvest of slightly more than 468,000 fish was the lowest for the management are in 35 years and was characterized by below 10-year average harvests of all salmon species except chum salmon. Commercial harvests in 2010 of chum salmon, at nearly 95,000 fish, were slightly greater than the recent 10-year average (87,000 fish) but almost double the 20-year average (48,600 fish) (Figure 5-68).

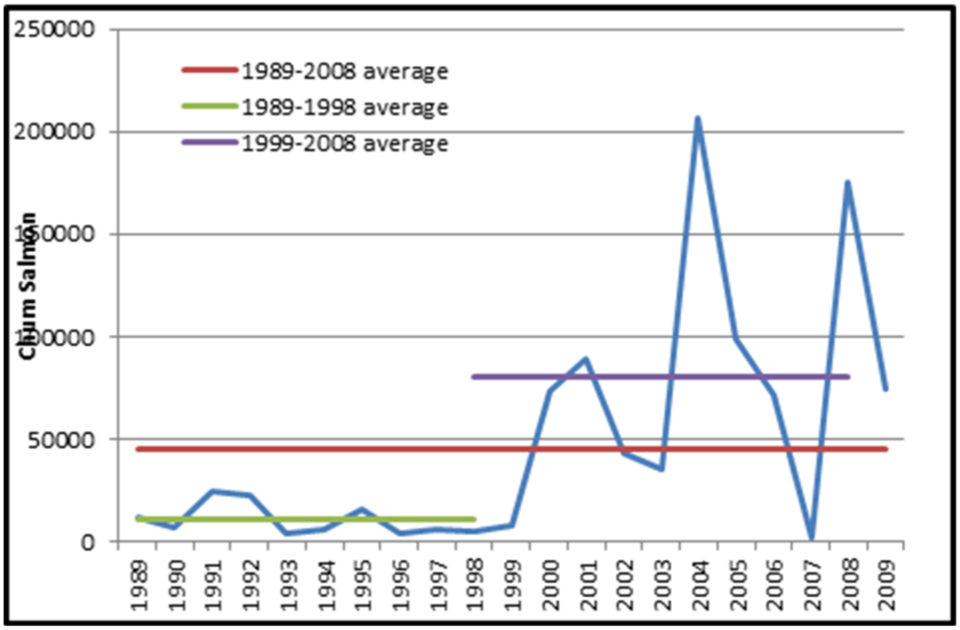



Figure 5-68. Lower Cook Inlet commercial chum salmon harvest for all gear and harvest types, 1990-2010.

After a disappointingly weak chum salmon season in 2007, chum salmon runs have since rebounded and were a major bright spot for the LCI area in 2010, marking the tenth season out of the past eleven that produced relatively strong chum runs coupled with moderate to good catches. The 2010 chum salmon harvest was the fourth highest for the species in LCI during the past two decades and exceeded the average harvest over the past 10 years by about 9%. The LCI area-wide commercial chum salmon harvest for the 2010 season was dominated by seine catches from Kamishak Bay District, on the west side of the management area, at three-fourths of the total, followed by seine catches in the Outer District (24%), with set gillnet catches in the Southern District accounting for the remaining 2% (Table 5-29).

Table 5-29. Commercial and hatchery chum salmon catches by district and gear type, 2010. Note: Figures for 2010 do not include a very small number or fish caught during commercial fishing but not sold (i.e., retained for personal use).

| District | Harvest Type | Gear Type | Chum Salmon |
|---|---|---|---|
| Southern | Commercial | Set Gillnet | 1,503 |
| | | Purse Seine | - |
| | Hatchery | Purse Seine | 4 |
| | | Total | 1,507 |
| Outer | Commercial | Purse Seine | 22,463 |
| Eastern | Commercial | Purse Seine | - |
| | Hatchery | Purse Seine | - |
| | | Weir | - |
| Kamishak Bay | Commercial | Purse Seine | 70,785 |
| | Hatchery | Purse Seine | - |
| | | Total | 70,785 |
| LCI Total | | | 94,755 |
| 1990-2009 Average | | | 48,550 |

### *Chum Salmon Escapement*

Escapement estimates for chum salmon in LCI are derived from periodic ground surveys with stream life factors applied, or from periodic aerial surveys that also incorporate stream life factors. For 2010, escapements into most LCI chum salmon systems were sufficient to achieve SEG goals, with the exception of McNeil river in Kamishak Bay District and Island Creek in the Outer District (Table 5-30).

### *Subsistence and Personal Use Chum Salmon Harvest*[37]

Subsistence and personal use chum salmon fisheries occur primarily in the Southern District of LCI in Nanwalek/Port Graham, and Seldovia. One of LCI's two subsistence salmon fisheries during 2010 occurred near the villages of Nanwalek (formerly English Bay) and Port Graham, located approximately 21 nautical miles southwest of Homer on the south side of Kachemak Bay. Gear in this fishery is limited to set gillnets. Most fishing occurs within close proximity to the respective villages, primarily targeting Chinook salmon transiting area waters and sockeye salmon returning to the English Bay Lakes system early in the summer, although participants will occasionally target pink salmon returning to Port Graham and English Bay Rivers later in the summer. Some additional fishing also occurs in Koyuktolik ("Dogfish") Bay, located about seven nautical miles south of English Bay, targeting non-local stocks of Chinook salmon as well as local stocks of chum salmon. In 2010, Port Graham subsistence fishermen reported a harvest of 37 chum salmon out of a total 331 salmon. Nanwalek subsistence fishermen in 2010 reported 271 chum salmon harvested out of a total 4,139 salmon.

### *2011 Lower Cook Inlet Chum Salmon Forecast*

Preliminary commercial harvest forecasts for Lower Cook Inlet chum salmon are expected to total up to 49,000 fish in 2011. However, no formal forecasts are prepared for this species, and these projections are based strictly on annual average harvests in LCI since 1989.

[37] There are no reported educational salmon fisheries in Lower Cook Inlet.

Table 5-30. Estimated chum salmon escapements in thousands of fish for the major spawning systems of Lower Cook Inlet, 1990 - 2010.

| Year | Port Graham | Dogfish Lagoon | Rocky River | Pt. Dick Head | Island Creek | Big Kamishak | Little Kamishak | McNeil River | Bruin Bay | Ursus Cove | Cotton-wood | Iniskin Bay | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1990 | 2.6 | 1.0 | 0.8 | 1.1 | 2.3 | 2.5 | 7.9 | 8.0 | 4.0 | 3.8 | 4.3 | 8.4 | 46.7 |
| 1991 | 1.1 | 3.1 | --- | 7.4 | 17.3 | 8.7 | 8.4 | 10.0 | 6.0 | 1.3 | 7.7 | 8.3 | 79.3 |
| 1992 | 1.4 | 0.8 | 1.7 | 5.4 | 6.7 | 4.5 | 7.1 | 19.2 | 8.5 | 1.7 | 6.1 | 3.4 | 66.5 |
| 1993 | 2.5 | 5.4 | 0.1 | 2.5 | 3.6 | 9.1 | 6.3 | 17.4 | 6.0 | 7.7 | 12.0 | 8.0 | 78.8 |
| 1994 | 5.2 | 11.3 | 1.9 | 3.5 | 8.8 | --- | 9.0 | 15.0 | 6.1 | 6.2 | 10.2 | 18.9 | 96.1 |
| 1995 | 3.8 | 4.2 | 5.1 | 3.3 | 7.7 | [a] | [a] | 14.4 | 6.6 | 11.1 | 15.4 | 22.7 | 90.9 |
| 1996 | 3.7 | 6.7 | 2.0 | 2.3 | 6.9 | 11.1 | 4.4 | 16.1 | 14.9 | 7.6 | 16.1 | 7.8 | 99.6 |
| 1997 | 4.1 | 12.7 | 1.1 | 1.9 | 5.2 | --- | --- | 27.5 | 8.8 | 6.2 | 5.6 | 15.4 | 88.5 |
| 1998 | 5.1 | 9.8 | 0.7 | 1.8 | 3.4 | 7.1 | 9.7 | 23.5 | 9.4 | 4.6 | 2.3 | 18.6 | 96.0 |
| 1999 | 6.6 | 18.8 | 5.4 | 2.9 | 16.4 | 11.6 | 8.9 | 13.5 | 10.3 | 21.0 | 12.0 | 23.3 | 150.7 |
| 2000 | 11.4 | 19.6 | 4.2 | 3.4 | 12.1 | 45.3 | 26.9 | 18.6 | 13.6 | 41.7 | 24.1 | 23.6 | 244.5 |
| 2001 | 6.0 | 6.1 | 3.0 | 1.8 | 6.3 | 36.3 | 27.2 | 17.0 | 21.8 | 37.7 | 15.9 | 13.8 | 192.9 |
| 2002 | 5.3 | 10.1 | 5.7 | 12.3 | 15.3 | 17.4 | 16.4 | 11.3 | 9.9 | 17.1 | 42.2 | 28.5 | 191.6 |
| 2003 | 2.9 | 13.3 | 5.5 | 5.6 | 16.3 | 16.4 | 22.2 | 23.3 | 13.1 | 30.4 | 72.8 | 18.7 | 240.5 |
| 2004 | 1.2 | 3.6 | 17.2 | 8.6 | 15.1 | 57.9 | 45.3 | 11.2 | 15.9 | 16.0 | 16.3 | 22.0 | 230.3 |
| 2005 | 0.7 | 2.7 | 6.1 | 4.8 | 20.7 | 25.7 | 12.1 | 17.4 | 21.2 | 12.2 | 17.9 | 16.5 | 158.0 |
| 2006 | 2.2 | 5.4 | 11.2 | 2.8 | 5.6 | 58.2 | 42.9 | 28.2 | 7.0 | 15.7 | 13.2 | 15.6 | 208.1 |
| 2007 | 1.9 | 4.9 | 1.6 | 2.8 | 3.1 | 14.8 | 15.6 | 13.6 | 3.1 | 20.9 | 12.5 | 5.3 | 100.0 |
| 2008 | 1.8 | 6.2 | 3.8 | 11.8 | 12.9 | 4.5 | 21.3 | 9.8 | 17.5 | 6.5 | 11.6 | 20.0 | 130.0 |
| 2009 | 1.0 | 4.4 | 2.5 | 5.6 | 9.3 | 15.0 | 4.2 | 18.8 | 10.1 | 12.9 | 19.4 | 30.8 | 140.3 |
| 2010 | 1.4 | 12.7 | 1.3 | 2.4 | 3.4 | [a] | 18.4 | 10.5 | 6.2 | 11.8 | 15.8 | 19.3 | 103.2 |
| 20-Year Avg. | 3.5 | 7.5 | 4.2 | 4.6 | 9.8 | 20.4 | 16.4 | 16.7 | 10.7 | 14.1 | 16.9 | 16.5 | 141.2 |
| 1990–1999 Avg. | 3.6 | 7.4 | 2.1 | 3.2 | 7.8 | 7.8 | 7.7 | 16.5 | 8.1 | 7.1 | 9.2 | 13.5 | 93.9 |
| 2000–2009 Avg. | 3.4 | 7.6 | 6.1 | 5.9 | 11.7 | 29.1 | 23.4 | 16.9 | 13.3 | 21.1 | 24.6 | 19.5 | 182.8 |
| Sustainable Esc. Goal[b] | 1.45–4.8 | 3.35–9.15 | 1.2–5.4 | 1.9–4.45 | 6.4–15.6 | 9.35–24.0 | 6.55–23.8 | 24.0–48.0 | 6.0 –10.25 | 6.05–9.85 | 5.75–12.0 | 7.85– 13.7 | 69.6 –158.75 |

*Note*: Escapement estimates are derived from periodic ground surveys with stream life factors applied, or from periodic aerial surveys. Aerial survey estimates after 1990 incorporate stream life factors; prior to 1990, aerial estimates are peak aerial survey counts adjusted for survey conditions and time of surveys.

[a] Insufficient data to generate escapement estimates.

[b] New sustainable escapement goals (SEG's) implemented for the first time beginning with the 2002 season, except for McNeil River, which was revised in 2007 and implemented beginning with the 2008 season.

### *5.2.9.1.3 Prince William Sound*

#### *5.2.9.1.3.1 Description of Management Area*

The Prince William Sound (PWS) management area encompasses all coastal waters and inland drainages entering the north central Gulf of Alaska between Cape Suckling and Cape Fairfield (Figure 5-69, Figure 5-70). This area includes the Bering River, Copper River and all of Prince William Sound with a total adjacent land area of approximately 38,000 square miles.

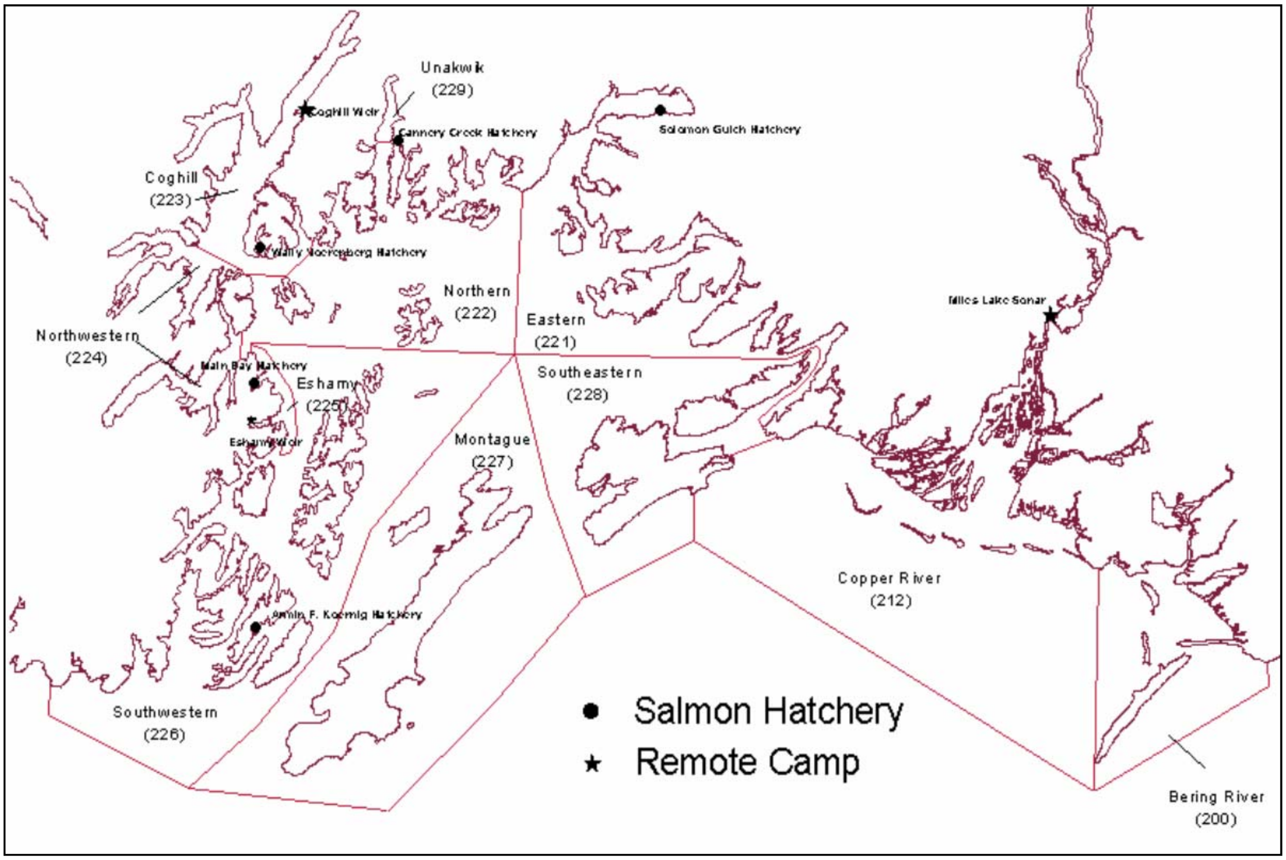



Figure 5-69. Prince William Sound Management Area showing commercial fishing districts, salmon hatcheries, weir locations, and Miles Lake sonar camp (Copper River district).

The salmon management area is divided into 11 districts (see Figure 5-69 above) that correspond to local geography and distribution of the five species of salmon harvested by the commercial fishery.

Six hatcheries contribute to the area's fisheries. Prince William Sound Aquaculture Corporation (PWSAC) operates five of the hatcheries: Gulkana Hatchery (GH) in Paxson; Cannery Creek Hatchery (CCH) located on the north shore of PWS; Armin F. Koernig (AFK) Hatchery in southwestern PWS; Wally Noerenberg Hatchery (WNH) in northwestern PWS; and Main Bay Hatchery (MBH) in western PWS. Valdez Fisheries Development Association (VFDA) operates Solomon Gulch Hatchery (SGH) in Port Valdez. Of these six hatcheries, only the Wally Noerenberg Hatchery augments production of chum salmon. Eggs are collected for chum salmon broodstock and fry are released onsite at WNH; dyed eggs are transferred to AFK for release with those fry transferred to Port Chalmers for remote release. PWSAC is the largest producer of hatchery salmon in Alaska, with a permitted capacity of 685 million eggs. They are also the largest producer of enhanced chum salmon in Alaska with a permitted capacity of 165 million eggs. The Armin F. Koerning Hatchery currently produces only pink salmon, although chum salmon were produced in 1996 and 1997.

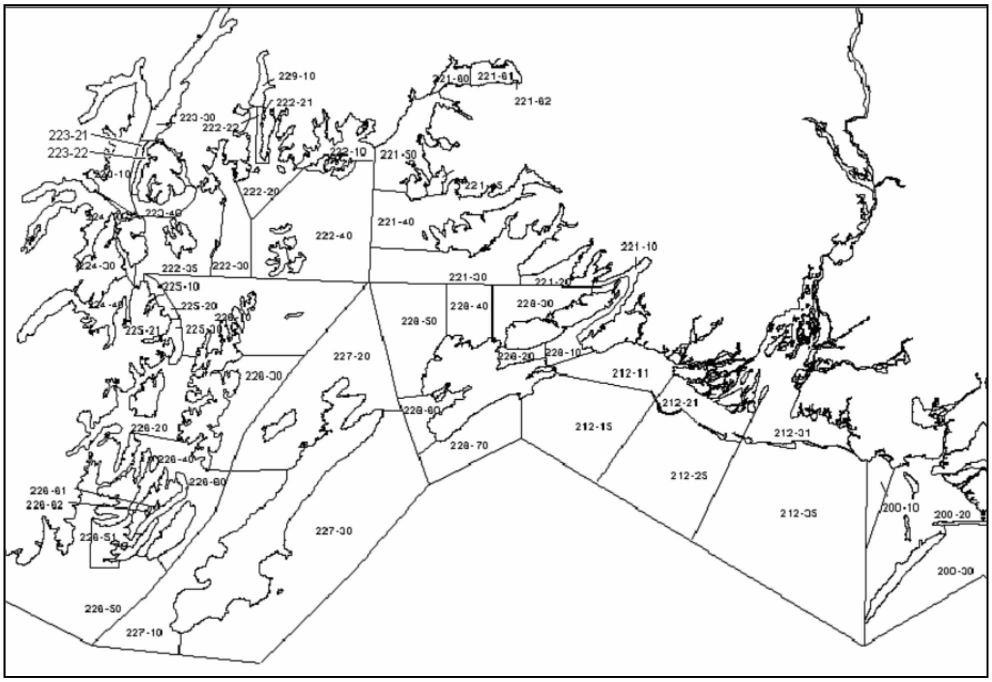



Figure 5-70. Prince William Sound Area showing commercial fishing districts and statistical reporting areas.

### *5.2.9.1.3.2 Commercial Chum Salmon Harvest*

Gear utilized in the PWS salmon fisheries includes purse seine, drift gillnet, and set gillnet. Drift gillnet permits are the most numerous and are permitted to fish in the Bering River, Copper River, Coghill, Unakwik, and Eshamy Districts. Set gillnet gear is permitted to fish only in the Eshamy District. Purse seine gear is permitted to fish in the Eastern, Northern, Unakwik, Coghill, Northwestern, Southwestern, Montague, and Southeastern Districts.

The 2009 Prince William Sound Area total commercial salmon harvest was 24.0 million fish, of which 3.2 million were chum salmon (Figure 5-71). Contributions from thermal mark sampling indicate >90% of the 2009 chum salmon commercial harvest was hatchery production from PWSAC. The 2009 preseason forecast for chum salmon in PWS was 4.6 million fish. The chum salmon common property fishery (CPF) harvest was 2.6 million fish, which was 1.1 million fish below the preseason forecast. Based on ADF&G's 2009 wild chum salmon forecast of 376,000 fish, there was a potential CPF harvest of 176,000 wild chum salmon. The 2009 purse seine common property fishery harvest of 269,000 chum salmon was composed of approximately 4% wild and 96% hatchery fish. The drift gillnet common property fishery harvest was 2.3 million chum salmon, which was above the five year average of 1.1 million fish. PWSAC forecasted a 2009 run of 2.8 million chum salmon to Wally Noerenberg Hatchery, 1 million chum salmon to Port Chalmers, and 409,000 chum salmon to Armin F. Koernig Hatchery. For the Port Chalmers subdistrict, 2009 was the first year that drift gillnet gear was given access to this area. Approximately 1% of the chum salmon harvested in Port Chalmers were of wild stock origin. PWSAC harvested 604,625 chum salmon for cost recovery and 151,835 chum salmon for broodstock requirements.

### *5.2.9.1.3.3 2010 Summary*

The 2010 chum salmon total run forecast for Prince William Sound was 3.4 million. The majority of the forecast, 3.0 million, were of hatchery origin. The common property fishery harvest was 3.6 million, 1.2 million above the preseason forecast. The total wild stock chum salmon escapement lagged behind anticipated aerial survey indices early in the season, with escapement ahead of anticipated in all but the Eastern District by the end of the season.

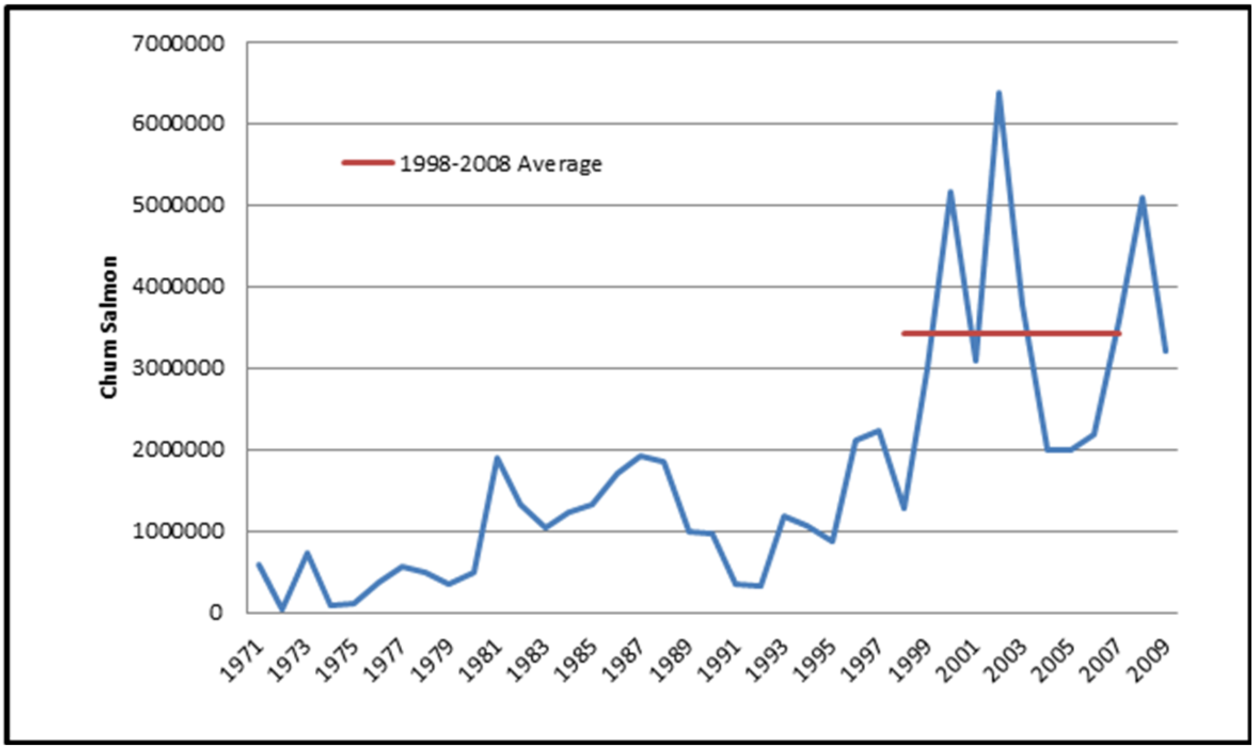



Figure 5-71. Total commercial chum salmon harvest by all gear types in Prince William Sound, 1971-2009.

The 2008 PWS Area commercial salmon harvest was 49.3 million fish, which included 5.1 million chum salmon. During this season, hatchery runs of chum salmon were above forecast levels. Of the 5.1 million chum salmon harvested, 95% (4.8 million fish) were produced by PWSAC. The 2008 chum salmon total run forecast in Prince William Sound was 3.8 million fish. The majority of the forecast (88%) was expected PWSAC hatchery production. Enhanced chum salmon returns to WNH, Port Chalmers, and AFK were forecast to be 2.3 million fish, 787,000 fish, and 309,000 fish respectively. Of that forecast, PWSAC's projection for cost recovery and broodstock requirements was approximately 842,000 fish (45%) of the 2.3 million, leaving 1.4 million chum salmon for the common property fishery (CPF). Based on ADF&G's wild chum salmon forecast of 446,000 fish, there was a potential common property harvest of 246,000 wild chum salmon. The total CPF chum salmon harvest for all three gear types was 1.7 million fish. Table 1 summarizes the commercial chum salmon harvest for PWS (2007–2009) by gear type and district.

The 2007 PWS Area commercial salmon harvest was 70.6 million fish, which included 3.6 million chum salmon. During this season, hatchery runs of chum salmon were above forecast levels. Of the 3.6 million chum salmon harvested, 96% (3.4 million fish) were produced by PWSAC. The 2007 chum salmon forecast in Prince William Sound was 3.4 million fish. The majority of that forecast (84%) was expected PWSAC hatchery production. Enhanced chum salmon returns to WNH, Port Chalmers, and AFK were forecast to be 1.9 million fish, 625,000 fish, and 404,000 fish respectively. Of that forecast, PWSAC's projection for cost recovery and broodstock requirements was approximately 844,000 fish (45%) of the 2.9 million, leaving 1.1 million chum salmon for the common property fishery (CPF). Based on ADF&G's wild chum salmon forecast of 454,000 fish, there was a potential common property harvest of 254,000 wild chum salmon. The total CPF chum salmon harvest for all three gear types was 1.5 million fish (Figure 5-31).

Table 5-31. Prince William Sound Management Area commercial chum salmon harvest by gear type and district, 2007-2009.

| District | 2009 Chum Salmon | 2008 Chum Salmon | 2007 Chum Salmon |
|---|---|---|---|
| Eastern | 4,752 | 20,808 | 81,077 |
| Northern | 15,234 | 38,525 | 9,901 |
| Coghill | 12,926 | 9,358 | 465,448 |
| Southwestern | 233,661 | 517,449 | 42,445 |
| Montague | - | 1,233,909 | 741,020 |
| Southeastern | 2,887 | 0 | 13,997 |
| Unakwik | 10 | 0 | 4 |
| Purse Seine | 269,470 | 1,820,049 | 1,353,892 |
| | | | |
| Bering River | 5 | 1 | 1 |
| Copper River | 8,629 | 1,330 | 9,657 |
| Coghill | 1,323,728 | 2,308,231 | 1,009,377 |
| Eshamy | 286,361 | 251,493 | 81,410 |
| Montague | 672,918 | - | - |
| Unakwik | 374 | 58 | 222 |
| Drift Gillnet | 2,292,015 | 2,561,113 | 1,100,667 |
| | | | |
| Eshamy | 50,748 | 53,627 | 24,651 |
| Set Gillnet | 50,748 | 53,627 | 24,651 |
| | | | |
| Solomon Gulch | 3,916 | - | - |
| Cannery Creek | - | - | - |
| Wally Noerenberg | 604,625 | 641,332 | 920,198 |
| Main Bay | - | - | 5,269 |
| Armin F. Koernig | - | - | 174,263 |
| Hatchery | 608,541 | 641,332 | 1,099,730 |
| | | | |
| Educational Permit | - | - | 20 |
| Personal Use | 67 | 14 | 102 |
| Donated Fish | - | - | 6 |
| Misc. | 67 | 14 | 128 |
| | | | |
| Prince William Sound Total | 3,220,841 | 5,076,135 | 3,579,068 |

PWSAC amended their initial 2007 WNH chum salmon cost recovery goal from 655,000 fish to 795,000 fish because the average fish weight was smaller than anticipated. PWSAC subsequently reported a chum salmon cost recovery harvest of 920,198 fish and a broodstock harvest of 173,452 fish, exceeding the inseason amended cost recovery goal by approximately 125,000 fish. ADF&G sought explanation as to why the cost recovery goal was exceeded, but did not receive a response from PWSAC staff.

#### *5.2.9.1.3.4 Chum Salmon Escapement*

The general purse seine districts are managed to achieve wild chum SEGs by district and allow for the orderly harvest of surplus wild and hatchery stocks. Escapement of chum salmon is monitored through the season by weekly aerial surveys of 208 index streams. Management to achieve hatchery corporate escapement goals is accomplished by opening and closing hatchery subdistricts and terminal harvest areas. Subdistrict and terminal harvest area openings are also utilized to target fishing effort on hatchery stocks when wild salmon escapement is weak.

Aerial survey escapement trends, compared to average historical performance, determine the duration of openings in PWS management districts. Aerial surveys of the index streams occur on a weekly basis, weather permitting. The 2009 total PWS chum salmon escapement of approximately 180,000 fish in districts with SEGs was almost double the SEG lower bound of 91,000. SEGs in PWS were met in each of the districts with established goals each year since 2006 (Table 5-32). No estimates for chum salmon escapements are included for the Unakwik, Eshamy, Southwestern, or Montague districts because there are no escapement goals for these districts.

Table 5-32. Prince William Sound chum salmon escapement goals and escapements, 2001-2009.

| | | | | Chum Salmon Escapement | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper | Type | Year Implemented | Enumeration Method | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
| | lower-bound SEG | 2006 | Multiple Aerial Surveys | 198,683 | 94,046 | 198,921 | 108,833 | 113,135 | 109,403 | 123,814 | 74,740 | 55,219 |
| | lower-bound SEG | 2006 | Multiple Aerial Surveys | 75,473 | 30,531 | 44,272 | 42,456 | 30,657 | 52,039 | 49,669 | 38,791 | 37,358 |
| | lower-bound SEG | 2006 | Multiple Aerial Surveys | 13,388 | 7,430 | 19,729 | 9,685 | 11,979 | 15,900 | 14,052 | 39,660 | 36,724 |
| | lower-bound SEG | 2006 | Multiple Aerial Surveys | 6,373 | 16,194 | 12,736 | 10,371 | 12,696 | 25,860 | 10,778 | 28,051 | 34,290 |
| | lower-bound SEG | 2006 | Multiple Aerial Surveys | 37,526 | 104,906 | 116,131 | 42,344 | 25,547 | 26,739 | 60,464 | 21,614 | 16,453 |

:scapement fell below stated goals. Yellow-shaded cells indicate escapement goals were met. Green-shaded cells indicate escapement goals were
icate no official escapement goal for that particular year. Shaded cells are based upon the escapement goal in place at the time of enumeration for salmon stocks
ıt goal provided.

#### *5.2.9.1.3.5 Subsistence Chum Salmon Harvest*

Subsistence fishing permits are not required in the PWS Management Area for marine finfish other than salmon. The Subsistence Management Area is divided into two districts: the Prince William Sound District and the Upper Copper River District. The Prince William Sound Management District includes the PWS and Lower Copper River subsistence fisheries and the Tatitlek and Chenega area subsistence fisheries. The Upper Copper River Management District includes the Glenallen subsistence fishery, the Batzulnetas subsistence fishery, and the Chitina personal use fishery.

The Tatitlek and Chenega area subsistence fisheries are the most significant in all of PWS for chum salmon harvest (Table 5-33). The Chenega area includes the entirety of the Southwestern District as well as a portion of the Montague District along the northwestern shore of Green Island from the westernmost tip to the northernmost tip of the island. The Tatitlek subsistence area is located south of Valdez narrows in portions of the Northern and Eastern districts.

Table 5-33. Chum salmon harvest and effort in the Tatilek and Chenega subsistence fisheries, 1988-2009.

| | Tatitlek | | | | Chenega | | |
|---|---|---|---|---|---|---|---|
| Year | Permits Issued | Chum Salmon | Total | Year | Permits Issued | Chum Salmon | Total |
| 1988 | 17 | 245 | 811 | 1988 | 10 | 294 | 604 |
| 1989 | 14 | 43 | 837 | 1989 | 8 | 180 | 1,056 |
| 1990 | 13 | 4 | 260 | 1990 | 7 | 2 | 64 |
| 1991 | 17 | 28 | 1,439 | 1991 | 12 | 53 | 638 |
| 1992 | 16 | 49 | 891 | 1992 | 14 | 99 | 962 |
| 1993 | 18 | 74 | 1,217 | 1993 | 22 | 124 | 1,293 |
| 1994 | 14 | 70 | 313 | 1994 | 16 | 161 | 837 |
| 1995 | 15 | | | 1995 | 10 | 41 | 329 |
| 1996 | 6 | 0 | 38 | 1996 | 7 | 46 | 315 |
| 1997 | 6 | 54 | 206 | 1997 | 5 | 272 | 649 |
| 1998 | 11 | 28 | 355 | 1998 | 4 | 119 | 331 |
| 1999 | 17 | 31 | 947 | 1999 | 14 | 101 | 887 |
| 2000 | 12 | 40 | 688 | 2000 | 12 | 143 | 646 |
| 2001 | 14 | 12 | 416 | 2001 | 16 | 146 | 454 |
| 2002 | 19 | 36 | 575 | 2002 | 10 | 60 | 418 |
| 2003 | 15 | 12 | 298 | 2003 | 13 | 147 | 677 |
| 2004 | 18 | 28 | 713 | 2004 | 8 | 84 | 722 |
| 2005 | 16 | 16 | 600 | 2005 | 13 | 174 | 908 |
| 2006 | 12 | 25 | 81 | 2006 | 11 | 111 | 299 |
| 2007 | 14 | unknown | unknown | 2007 | 4 | 55 | 381 |
| 2008 | 2 | 0 | 60 | 2008 | 15 | 30 | 276 |
| 2009 | 12 | 0 | 301 | 2009 | 4 | 84 | 285 |
| 2000-2009 average | 13 | 19 | 415 | 2000-2009 average | 11 | 103 | 507 |

### *5.2.9.1.3.6 2011 Prince William Sound Chum Salmon Forecast*

The 2011 chum salmon total run forecast for the Prince William Sound Management Area is 3.9 million fish, the majority of which (3.5 million) would be from Prince William Sound Aquaculture Corporation hatchery production. The early run of chum salmon to WNH was forecast by PWSAC to be 2.6 million fish, (Table 5-34). PWSAC forecasted 280,000 chum salmon to AFK and 624,000 chum salmon to Port Chalmers. Based upon ADF&G's wild chum salmon forecast of 400,000 fish (range 390,000-410,000), there is a potential common property harvest of 200,000 wild chum salmon (range 190,000-210,000).

Table 5-34. Prince William Sound chum salmon return estimate, 2011.

| | |
|---|---|
| Natural Stocks | 400,000 |
| Hatchery Stocks | |
| Wally Noerenberg | 2,612,000 |
| Armin F. Koernig | 280,000 |
| Port Chalmers | 624,000 |
| Natural & Hatchery | 3,916,000 |

### 5.2.9.2 Kodiak, Chignik, and the Aleutian Islands areas

For purposes of salmon management, the State of Alaska groups the Alaska Peninsula, Aleutian Islands, and Atka-Amlia Management Areas collectively into a single management region. This region is often referred to as Management Areas M & F, which is divided into four subareas: (1) the North Peninsula, consisting of Bering Sea waters extending west from Cape Menshikof to Cape Sarichef on Unimak Island; (2) the South Peninsula, consisting of Pacific Ocean coastal waters extending west of Kupreanof Point to Scotch Cap on Unimak Island; (3) the Aleutian Islands, consisting of the Bering Sea and Pacific Ocean waters of the Aleutian Islands west of Unimak Island and exclusive of the Atka-Amlia Management Area; and (4) the Atka-Amlia Management Area, also known as Area F, consisting of Bering Sea and Pacific Ocean waters extending west of Seguam Pass and east of Atka Pass. In this document, the Aleutian Islands and Atka-Amlia Management Areas (see Section 5.3.3.3 below) are treated separately from the Alaska Peninsula (refer to Section 5.2.7), which is being considered as a separate salmon stock grouping in western Alaska.

#### *5.2.9.2.1 Kodiak*

##### *5.2.9.2.1.1 Description of Management Area*

The Kodiak Management Area (KMA) comprises the waters of the western Gulf of Alaska surrounding the Kodiak Archipelago and that portion of the Alaska Peninsula bordering the Shelikof Strait between Cape Douglas and Kilokak Rocks (Figure 5-72). The archipelago is approximately 150 miles long, extending from northeast to southwest. In season management of the KMA commercial salmon fishery is structured around seven management districts that are further subdivided into 56 sections. Each section defines a traditional geographic harvest area managed for specific stocks or traditional fishing patterns.

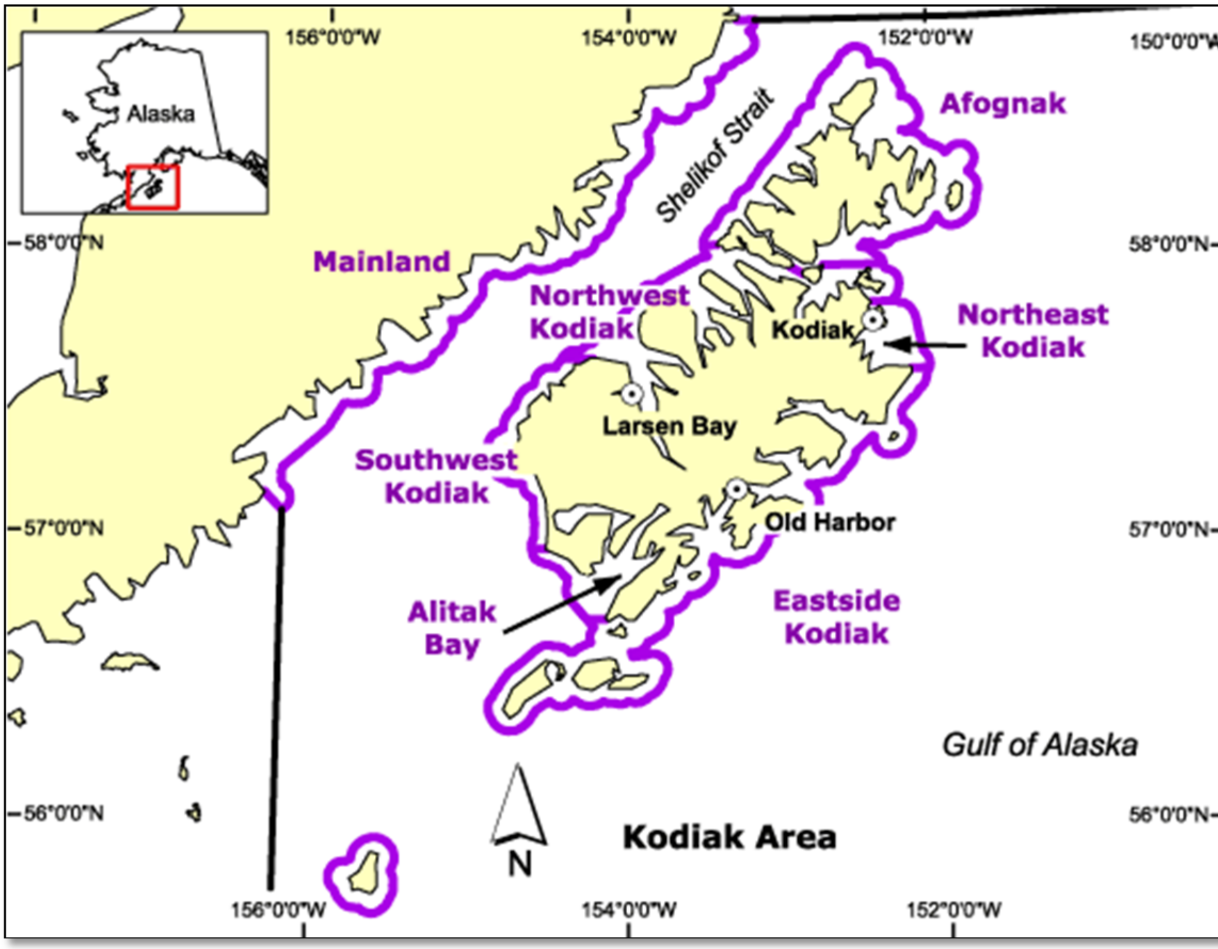



Figure 5-72. Kodiak Management Area identifying commercial salmon fishing districts.

Salmon migration or spawning has been documented in approximately 750 streams within the KMA. Of these, 415 streams have been documented to support yearly spawning populations of salmon while the remaining 335 are small streams used by pink salmon in years with very large returns. Chum salmon stocks are found in approximately 179 streams within the KMA (Table 5-35). Of the total number of streams, 97 are located in the Mainland District (on the Alaska Peninsula), while the remainder are located in the Kodiak Archipelago (in the Afognak, Northwest Kodiak, Southwest Kodiak, Alitak, Eastside Kodiak and Northeast Kodiak districts).

Table 5-35. Estimated number of streams in the Kodiak Management Area with documented chum salmon production by district.

| Management District | Number of Streams | Number of Streams with Chum salmon |
|---|---|---|
| Afognak | 92 | 9 |
| Northwest Kodiak | 67 | 22 |
| Southwest Kodiak | 11 | 6 |
| Alitak | 30 | 15 |
| Eastside Kodiak | 91 | 54 |
| Northeast Kodiak | 27 | 12 |
| Mainland | 97 | 61 |
| Total | 415 | 179 |

The KMA has two hatcheries, the Kitoi Bay and Pillar Creek hatcheries, that currently produce salmon to supplement natural salmon production. Both hatcheries are located on the east side of Afognak Island, are operated by the Kodiak Regional Aquaculture Association (KRAA), and mainly produce pink salmon; however, sockeye, chum, and coho salmon are also cultured.

#### *5.2.9.2.1.2 Commercial Chum Salmon Fishery*

Commercial fishing effort was low during the 2009 commercial salmon fishing season (although increased slightly from 2008) with only 291 of 608 eligible permits making commercial landings. In the KMA there are restrictions on which gear types can operate in specific management districts based on historical gear use patterns. The majority of the KMA is open to seine (purse and beach) gear only. Set gillnet and seine gear are allowed in the Central and North Cape sections of the Northwest Kodiak District and the Olga Bay, Moser Bay, and Alitak Bay sections of the Alitak District. All gear types are allowed in the Central and North Cape sections for the entire season, however only set gillnet gear is allowed in the Olga Bay, Moser Bay, and Alitak Bay sections until September 4, after which all gear is allowed. By gear type, a total of 132 set gillnet, 158 purse seine, and one beach seine permit holder(s) fished in 2009. During 2009 set gillnet permit holder participation was lower than in 2008 while purse seine permit holder participation was higher than in 2008; however, participation in both gear types was below the previous 10-year (1999-2008) average. Purse seine fishermen accounted for 93% of the total number of salmon harvested in the KMA while set gillnet fishermen accounted for the remaining 7% of the total (Dinnocenzo et al., 2010).

For 2009, there was a projected all-species salmon harvest of 24,666,992 fish. A total of 30,627,685 salmon were actually harvested in the 2009 KMA commercial salmon fisheries, which included a total of 955,808 chum salmon. Commercial harvests of chum salmon exceeded projections of 623,000 fish and were slightly above the 1999-2008 average of 928,203 fish (Figure 5-73). Westside fisheries harvested 262,614 chum salmon, which was above the forecast of 197,819 fish; Eastside/North end Kodiak fishery harvest totaled 355,205 chum salmon, well above the forecast of 149,703 fish; and Mainland District catches totaled 121,807 chum salmon, close to the forecast of 104,387 fish (Table 5-36).

#### *5.2.9.2.1.3 2010 Summary*

The chum salmon harvest of 734,806 fish was well below the forecast of 1.02 million and below the 2000 to 2009 average of 932,402 fish. The eastside and the north end of Kodiak Island accounted for 136,434 chum salmon. Kitoi Bay Hatchery chum salmon production was weaker than expected, with 191,284 harvested, below the 2010 forecast of 273,668 fish.

Table 5-36. Projected vs. actual 2009 commercial chum salmon harvest for Kodiak Management Area.

| | 2009 Harvest | |
|---|---|---|
| Fishery | Projection | Actual |
| Afognak | 20,328 | 50,386 |
| Westside Kodiak | 197,819 | 262,614 |
| Alitak District | 32,763 | 72,497 |
| Eastside/Northend Kodiak | 149,703 | 355,205 |
| Mainland District | 104,387 | 121,807 |
| Total | 505,000 | 862,509 |

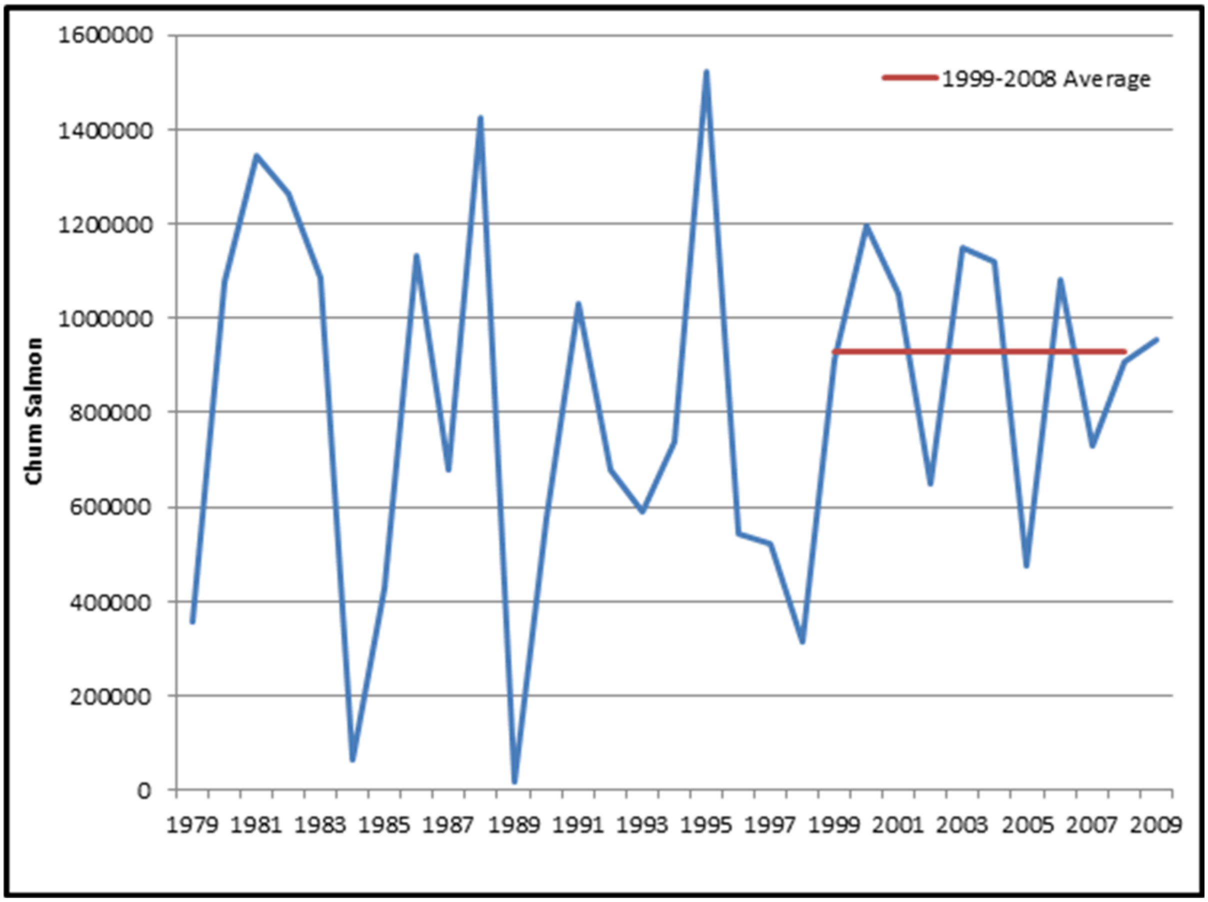



Figure 5-73. Commercial chum salmon harvest in the Kodiak Management Area, 1979-2009. Note: Average does not include 1989, when commercial fisheries were severely limited due to the M/V Exxon Valdez oil spill.

The recent ten year (1999-2008) average supplemental production from KRAA has included an estimated 202,857 chum salmon. The commercial chum salmon harvest attributed to the Kitoi Bay Hatchery of 93,299 fish was less than the forecast of 118,000 fish.

### *5.2.9.2.1.4 Chum Salmon Escapement*

Since 2008, the KMA commercial chum salmon fisheries have been managed to exceed the lower bounds of sustainable escapement goals (LB SEGs) for two aggregate stocks, the Mainland District (104,000 chum salmon) and the Kodiak Archipelago (151,000 chum salmon). These two aggregates were designated as a result of the most recent escapement goal review by ADF&G salmon management and research staff in 2007 (Honnold et al. 2007), and replaced the seven district goals that had been in existence prior. In 2008, the LB SEG was met for the Mainland District aggregate stock, but not for the Kodiak Archipelago stock. In 2009, the LB SEG was met for the Kodiak Archipelago aggregate stock, but not for the Mainland District aggregate stock. The 2009 chum salmon escapement in the Mainland District was 83,106 fish, not achieving the minimum goal of 104,000 fish. The chum salmon escapement for the Kodiak Archipelago of 210,039 fish exceeded the minimum goal of 151,000 fish (Table 5-40). Total 2009 escapement of chum salmon in the KMA was 293,145 fish.

The majority of the 2009 chum salmon escapement was estimated from aerial surveys, with less than 1% counted through weirs. Aerial surveys were conducted on several major KMA chum salmon systems along Kodiak Island's west side and in the Mainland District, mostly surveys of bays and streams from fixed-wing aircraft. Escapement estimates based on aerial surveys are considered minimum estimates of actual escapement. Foot surveys were also conducted on a few streams, primarily along the Kodiak road system. Aerial and foot survey counts were considered indices of actual escapement for use inseason to aid fishery management. Peak indexed escapement was calculated postseason for all systems surveyed and, together with weir escapement data, was used to estimate an area-wide escapement. Peak indexed escapement for chum salmon was defined as the highest daily aerial or foot survey count for each system for each year

Overall chum salmon escapement of 300,285 fish was below the recent 10-year average of 473,392 fish. Escapement goals have been established in Kodiak Archipelago and the Mainland. The escapement in the Kodiak Archipelago was above the escapement goal of 151,000 fish with an estimate of 155,570 and the Mainland District escapement of 144,715 was also above the escapement goal of 104,000 chum salmon.

##### *5.2.9.2.1.5 Subsistence Chum Salmon Harvest*

With few restrictions, the entire KMA has been open to subsistence salmon fishing in recent years. Only the freshwater systems of Afognak Island (which are relatively small, easily accessible, and at risk of over-exploitation) and some areas near heavily exploited salmon systems were closed to subsistence salmon fishing by regulation.

The 2009 reported subsistence harvest of 29,716 salmon included 345 chum salmon. Historically, the most utilized subsistence fishery areas are the north end of Kodiak Island, the Buskin and Pasagshak rivers, and the southeast side of Afognak Island at Litnik. Reported subsistence salmon harvests averaged 36,414 fish annually for the 10-year period 2000-2009 (2011 Chum Salmon Forecast)

The 2011 preseason forecast for the Kodiak Management Area projected a harvest of 1,139,578 chum salmon out of a total all-species salmon harvest of 32,885,854 fish. Of this total, the KRAA forecasted the harvest of chum salmon returning to the Kitoi Bay Hatchery to be approximately 411,000 fish (Table 5-38). Chum salmon have only accounted for 1% of the recent 10-year average harvest (363 fish per year).

##### *5.2.9.2.1.6 2011 Chum Salmon Forecast*

The 2011 preseason forecast for the Kodiak Management Area projected a harvest of 1,139,578 chum salmon out of a total all-species salmon harvest of 32,885,854 fish. Of this total, the KRAA forecasted the harvest of chum salmon returning to the Kitoi Bay Hatchery to be approximately 411,000 fish (Table 5-38).

Table 5-37. Number of subsistence permits issued and estimated subsistence salmon harvest for the Kodiak Management Area, 2000-2009.

| Year | Permits Issued | Chum Salmon | Total All Salmon |
|---|---|---|---|
| 2000 | 1,711 | 375 | 39,753 |
| 2001 | 2,378 | 427 | 41,656 |
| 2002 | 2,277 | 350 | 42,622 |
| 2003 | 2,272 | 388 | 40,698 |
| 2004 | 2,241 | 261 | 38,403 |
| 2005 | 2,290 | 592 | 38,743 |
| 2006 | 2,095 | 441 | 32,173 |
| 2007 | 2,096 | 266 | 32,429 |
| 2008 | 2,037 | 186 | 27,947 |
| 2009 | 1,926 | 345 | 29,716 |

Table 5-38. Projected commercial chum salmon harvest for the Kodiak Management Area, 2011.

| Fishery | 2011 Projection |
|---|---|
| Kitoi Bay Hatchery | 411,000 |
| Afognak (wild) | 36,446 |
| Westside Kodiak | 221,945 |
| Alitak District | 52,972 |
| Eastside/Northend Kodiak | 267,112 |
| Mainland District | 150,102 |
| Total | 1,139,578 |

### *5.2.9.2.2 Chignik*

#### *5.2.9.2.2.1 Description of Management Area*

The Chignik Management Area (CMA) encompasses all coastal waters and inland drainages of the northwest Gulf of Alaska between Kilokak Rocks and Kupreanof Point (Figure 5-74). For management purposes, these waters are divided into five fishing districts: Eastern, Central, Chignik Bay, Western, and Perryville districts. Each district is further broken down into sections and statistical reporting areas. The CMA is also known as Area L.

All five species of Pacific salmon are commercially harvested in the CMA; however, sockeye salmon are the primary species targeted and the most important commercial and subsistence salmon species in the CMA. The majority of fishing effort is concentrated on salmon returning to the Chignik River watershed.

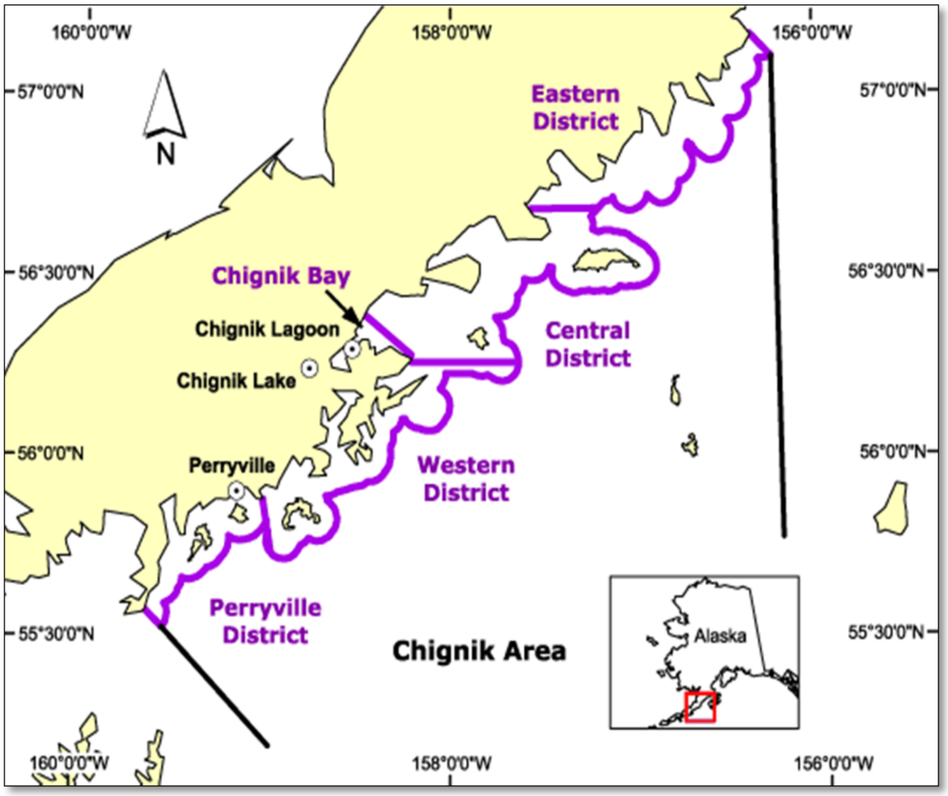



Figure 5-74. Chignik Management Area identifying the five commercial salmon fishing districts.

### *5.2.9.2.2.2 Commercial Chum Salmon Harvest*

A total of 256,425 chum salmon were harvested in 2009, which (as with 2008) was higher than the five and ten year average harvests (Figure 5-75). The majority of the chum harvest in 2009 took place in the Western District, although the Central and Eastern districts also yielded substantial catches (Table 5-39). Purse and hand purse seines are the only legal commercial salmon fishing gear within the CMA. A total of 209,325 chum salmon were harvested from the CMA during 2008. The majority of the 2008 chum salmon harvest occurred in the Eastern and Western districts during August.

A total of 581,329 chum salmon were commercially harvested in 2010, which was the highest catch since accurate harvest records began in 1954. The majority of the chum salmon harvest in 2010 took place in the Central District, although the Western and Eastern districts also yielded substantial catches. Most chum salmon were harvested between late June and mid-August.

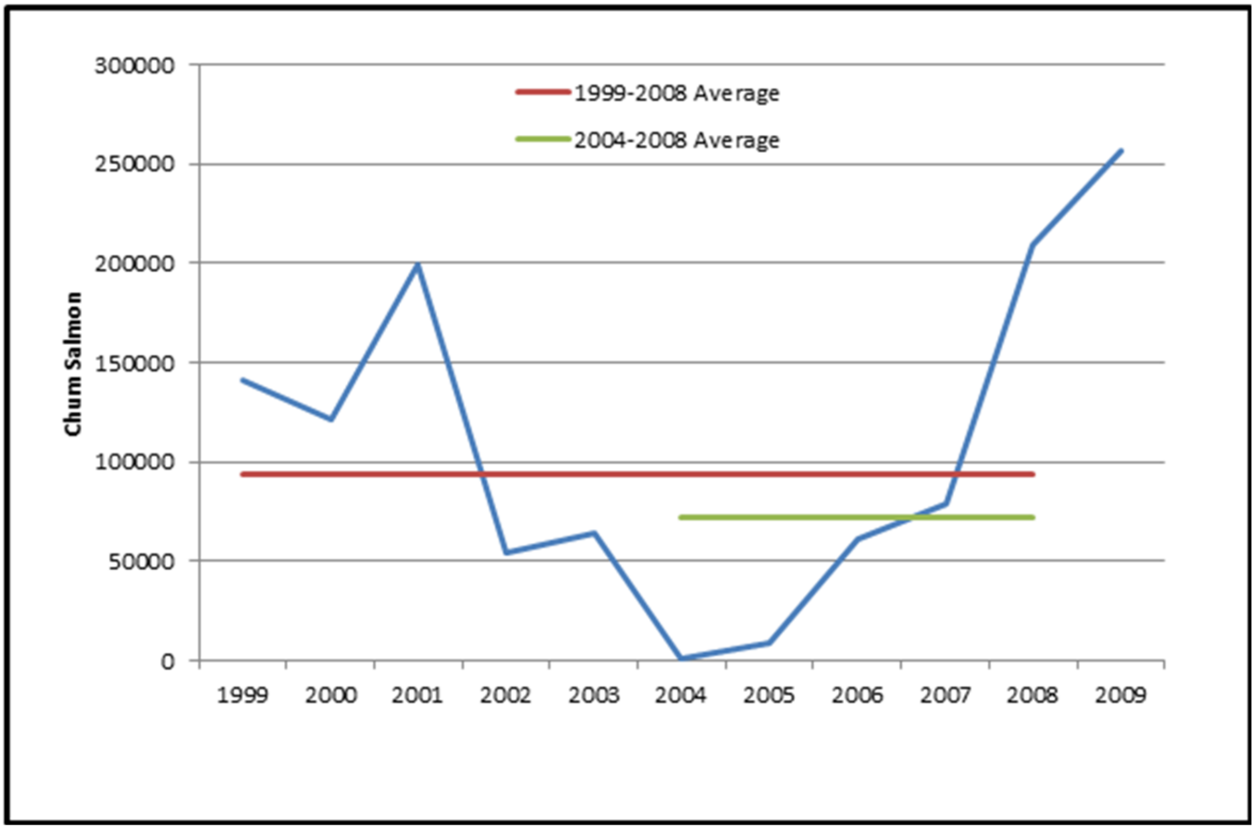



Figure 5-75. Commercial chum salmon harvest in the Chignik Management Area, 1999-2009.

Table 5-39. Chignik Management Area commercial chum salmon harvest by district, 1999-2009.

| | Chum Salmon Harvested | | | | | |
|---|---|---|---|---|---|---|
| Year | Chignik Bay | Central | Eastern | Western | Perryville | Total |
| 1999 | 12,150 | 75,495 | 11,332 | 37,089 | 4,531 | 140,597 |
| 2000 | 8,389 | 66,904 | 8,045 | 34,823 | 2,796 | 120,957 |
| 2001 | 11,534 | 84,132 | 50,911 | 37,466 | 14,960 | 199,003 |
| 2002 | 3,949 | 9,643 | 513 | 40,337 | 117 | 54,559 |
| 2003 | 10,891 | 11,304 | 50 | 39,883 | 1,916 | 64,044 |
| 2004 | 499 | 6 | - | - | - | 505 |
| 2005 | 2,370 | 5,329 | 2 | 1,054 | 66 | 8,821 |
| 2006 | 2,303 | 9,455 | 776 | 49,096 | - | 61,630 |
| 2007 | 3,829 | 19,595 | 7,851 | 46,943 | 335 | 78,553 |
| 2008 | 13,453 | 40,130 | 58,925 | 88,078 | 8,739 | 209,325 |
| 2009 | 14,553 | 62,149 | 59,800 | 116,231 | 3,692 | 256,425 |

### *Chum Salmon Escapement*

Salmon escapements in the CMA are enumerated through the use of a weir on the Chignik River, and the escapement goal is an aggregate, area-wide LB SEG. After the latest review of escapement goals for the Chignik Management Area in 2007 (Witteveen et al. 2007), this LB SEG was changed from 50,400 to

57,400, effective beginning in 2008. This LB SEG was exceeded in both 2008 (197,259 chum salmon) and 2009 (214,959 chum salmon).

The 2010 Chignik River chum salmon escapement was 95, which was below average for the Chignik River. Chum salmon escapements to other CMA streams were estimated via aerial survey and summarized by district. The SEG of all districts combined (57,400) was exceeded with an estimated total peak escapement of 177,220 fish.

Table 5-40. Chignik and Kodiak area chum salmon escapement goals and escapements, 2001-2009.

| | | | | Chum Salmon Escapement | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper | Type | Year Implemented | Enumeration Method | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
| | lower-bound SEG | 2008 | Weir Count and Aerial Survey | 550,800 | 235,634 | 300,325 | 349,518 | 38,700 | 93,489 | 238,098 | 197,259 | 214,959 |

| | | | | Chum Salmon Escapement | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper | Type | Year Implemented | Enumeration Method | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
| | lower-bound SEG | 2008 | Weir Count and Aerial Survey | 294,700 | 197,175 | 114,750 | 364,395 | 37,500 | 346,140 | 87,350 | 122,425 | 83,106 |
| | lower-bound SEG | 2008 | Weir Count and Aerial Survey | 263,225 | 333,416 | 265,773 | 168,696 | 206,755 | 441,409 | 206,992 | 101,482 | 210,039 |

scapement fell below stated goals. Yellow-shaded cells indicate escapement goals were met. Cells with no color indicate no official escapement goal for
based upon the escapement goal in place at the time of enumeration for salmon stocks rather than the most recent escapement goal provided.

### *Subsistence Chum Salmon Harvest*[38]

In 2009, ADF&G issued 95 subsistence fishing permits in the CMA. Based on the 82 permits returned to ADF&G Division of Subsistence, the estimated subsistence harvest totaled 8,907 salmon, which included only 137 chum salmon. This harvest was lower than the previous five and 10-year subsistence harvest averages of 264 chum salmon and 223 chum salmon, respectively (Table 5-41). Sockeye salmon comprise the majority of the subsistence harvest in CMA.

Table 5-41. Number of subsistence permits issued and estimated subsistence salmon harvest for the Chignik Management Area, 1999-2009.

| Year | Permits Issued | Chum Salmon | Total All Salmon |
|---|---|---|---|
| 1999 | 106 | 136 | 12,289 |
| 2000 | 130 | 517 | 13,228 |
| 2001 | 135 | 213 | 13,663 |
| 2002 | 120 | 23 | 11,980 |
| 2003 | 146 | 286 | 15,395 |
| 2004 | 104 | 202 | 10,357 |
| 2005 | 119 | 353 | 11,590 |
| 2006 | 113 | 275 | 11,186 |
| 2007 | 128 | 165 | 13,372 |
| 2008 | 89 | 57 | 8,783 |
| 2009 | 95 | 137 | 8,907 |

### *2010 Chum Salmon Forecast*[39]

Harvest projections for chum salmon in the CMA for 2010 were generated by averaging the last four fishery years (2006-2009). The 2010 projected chum salmon harvest was 151,000 fish. Historically, the Western and Perryville districts provided the largest proportion of the commercial harvest.

## 5.2.9.3 Aleutian Islands

### *5.2.9.3.1 The Aleutians Islands and Atka-Amlia Management Area*

The Aleutian Islands Management Area (AIMA) includes waters west of Cape Sarichef Light and Scotch Cap (both located on Unimak Island), and the Pribilof Islands (Figure 5-76). The AIMA is one of three subareas comprising Area M, the other two of which are the North and South Alaska Peninsula management areas (Hartill 2009) and are included in the Western Alaska portion of this document. A fourth subarea, the Atka-Amlia Islands Management Area, encompasses Aleutian Islands waters between Seguam Pass and Atka Pass (Figure 5-76) and is also known as Area F.

[38] There is no reported information on educational or personal use salmon fisheries in the Chignik Management Area.
[39] Forecasts for the 2011 fishery are not yet available.

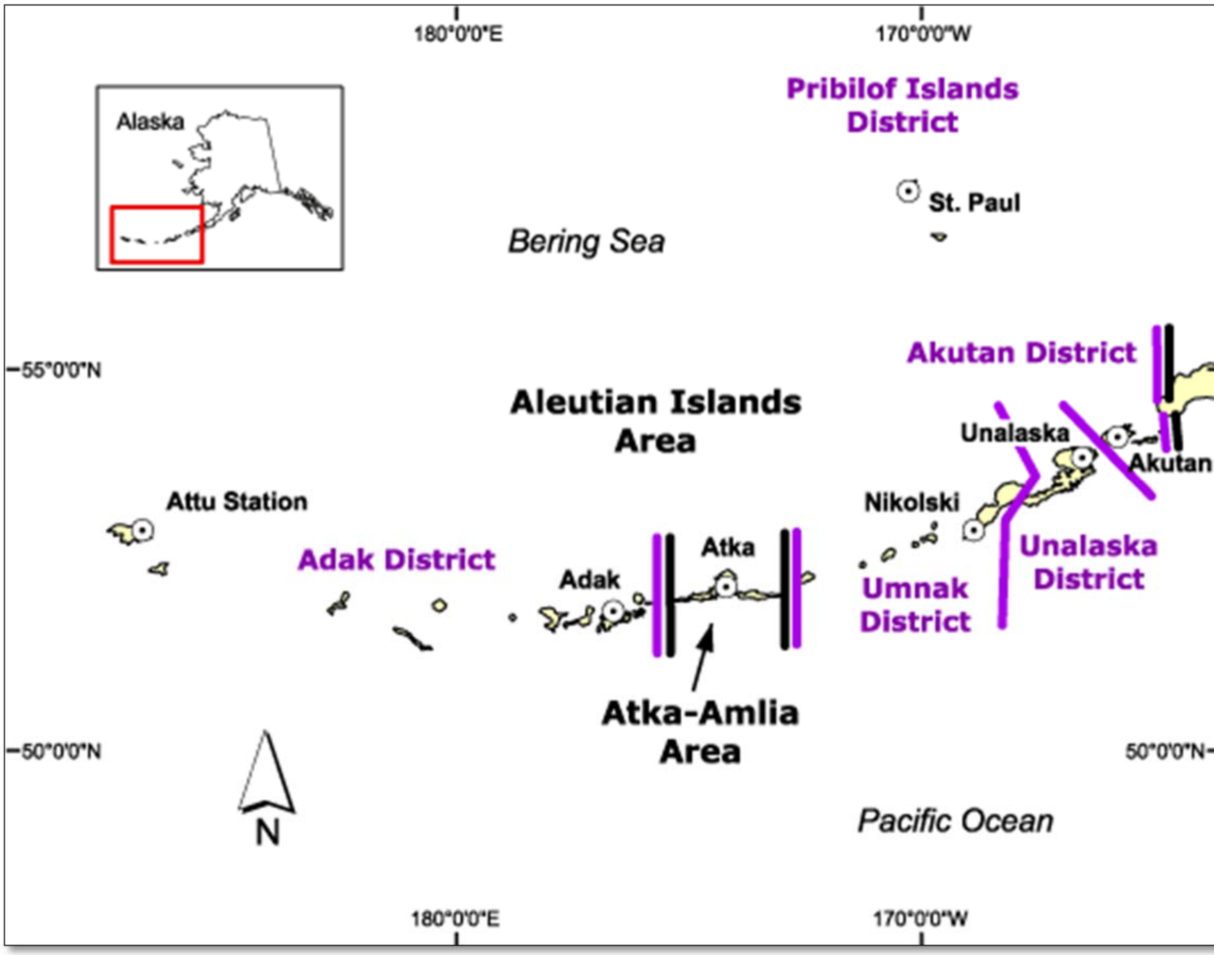



Figure 5-76. The Aleutian Islands and Atka-Amlia Islands management areas.

Streams in the Aleutian Islands have runs of sockeye, coho, pink, and chum salmon; however, poor salmon markets have generally limited commercial salmon harvests in both the Unalaska Island and Atka-Amlia Island fisheries. Pink salmon are the dominant harvest species in the Aleutian Islands.

### *Commercial Chum Salmon Harvest*

Purse seines, hand purse seines, and beach seines are the only legal gear types allowed to fish for salmon in the Aleutian Islands Management Area. Small commercial harvests occurred in the Atka-Amlia Islands Management Area between 1992 and 1996 with no commercial effort since that time. Interest in this fishery diminished due to lack of markets, high processing costs, and low volumes of fish.

Table 5-42. Commercial chum salmon harvest in the Aleutian Islands Management Area (excluding Atka-Amlia Islands Area), 1980-2009.

| Year | Chum Salmon | Year | Chum Salmon |
|---|---|---|---|
| 1980 | 4,874 | 1995 | - |
| 1981 | 6,553 | 1996 | - |
| 1982 | 6,148 | 1997 | - |
| 1983 | 11,361 | 1998 | - |
| 1984 | 32,025 | 1999 | - |
| 1985 | * | 2000 | * |
| 1986 | 38,819 | 2001 | - |
| 1987 | - | 2002 | - |
| 1988 | 450 | 2003 | - |
| 1989 | - | 2004 | - |
| 1990 | 1,038 | 2005 | - |
| 1991 | * | 2006 | 1,534 |
| 1992 | 1,230 | 2007 | * |
| 1993 | - | 2008 | 261 |
| 1994 | 617 | 2009 | 2,005 |

* Confidentiality rules prohibit the release of information for 1985, 1991, 2000, and 2007.

In total 2,005 chum salmon were harvested in the commercial fishery in the Aleutian Islands Management Area in 2009 (Table 5-42), along with 1,625,910 pink salmon. All the commercial harvest was around Unalaska Island and most of that harvest occurred in the Makushin Bay area. There was no commercial salmon harvest in the Atka-Amlia Islands Area in 2009 (Table 5-43).

Table 5-43. Commercial chum salmon harvest in the Atka-Amlia Islands Area, 1992-2009.

| Year | Chum Salmon |
|---|---|
| 1992 | 308 |
| 1993 | 563 |
| 1994 | 0 |
| 1995 | 0 |
| 1996 | 0 |
| 1997 | 0 |
| 1998 | 0 |
| 1999 | 0 |
| 2000 | 0 |
| 2001 | 0 |
| 2002 | 0 |
| 2003 | 0 |
| 2004 | 0 |
| 2005 | 0 |
| 2006 | 0 |
| 2007 | 0 |
| 2008 | 0 |
| 2009 | 0 |

### *Chum Salmon Escapement*

There is little salmon escapement information collected for the Aleutian Islands and Atka-Amlia Islands areas. Poor weather, remoteness, unavailability of suitable aircraft, and the high cost of aircraft charters limit surveys.

## *Subsistence Chum Salmon Harvest*[40]

Subsistence salmon fishing is important to Aleutian Islands communities; however, due to the remoteness of most villages in the AIMA, subsistence salmon fishing permits are only required in the larger communities in the Unalaska and Adak districts. Subsequently, Unalaska and Adak are the only communities from which subsistence information (from returned permits) is compiled on an annual basis. Sockeye salmon are the preferred species in the Unalaska subsistence fishery.

A total of 215 subsistence permits were issued for the Unalaska District in 2009, which was 11 permits more than in 2008 and 14 permits more than the average from 2004 through 2008. The total estimated harvest of 4,513 salmon in 2009 was more than the estimated 2008 catch of 3,243 fish, and more than the 2004-2008 average estimated harvest of 4,062 salmon. Chum salmon are not abundant in Unalaska Island waters and account for only a small portion of the subsistence harvest. In 2009, an estimated 182 chum salmon were caught in the Unalaska District subsistence fishery (Table 5-44).

Table 5-44. Estimated chum salmon subsistence harvest in the Aleutian Islands and Atka-Amlia Management Area, 1985-2009.

| Year | Permits Issued | Chum Salmon |
|---|---|---|
| 1985 | 65 | 20 |
| 1986 | 121 | 375 |
| 1987 | 81 | 151 |
| 1988 | 74 | 83 |
| 1989 | 70 | 36 |
| 1990 | 94 | 100 |
| 1991 | 89 | 45 |
| 1992 | 144 | 11 |
| 1993 | 137 | 136 |
| 1994 | 15 | 48 |
| 1995 | 159 | 23 |
| 1996 | 189 | 49 |
| 1997 | 218 | 110 |
| 1998 | 206 | 26 |
| 1999 | 208 | 13 |
| 2000 | 205 | 24 |
| 2001 | 201 | 100 |
| 2002 | 226 | 63 |
| 2003 | 220 | 41 |
| 2004 | 207 | 26 |
| 2005 | 207 | 15 |
| 2006 | 193 | 92 |
| 2007 | 171 | 36 |
| 2008 | 195 | 115 |
| 2009 | 205 | 182 |

[40] There is no reported information on educational or personal use salmon fisheries in the Aleutian Islands and Atka-Amlia Management Areas.

### 5.2.9.4 Southeast Alaska and Yakutat

***Description of Management Area***

The Southeast Alaska/Yakutat Region (Region I) consists of Alaska waters between Cape Suckling on the north and Dixon Entrance on the south (Figure 5-77). Region I is divided into 2 salmon net registration areas. Registration Area A, the Southeast Alaska area, extends from Dixon Entrance to Cape Fairweather. The Southeast Alaska area is divided into 17 regulatory districts, Districts 1 through 16 and the Dixon Entrance District (Figure 5-78). Registration Area D, the Yakutat area, extends from Cape Fairweather to Cape Suckling. The Yakutat area is further divided into the Yakutat District, extending from Cape Fairweather to Icy Cape, and the Yakataga District extending westward from Icy Cape to Cape Suckling (Figure 5-79).

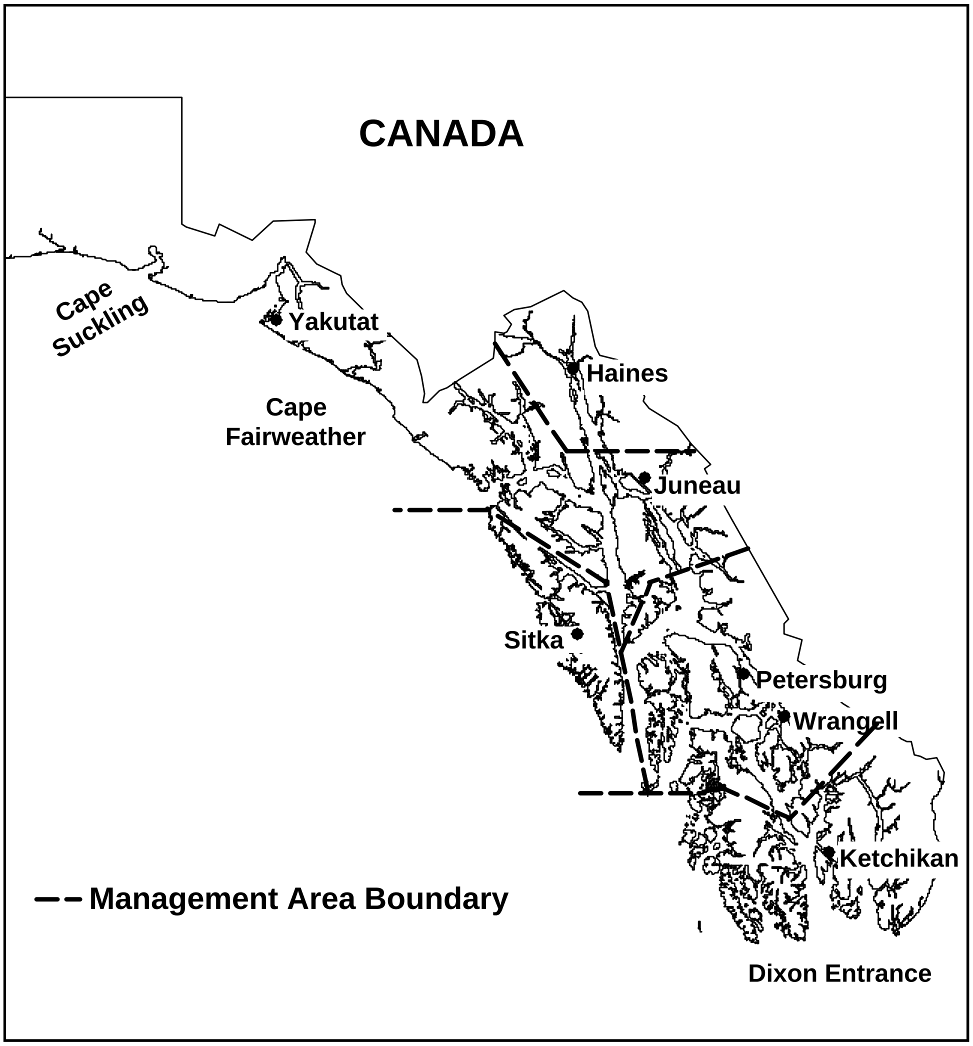



Figure 5-77. The Southeast Alaska/Yakutat Region (Region I) consists of Alaska waters between Cape Suckling on the north and Dixon Entrance on the south. Troll fisheries are managed regionally, and drift gillnet, set net, and purse seine fisheries are managed by area offices in Ketchikan, Petersburg/Wrangell, Sitka, Juneau, Haines, and Yakutat.

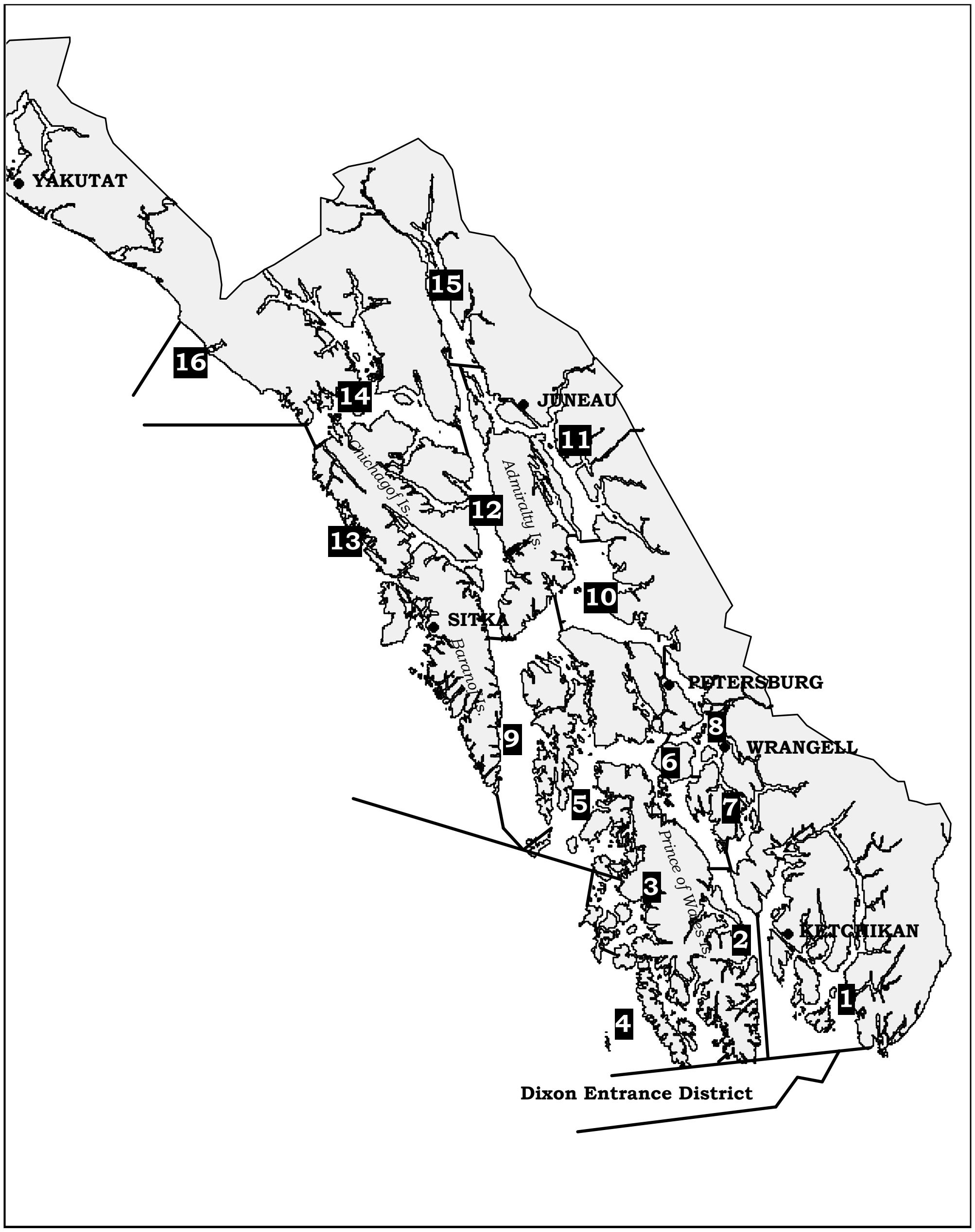



Figure 5-78. Boundaries for regulatory districts 1 to 16, as well as Dixon Entrance district, within Southeast Alaska.

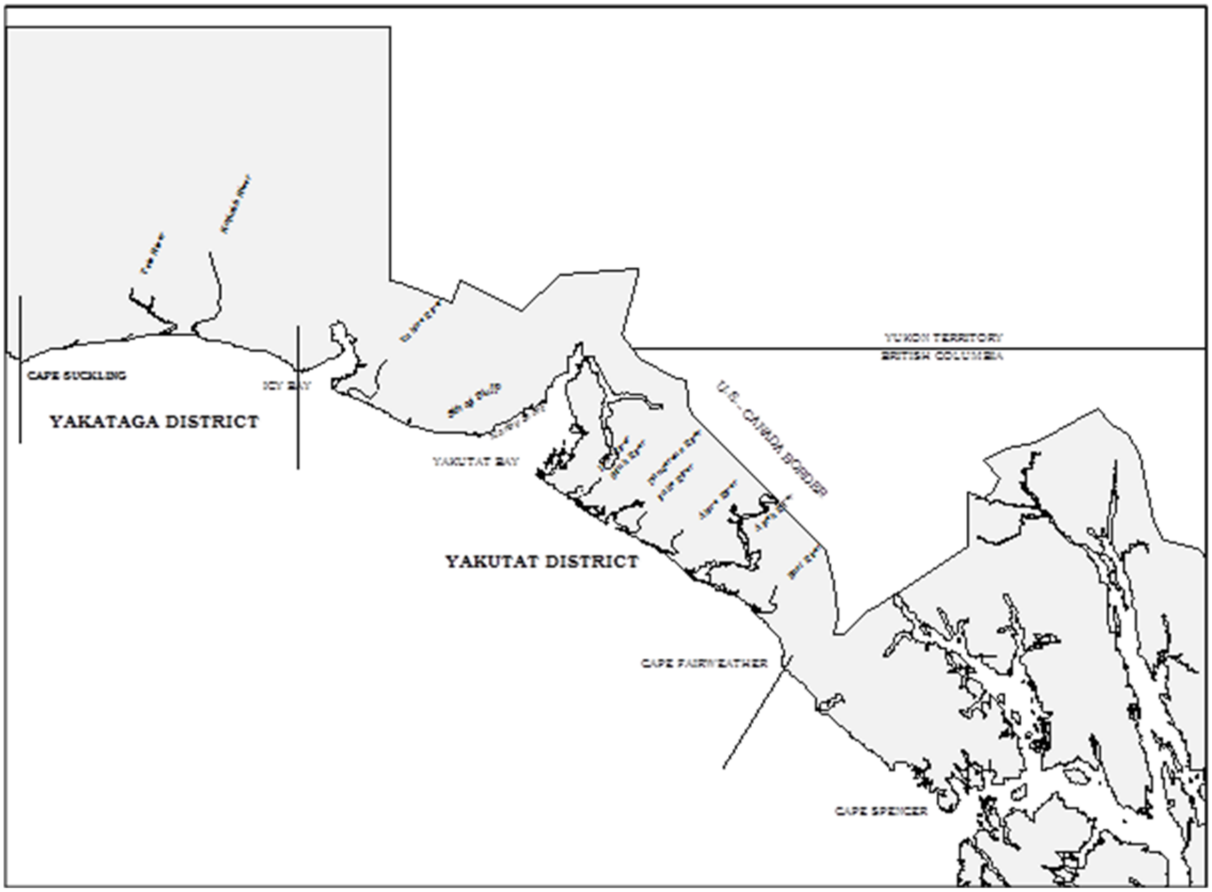



Figure 5-79. Boundaries for Yakutat and Yakataga regulatory districts, within the Yakutat management area (Registration Area D).

There are seven major hatcheries operating in Southeast Alaska: the Southern Southeast Regional Aquaculture Association (SSRAA); the Northern Southeast Regional Aquaculture Association (NSRAA); Douglas Island Pink and Chum Inc. (DIPAC); the Prince of Wales Hatchery Association (POWHA); the Kake Nonprofit Fishery Corporation (KAKE); Armstrong Keta, Inc. (AKI); and Sheldon Jackson College (SJC).

### *5.2.9.4.1.1 Commercial Chum Salmon Harvest*

For salmon management in Region 1, separate annual management reports are issued, which provide detailed summaries of the Southeast and Yakutat Salmon Troll Fishery, the Yakutat Area Commercial Set Net Fishery, and the Southeast Alaska Purse Seine and Drift Gillnet Fisheries. Prior to 2006 these reports were combined annually into the Commercial, Personal Use, and Subsistence Salmon Fisheries: Report to the Alaska Board of Fisheries.

Salmon are commercially harvested in Southeast Alaska (Registration Area A) with purse seines and drift gillnets; in Yakutat (Registration Area D) with set gillnets; and in both areas with hand and power troll gear. The salmon net fisheries are confined to state waters. The troll fishery operates in both state waters and in the federal waters of the Exclusive Economic Zone (EEZ). Approximately 51.6 million salmon were commercially harvested (including hatchery cost recovery) in the combined Southeast Alaska/Yakutat Region in 2009. The total common property commercial harvest was 45.5 million, 88% of total harvests, excluding cost recovery and Annette Island harvests (fishery data for 2009 were reported by Tingley and Davidson 2010). A total of 1,915 permit holders participated in the common property commercial salmon season in 2009, a slight increase from 2008 effort levels. Salmon harvests (in numbers of fish) by gear type for 2009 included 44.4 million by purse seine, 4.3 million by drift gillnet, 0.3 million by set net, and 2.2 million by hand and power troll.

Since the mid-1970s, salmon harvests in Region I have generally increased with a record harvest of chum salmon occurring in 1996. The various salmon fisheries in the region are well-established and the distribution of harvests between fisheries has changed little comparing the recent year, the recent 10-year average, or the long term average since 1962. The exception is that private hatchery cost recovery harvests, which only began in 1980, now account for a larger proportion of overall harvests. Harvests of chum salmon increased as new hatchery production began in the mid-1980s and in recent years the majority of chum salmon harvests in the region are attributable to hatchery production. In 1980, hatchery operators in Southeast Alaska released 8.7 million chum salmon fry at eight locations; by 2007, this number had risen to 454 million fry released at 22 locations.

The total harvest of 9.7 million chum salmon in 2009 was slightly higher than the preceding year and 89% of the recent 10-year average of 10.8 million (Table 5-45, Figure 5-80). Hatchery-produced chum salmon accounted for 88% of the chum harvested in Southeast Alaska common property fisheries (White 2010) and 92% of the total chum salmon harvested in Southeast Alaska (Figure 5-81). The 2009 chum salmon harvest made up 19% of the all-salmon species harvest and was above the long-term average from 1962-2008. For 2009, purse seiners harvested 3.5 million (36%) chum salmon, drift gillnetters accounted for 2.7 million (28%) chum salmon and 2.9 million (30%) chum salmon were taken in the hatchery cost recovery fisheries (Table 5-46).

The total commercial chum salmon harvest was 9.5 million in 2010, well above the long-term average harvest of 5.3 million. A large portion of chum salmon harvests in the region resulted from hatchery production, including harvest outside of terminal areas as hatchery returns pass through traditional fisheries. Wild summer chum salmon escapements, based on three recently established sustainable escapement goal thresholds, were below goal in Southern Southeast and Northern Southeast Inside areas, but reached the goal for the Northern Southeast Outside area. Fall chum salmon escapements were good in most systems monitored.

Table 5-45. Southeast Alaska and Yakutat Area total chum salmon harvest and percentage of all salmon species harvest, 1980-2009.

| Year | Chum Salmon | Percentage |
|---|---|---|
| 1980 | 1,642,938 | 9% |
| 1981 | 837,240 | 4% |
| 1982 | 1,330,219 | 5% |
| 1983 | 1,170,126 | 3% |
| 1984 | 4,084,200 | 13% |
| 1985 | 3,275,417 | 5% |
| 1986 | 3,358,992 | 6% |
| 1987 | 2,721,661 | 17% |
| 1988 | 3,535,591 | 20% |
| 1989 | 1,968,894 | 3% |
| 1990 | 2,217,895 | 6% |
| 1991 | 3,336,043 | 5% |
| 1992 | 4,936,515 | 11% |
| 1993 | 7,879,868 | 11% |
| 1994 | 10,403,085 | 14% |
| 1995 | 11,225,693 | 17% |
| 1996 | 16,043,397 | 18% |
| 1997 | 11,789,139 | 26% |
| 1998 | 15,695,285 | 25% |
| 1999 | 14,930,932 | 15% |
| 2000 | 15,910,909 | 40% |
| 2001 | 8,754,416 | 11% |
| 2002 | 7,455,007 | 13% |
| 2003 | 11,115,085 | 16% |
| 2004 | 11,371,623 | 18% |
| 2005 | 6,427,530 | 9% |
| 2006 | 14,002,610 | 47% |
| 2007 | 9,416,164 | 16% |
| 2008 | 9,065,156 | 32% |
| 2009 | 9,660,364 | 19% |
| 1962-2008 Avg. | 5,229,792 | 13% |
| 1998-2008 Avg. | 10,844,947 | 22% |

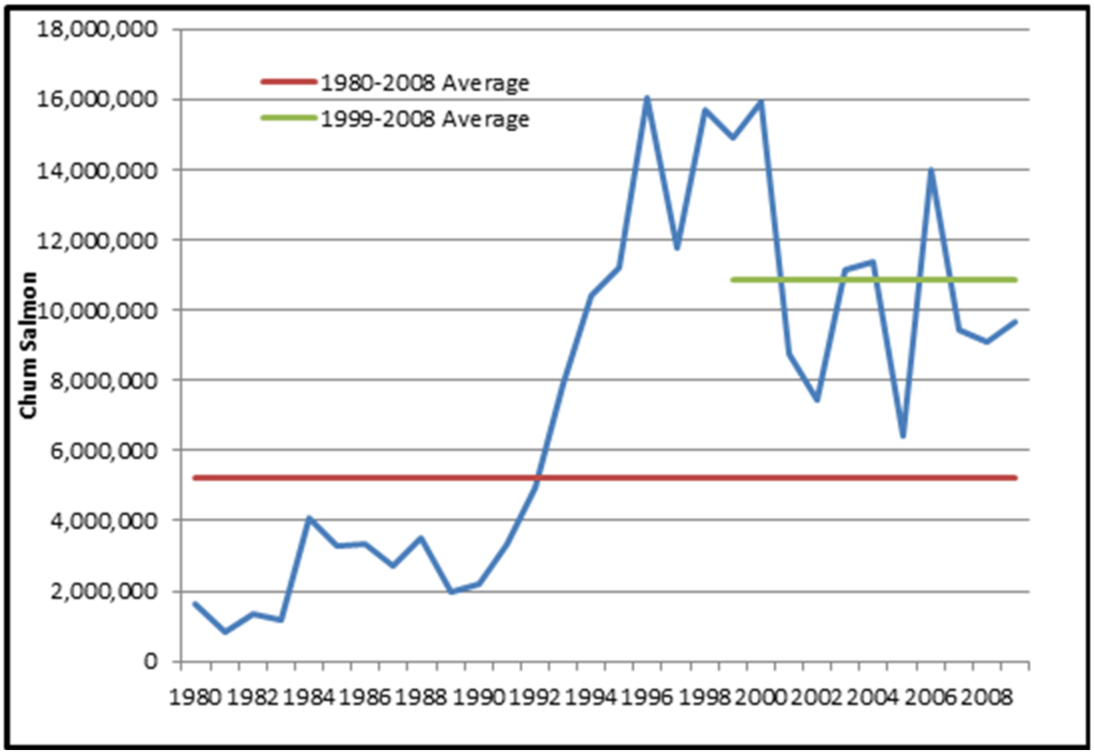



Figure 5-80. Southeast Alaska and Yakutat Area total chum salmon harvest and percentage of total, 1980-2009.

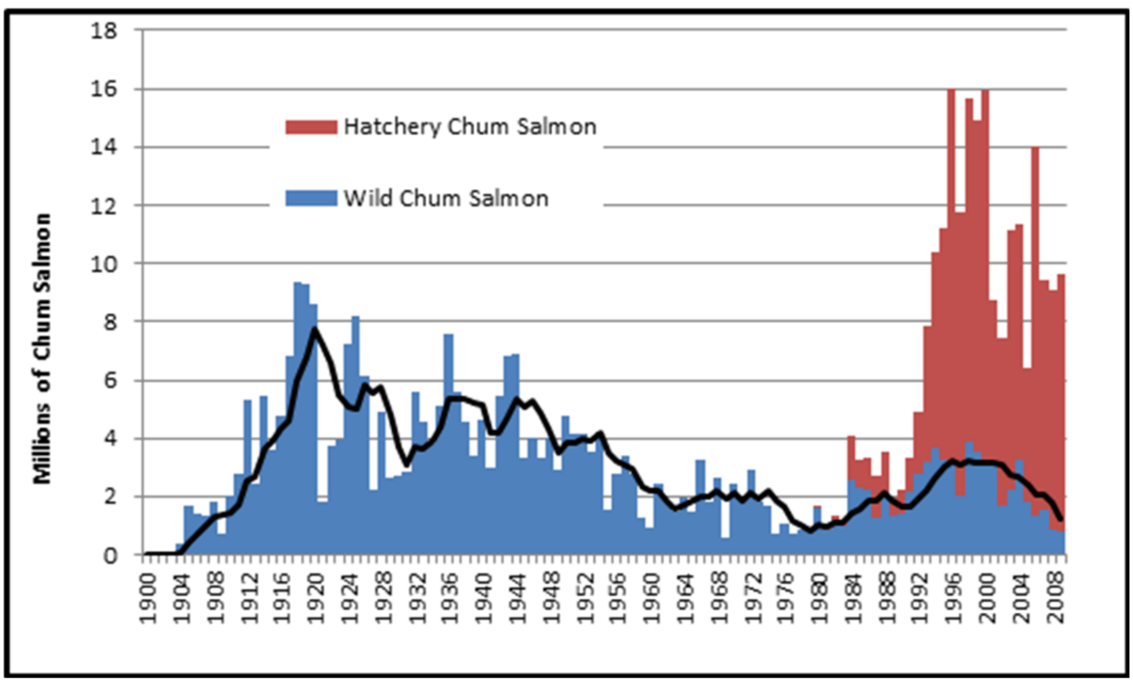



Figure 5-81. Southeast Alaska total chum salmon harvest including estimated hatchery contribution, 1900-2009.

Table 5-46. Southeast Alaska and Yakutat Area commercial chum salmon harvest by fishery, 2009.

| Fishery | Chum Salmon | Percentage |
|---|---|---|
| Purse Seine | 3,502,998 | 36% |
| Drift Gillnet | 2,729,966 | 28% |
| Set Gillnet | 871 | <1% |
| Troll | 342,866 | 4% |
| Annette Island | 158,637 | 2% |
| Hatchery Cost Recovery | 2,912,641 | 30% |
| Miscellaneous | 12,385 | <1% |
| Total | 9,660,364 | |

Note: Miscellaneous fishery includes chum salmon that were confiscated, caught in sport fish derbies, or commercial test fisheries, and sold.

In 2009, of the 51.6 million total all-gear, all-species salmon harvest, 81% were harvested in traditional fisheries, 7% in THA fisheries, and 8% in hatchery cost recovery fisheries. Of the 9.7 million chum harvested in 2009, 38% were harvested in traditional areas, 30% were harvested in hatchery THAs, and 30% were harvested in cost recovery fisheries. The estimated hatchery contribution of chum salmon to the common property seine harvest for 2009 was 87%, or 3.1 million fish. Total combined hatchery contributions estimated by NSRAA, SSRAA, and DIPAC to the common property drift gillnet fisheries was 95%, or 2.6 million chum salmon.

Hatchery cost recovery harvests in 2009 totalled approximately 4.0 million fish (all species combined), 84% of the recent 10-year average harvest of 4.8 million. The harvest included 2.9 million chum salmon. Chum salmon made up 73% of the total cost recovery harvest in the region in numbers of fish and was 15% below the recent 10-year average harvest of 3.4 million. Chum salmon cost recovery harvests were conducted by SSRAA (761,000), DIPAC (1,588,000), NSRAA (446,000), AKI (38,000), and SJC (17,000). No cost recovery harvests were reported by KAKE or MIC.

*Southeast Alaska Commercial Purse Seine and Drift Gillnet Fisheries*

During the 2009 purse seine fishery, 379 permits were issued and 269 permits were fished. Effort in 2009 increased greatly over the 213 permits fished in 2008 (the second lowest effort on record) and was the greatest since 273 permits were fished in 2002.

In 2009, the total harvest by purse seine gear was 44.4 million salmon (all species combined) of which the total common property purse seine harvest was 39.1 million salmon. Common property fisheries include traditional wild stock fisheries and terminal harvest area (THA) fisheries where fishermen compete to harvest surplus returns. Common property purse seine harvests for 2009 included 36.2 million fish in traditional areas and 2.8 million fish in hatchery terminal areas. The total common property purse seine harvest included approximately 3.5 million chum salmon. On average, the common property purse seine harvests since 1962 account for 69% of chum salmon harvests in the region.

Historically, the total purse seine fishery in Southeast Alaska has accounted for approximately 82% of the total commercial common property salmon harvest (all species combined). Pink salmon is the primary species targeted by the purse seine fleet; therefore, most management actions are based on inseason assessments of the abundance of pink salmon. Other salmon species are harvested incidentally to pink salmon in the purse seine fishery. Common property purse seine harvests for all salmon species (except Chinook salmon) were below the recent 10-year average. The chum salmon harvest for 2009 was 71% of the recent 10-year average harvest of 5.0 million fish. Cost recovery seine harvests to support privately operated salmon enhancement programs totaled 3.6 million, of which 75% were chum salmon. Seine harvests reported by the Annette Island Reservation[41] totaled 1.7 million fish (all species) which included approximately 38,500 chum salmon. Miscellaneous harvests of 41,000 salmon include test fisheries authorized by the department as well as illegally harvested fish, later confiscated by the Alaska Wildlife Troopers.

Of the 44.4 million salmon harvested by purse seine gear in 2009, 28.4 million were harvested in Southern Southeast districts and 16.0 million were harvested in Northern Southeast districts. Purse seine fishing in Northern Southeast Alaska includes the fisheries that occur in Districts 9 through 14. For 2009, traditional and THA purse seine harvests in Northern Southeast Alaska totaled 13.1 million fish, and included 2.4 million chum salmon (Table 5-47, Figure 5-82). The harvest of chum salmon was above the long-term average but below the most recent 10-year average harvests. The 2009 harvest of chum salmon in Northern Southeast Alaska was 79% of the recent 10-year average harvest of 3.3 million.

Purse seine fishing in southern Southeast Alaska occurs in Districts 1 through 7. In 2009, the common property purse seine harvest (traditional and THA) in southern Southeast Alaska totaled 25.9 million fish. The harvest included 1.1 million chum salmon (Table 5-47, Figure 5-82). The harvest of chum salmon was 65% of the recent 10-year average in 2009.

[41] Presidential proclamation established the Annette Island Fishery Reserve in 1916. It provides a 3,000-foot offshore zone wherein the reserve natives have exclusive fishing rights. Salmon are harvested by purse seine, gillnet, and troll gear.

Table 5-47. Southeast Alaska annual commercial, common property, purse seine chum salmon harvest (from traditional and terminal areas), 1980-2009.

| Year | Total Chum Salmon | Northern Southeast Contribution | Southern Southeast Contribution |
|---|---|---|---|
| 1980 | 1,002,478 | 415,511 | 586,967 |
| 1981 | 517,002 | 282,754 | 234,248 |
| 1982 | 828,444 | 162,007 | 666,437 |
| 1983 | 579,168 | 271,365 | 307,803 |
| 1984 | 2,433,749 | 1,473,603 | 960,146 |
| 1985 | 1,849,523 | 1,011,367 | 838,156 |
| 1986 | 2,198,907 | 947,510 | 1,251,397 |
| 1987 | 1,234,552 | 833,647 | 400,905 |
| 1988 | 1,625,435 | 653,809 | 971,626 |
| 1989 | 1,079,555 | 336,503 | 743,052 |
| 1990 | 1,062,522 | 603,299 | 459,223 |
| 1991 | 2,125,308 | 1,063,401 | 1,061,907 |
| 1992 | 3,193,433 | 1,948,819 | 1,244,614 |
| 1993 | 4,606,463 | 3,004,370 | 1,602,093 |
| 1994 | 6,376,472 | 4,781,593 | 1,594,879 |
| 1995 | 6,600,529 | 4,310,379 | 2,290,150 |
| 1996 | 8,918,577 | 6,246,728 | 2,671,849 |
| 1997 | 5,863,603 | 3,534,803 | 2,328,800 |
| 1998 | 9,406,979 | 4,800,326 | 4,606,653 |
| 1999 | 8,944,184 | 6,148,309 | 2,795,875 |
| 2000 | 8,306,257 | 6,232,888 | 2,073,369 |
| 2001 | 4,436,178 | 2,203,419 | 2,232,759 |
| 2002 | 3,110,330 | 2,057,813 | 1,052,517 |
| 2003 | 4,336,128 | 2,864,976 | 1,471,152 |
| 2004 | 5,684,447 | 4,098,981 | 1,585,466 |
| 2005 | 2,817,026 | 1,835,247 | 981,779 |
| 2006 | 5,614,232 | 3,810,988 | 1,803,244 |
| 2007 | 3,043,032 | 1,242,118 | 1,800,914 |
| 2008 | 3,215,231 | 2,332,622 | 882,609 |
| 2009 | 3,502,998 | 2,427,762 | 1,075,236 |
| 1999-2008 Avg. | 4,950,705 | 3,282,736 | 1,667,968 |

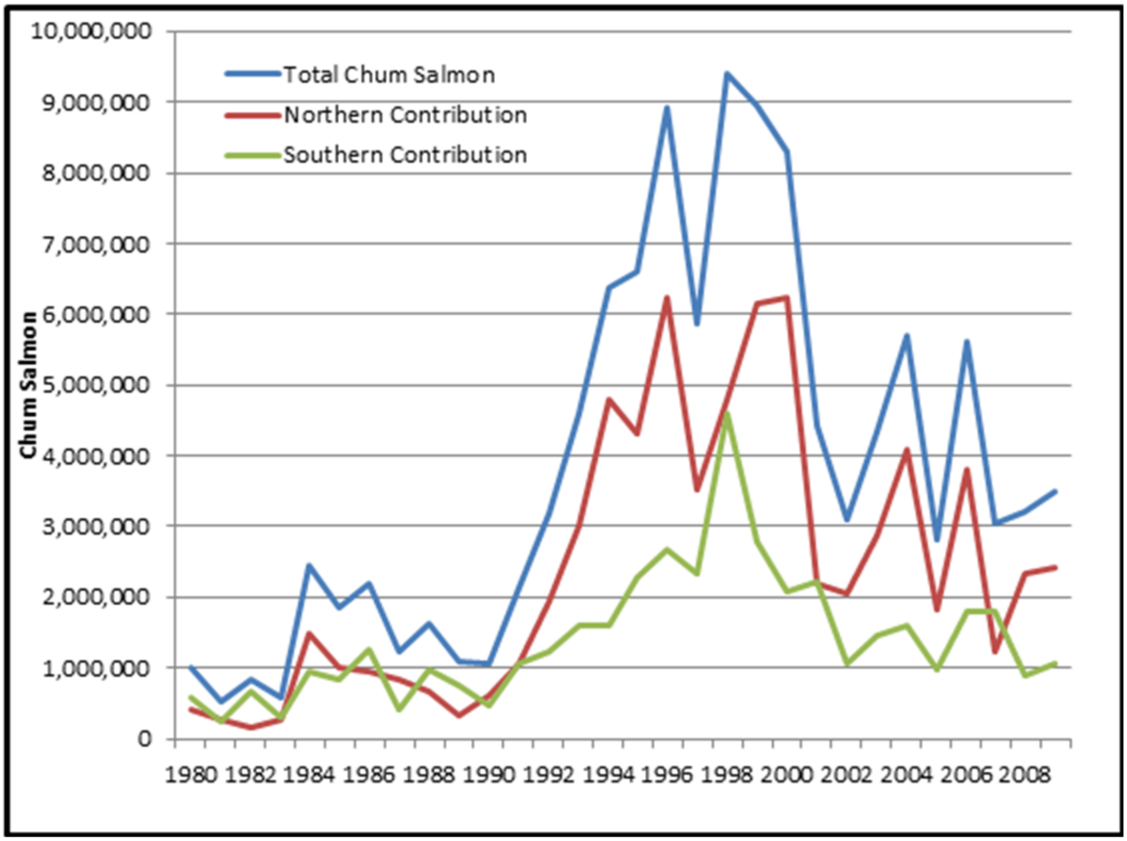



Figure 5-82. Southeast Alaska annual commercial, common property, purse seine chum salmon harvest (from traditional and terminal areas), 1980-2009.

Drift gillnet fishing is allowed by regulation in District 1 (Sections 1-A and 1-B), District 6 (Sections 6-A, 6-B, 6-C, and 6-D), District 8, District 11 (Sections 11-B and 11-C), and District 15 (Sections 15-A, 15-B, and 15-C). During the 2009 drift gillnet fishery, 474 permits were issued and 408 permits were fished; a slight increase over the 10-year average of 391 permits fished. The 2009 drift gillnet common property fisheries (traditional and THA) harvested 4.0 million salmon (all species combined). The total common property drift gillnet harvest included approximately 2.7 million chum salmon (68% of the harvest) (Table 5-48, Figure 5-83). The chum salmon harvest was 31% above the recent 10-year average harvest of 2.1 million fish. Common property harvests included 2.2 million chum salmon in traditional fisheries and 0.5 million fish in hatchery terminal areas. Cost recovery harvests by drift gillnet gear were minimal. Drift gillnet harvests from the Annette Island Reservation were 272,000 salmon (all species combined), which included approximately 120,000 chum salmon.

Table 5-48. Southeast Alaska total commercial, common property, drift gillnet chum salmon harvest (from traditional and terminal areas), 1980-2009.

| Year | Chum Salmon |
|---|---|
| 1980 | 548,674 |
| 1981 | 270,231 |
| 1982 | 448,332 |
| 1983 | 516,639 |
| 1984 | 1,030,346 |
| 1985 | 1,134,446 |
| 1986 | 815,813 |
| 1987 | 747,363 |
| 1988 | 1,144,856 |
| 1989 | 542,846 |
| 1990 | 616,226 |
| 1991 | 707,277 |
| 1992 | 845,176 |
| 1993 | 1,401,186 |
| 1994 | 1,823,497 |
| 1995 | 2,478,672 |
| 1996 | 2,033,650 |
| 1997 | 1,689,474 |
| 1998 | 1,923,764 |
| 1999 | 2,166,260 |
| 2000 | 2,561,607 |
| 2001 | 1,576,881 |
| 2002 | 1,415,849 |
| 2003 | 1,528,198 |
| 2004 | 1,835,679 |
| 2005 | 1,511,570 |
| 2006 | 3,126,663 |
| 2007 | 2,484,769 |
| 2008 | 2,592,212 |
| 2009 | 2,729,966 |
| 1999-2008 Avg. | 2,079,969 |

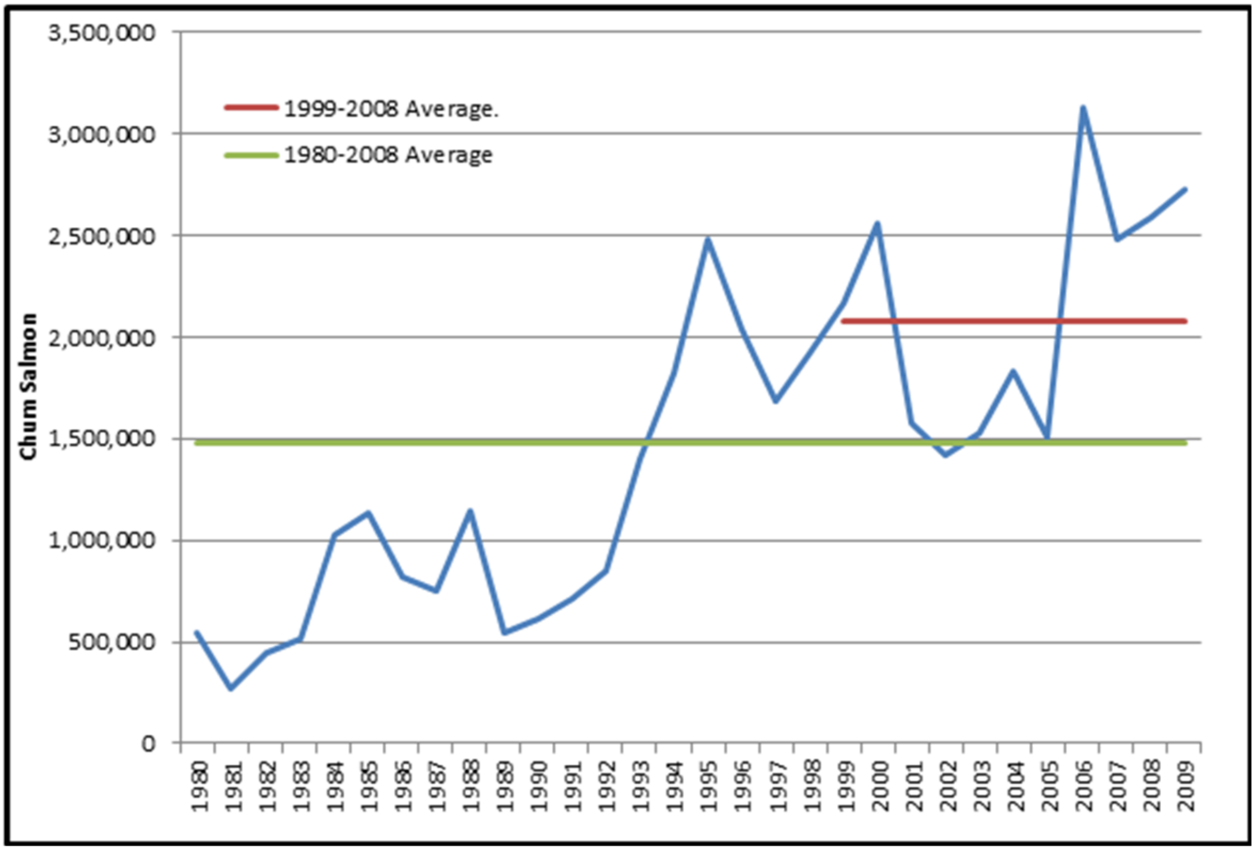



Figure 5-83. Southeast Alaska total commercial, common property, drift gillnet chum salmon harvest (from traditional and terminal areas), 1980-2009.

Yakutat Set Gillnet Fishery

In Registration Area D, the Yakutat District set gillnet fisheries primarily target sockeye and coho salmon although all five species of salmon are harvested. The Yakataga District fisheries only target coho salmon. Of the 167 Yakutat set gillnet permits, 123 were active for the 2009 season, compared to the recent 10-year average of 114 permits fished.

The Yakutat set gillnet fishery produced a cumulative harvest of 319,000 salmon (all species combined), which was nearly equal to the recent 10-year average of 320,000 salmon. The chum salmon harvest of 871 fish was 88% of the recent 10-year average (Table 5-49). Chum salmon are a non-target species in the Yakutat Area due to the combination of low abundance and low price, and the harvest is entirely incidental. The East River was the only consistent producer of chum in the Yakutat Area; however, the chum salmon run (as well as the sockeye salmon run) in the East River declined in the early 1990s, probably due to changes in habitat (see Clark et al. 2003). A total of 275 chum salmon were harvested in the East River fishery in 2009. In addition, chum salmon were also harvested in the Situk-Ahrnklin Inlet (147 fish; 89% of the recent 10-year average) and Yakutat Bay (353 fish; 35% of the recent 10-year average).

Table 5-49. Commercial chum salmon harvest in the Yakutat area set gillnet fishery, 1998-2009.

| Year | Chum Salmon |
|---|---|
| 1998 | 1,351 |
| 1999 | 928 |
| 2000 | 1,185 |
| 2001 | 406 |
| 2002 | 204 |
| 2003 | 542 |
| 2004 | 1,555 |
| 2005 | 525 |
| 2006 | 1,225 |
| 2007 | 2,782 |
| 2008 | 546 |
| 2009 | 871 |
| 1999-2008 Avg. | 990 |

### *Southeast Alaska/Yakutat Troll Fishery*

The commercial troll fishery in Southeast Alaska and Yakutat (Region 1) occurs in State of Alaska waters and in the Federal Exclusive Economic Zone (EEZ) east of the longitude of Cape Suckling. All other waters of Alaska are closed to commercial trolling. The commercial troll fleet is comprised of hand and power troll gear types. Approximately 2.1 million salmon were harvested in the 2009 Southeast Alaska/Yakutat troll fishery (common property and terminal areas) by 748 power troll and 367 hand troll permit holders. The harvest included 343,000 chum salmon landed, of which 5,300 chum salmon (1.5%) were taken by hand troll gear and 338,000 chum salmon (98.5%) by power troll gear. A total of 748 chum salmon were reported as harvested outside state waters in the EEZ.

Historically, chum salmon were harvested incidentally in the general summer troll fishery and were not targeted until the Cross Sound pink and chum fishery was established in 1988 as an indicator of pink and chum salmon abundance in inside waters. The troll chum harvest increased significantly in 1992, when for the first time over 1 million chum salmon returned to the NSRAA Hidden Falls hatchery, located on eastern Baranof Island. In 1993, the NSRAA Medvejie/Deep Inlet facility near Sitka saw a return of over 1.0 million chum and the troll chum salmon harvest increased to over 500,000 fish. Since that time, trollers have targeted chum and, with the exception of 1999 and 2008, the annual troll harvest of chum salmon outside of terminal harvest areas has been consistently greater than 100,000 fish (Table 5-50, Figure 5-84). In 2009, trollers harvested a total of 109,000 chum salmon in Sitka Sound. The majority (66,000) were harvested during the general summer fishery in Sitka Sound/Eastern Channel, with peak harvests occurring during the first 2 weeks of August. Trollers also harvested 40,300 chum salmon in Eastern Channel during the August troll closure and 2,700 chum salmon in the Deep Inlet THA.

Currently, trollers are allowed to fish in the Neets Bay THA only in years in which a surplus above SSRAA's broodstock and cost recovery needs is identified. In 2009, trollers harvested 186,000 chum salmon in the Neets Bay THA from July 1–17. Trollers also harvested 26,000 chum salmon in West Behm Canal, adjacent to the Neets Bay THA, with the majority taken during the two weeks following the closure of the THA. A total of 213,000 chum salmon were harvested by trollers in Neets Bay and West Behm Canal.

Table 5-50. Southeast Alaska/Yakutat Region commercial troll (common property) chum salmon harvest, 1980-2009.

| Year | Total Chum Salmon | Hand Troll Contribution | Power Troll Contribution |
|---|---|---|---|
| 1980 | 12,048 | 4,532 | 7,516 |
| 1981 | 8,680 | 2,582 | 6,098 |
| 1982 | 5,700 | 1,187 | 4,513 |
| 1983 | 20,309 | 2,777 | 17,532 |
| 1984 | 28,052 | 4,894 | 23,158 |
| 1985 | 52,787 | 9,746 | 43,041 |
| 1986 | 51,389 | 6,687 | 44,702 |
| 1987 | 12,846 | 3,016 | 9,830 |
| 1988 | 88,261 | 14,536 | 73,725 |
| 1989 | 68,988 | 6,578 | 62,410 |
| 1990 | 62,818 | 6,489 | 56,329 |
| 1991 | 28,438 | 3,839 | 24,599 |
| 1992 | 85,013 | 6,023 | 78,990 |
| 1993 | 525,138 | 34,449 | 490,689 |
| 1994 | 330,376 | 32,061 | 298,315 |
| 1995 | 277,453 | 21,282 | 256,171 |
| 1996 | 406,244 | 53,646 | 352,598 |
| 1997 | 312,042 | 20,042 | 292,000 |
| 1998 | 117,642 | 2,051 | 115,591 |
| 1999 | 74,672 | 583 | 74,089 |
| 2000 | 478,144 | 6,427 | 471,717 |
| 2001 | 467,830 | 12,480 | 455,350 |
| 2002 | 117,672 | 578 | 117,094 |
| 2003 | 286,410 | 3,095 | 283,315 |
| 2004 | 161,070 | 861 | 160,209 |
| 2005 | 165,393 | 418 | 164,975 |
| 2006 | 143,030 | 437 | 142,593 |
| 2007 | 185,800 | 1,385 | 184,415 |
| 2008 | 56,175 | 735 | 55,440 |
| 2009 | 299,593 | 4374 | 295,219 |
| 1999-2008 Avg. | 213,620 | 2,700 | 210,920 |

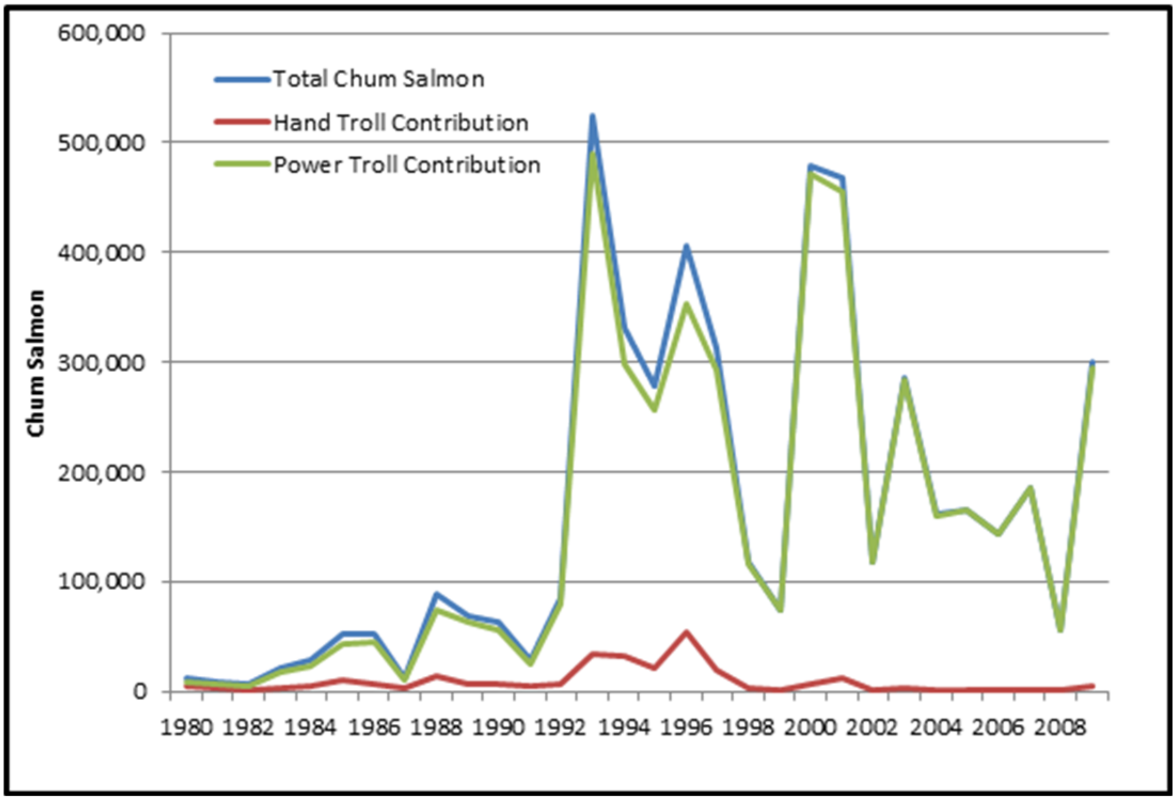



Figure 5-84. Southeast Alaska/Yakutat Region commercial troll (common property) chum salmon harvest, 1980-2009.

*Southeast Alaska Chum Salmon Escapement*

Chum salmon are known to spawn in more than 1,200 streams in Southeast Alaska. The vast majority of those streams do not have a long time series of survey information—probably because most are not significant producers of chum salmon, and survey effort has been directed at the more productive chum salmon streams. Of the chum salmon populations that have been monitored, most have been monitored through aerial surveys, although several have been monitored annually by foot surveys, and in-river fish wheel counts have been used to monitor salmon escapements to the Taku and Chilkat rivers, two large, glacial, mainland river systems. ADF&G completed work in 2009 to establish sustainable escapement goals for chum salmon in Southeast Alaska. Survey information from 88 Southeast Alaska chum salmon index streams was divided into appropriate stock groups by area and migration run-timing (summer or fall). Summer-run fish generally peak during the period mid-July to mid-August and fall-run fish peak in September or later. For summer runs, which are typically harvested in mixed-stock fisheries, stocks were divided into three aggregates of streams in Southern Southeast, Northern Southeast Inside, and Northern Southeast Outside subregions. The abundance of summer-run chum salmon has increased since the early 1970s and escapement indices have been stable or increasing since 1980. However, the 2008 and 2009 summer chum salmon runs in Southeast Alaska were generally weak, with observed escapements below the recommended goals for the Northern Inside and Southern aggregates. Summer chum salmon runs were notably poor over most of the region in 2009.

For fall runs that support, or have supported, a directed fishery, stocks were divided into five aggregates in Cholmondeley Sound, Port Camden, Security Bay, Excursion Inlet, and Chilkat River areas. The abundance of fall-run chum salmon has decreased from the high levels observed from the 1960s to the early 1970s; however, fall-run chum salmon escapement indices have been relatively stable for two decades and have increased since the mid 1990s for the Chilkat River. Escapement indices for fall chum salmon for 2008 were generally within or above escapement goals. In 2009, with the exception of Port Camden and Excursion Inlet, fall runs performed better with respect to escapement goals than summer runs, particularly in the Chilkat River(Table 5-51). It should be noted that allozyme studies by Kondzela et al. (1994), Phelps et al. (1994), and Wilmot et al. (1994) suggested that run-timing is an isolating mechanism for chum salmon populations: "reproductive isolation between summer-run and fall-run chum salmon is an important component of the genetic diversity of this species" (Phelps et al. 1994).

Table 5-51. Southeast Alaska chum salmon escapement goals and escapements, 2001-2009.

| ange | | | | Chum Salmon Escapement | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pper | Type | Year Implemented | Enumeration Method | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
| | lower-bound SEG | 2009 | Aerial Survey | 125,000 | 55,000 | 66,000 | 74,000 | 66,000 | 76,000 | 132,000 | 13,000 | 41,000 |
| | lower-bound SEG | 2009 | Aerial Survey | 229,000 | 397,000 | 210,000 | 242,000 | 185,000 | 282,000 | 149,000 | 99,000 | 107,000 |
| | lower-bound SEG | 2009 | Aerial Survey | 58,000 | 19,000 | 30,000 | 86,000 | 77,000 | 57,000 | 34,000 | 46,000 | 15,000 |
| 8,000 | SEG | 2009 | Aerial Survey | 45,000 | 39,000 | 75,000 | 60,000 | 15,000 | 54,000 | 18,000 | 49,500 | 39,000 |
| ,000 | SEG | 2009 | Aerial Survey | n/a | 450 | 676 | 3,300 | 2,110 | 2,420 | 505 | 1,400 | 1,711 |
| 5,000 | SEG | 2009 | Aerial Survey | 3,500 | 6,000 | 8,700 | 13,100 | 2,750 | 15,000 | 54,000 | 11,700 | 5,100 |
| 8,000 | SEG | 2009 | Aerial Survey | 17,750 | 4,680 | 6,300 | 5,200 | 1,100 | 2,203 | 6,000 | 8,000 | 1,400 |
| 70,000 | SEG | 2009 | Mark-recapture, fish wheel | 312,000 | 206,000 | 166,000 | 310,000 | 202,000 | 704,000 | 331,000 | 451,000 | 337,000 |

scapement fell below stated goals. Yellow-shaded cells indicate escapement goals were met. Green-shaded cells indicate escapement goals were exceeded.
icial escapement goal for that particular year. Shaded cells are based upon the escapement goal in place at the time of enumeration for salmon stocks rather than the
.

### *Subsistence Chum Salmon Harvest*

A total of 3,427 subsistence permits were issued in Southeast Alaska in 2009: 3,294 in Registration Area A, and 133 subsistence permits in the Yakutat area, Registration Area D (Table 5-52). Of that total, 3,107 permits were returned, with a total reported subsistence harvest of 52,550 fish, of which only 1,714 (3%) were chum salmon. Those numbers are slightly below the 10-year average of 2,356 chum salmon (average 4% of total harvest). Sockeye salmon make up 85% of the annual subsistence harvest in Southeast Alaska.

Table 5-52. Number of subsistence permits issued and returned, and reported chum salmon subsistence harvest in Southeast Alaska, 1999–2009.

| Year | Permits Issued | Permits Returned | Total Fish Harvested | Reported Chum Harvest | Proportion Chum |
|---|---|---|---|---|---|
| 1999 | 4,308 | 3,709 | 59,766 | 4,356 | 7% |
| 2000 | 3,771 | 3,198 | 54,384 | 2,981 | 5% |
| 2001 | 3,609 | 3,122 | 59,340 | 3,308 | 6% |
| 2002 | 3,328 | 2,785 | 58,142 | 1,846 | 3% |
| 2003 | 3,597 | 2,956 | 67,156 | 3,207 | 5% |
| 2004 | 3,703 | 3,294 | 63,105 | 2,748 | 4% |
| 2005 | 3,315 | 2,799 | 42,836 | 1,636 | 4% |
| 2006 | 3,406 | 2,810 | 53,941 | 1,526 | 3% |
| 2007 | 3,161 | 2,802 | 41,863 | 628 | 2% |
| 2008 | 3,153 | 2,823 | 43,482 | 1,325 | 3% |
| 2009 | 3,427 | 3,107 | 52,550 | 1,714 | 3% |
| 1999-2008 Avg. | 3,535 | 3,030 | 54,402 | 2,356 | 4% |

## 5.3 Impacts on chum salmon

The following criteria are used to evaluate the impact of alternative management measures on Chum salmon PSC in comparison to the status quo management.

Criteria used to estimate the significance of impacts on incidental catch of PSC and other non-target species

| | |
|---|---|
| No impact | No incidental take of the prohibited species in question. |
| Adverse impact | There are incidental takes of the prohibited species in question |
| Beneficial impact | Natural at-sea mortality of the prohibited species in question would be reduced – perhaps by the harvest of a predator or by the harvest of a species that competes for prey. |
| Significantly adverse impact | An action that diminishes protections afforded to prohibited species and forage fish in the current management of groundfish fisheries would be a significantly adverse impact. |
| Significantly beneficial impact | No benchmarks are available for significantly beneficial impact of the groundfish fishery on the prohibited species, and significantly beneficial impacts are not defined for these species. |
| Unknown impact | Not applicable |

Note these criteria were modified from those employed in the 2006-2007 groundfish harvest specifications environmental assessment/final regulatory flexibility analysis (EA/FRFA).

### 5.3.1 Pollock fishery bycatch of Chum salmon under Alternative 1

The majority of non-Chinook bycatch in the Bering Sea occurs in the pollock fishery. Historically, the contribution of non-Chinook bycatch from the pollock trawl fishery has ranged from a low of 88% of all bycatch to a high of >99.5% in 1993. Since 2005 the pollock fishery contribution to the total non-Chinook bycatch has ranged from 88% in 2010 to 99.3% in 2005. Total catch of non-Chinook salmon in the pollock fishery reached an historic high in 2005 at 704,552 fish (Table 5-53). Bycatch of non-Chinook salmon in this fishery occurs almost exclusively in the B season.

Table 5-53. Non-Chinook (chum) salmon mortality in BSAI pollock directed fisheries 1991-2011. Updated 1/14/2012.

| Year | Annual with CDQ | Annual without CDQ | Annual CDQ only | A season with CDQ | B season with CDQ | A season without CDQ | B season without CDQ | A season CDQ only | B season CDQ only |
|---|---|---|---|---|---|---|---|---|---|
| 1991 | Na | 28,951 | na | na | na | 2,850 | 26,101 | na | na |
| 1992 | Na | 40,274 | na | na | na | 1,951 | 38,324 | na | na |
| 1993 | Na | 242,191 | na | na | na | 1,594 | 240,597 | na | na |
| 1994 | 92,672 | 81,508 | 11,165 | 3,991 | 88,681 | 3,682 | 77,825 | 309 | 10,856 |
| 1995 | 19,264 | 18,678 | 585 | 1,708 | 17,556 | 1,578 | 17,100 | 130 | 456 |
| 1996 | 77,236 | 74,977 | 2,259 | 222 | 77,014 | 177 | 74,800 | 45 | 2,214 |
| 1997 | 65,988 | 61,759 | 4,229 | 2,083 | 63,904 | 1,991 | 59,767 | 92 | 4,137 |
| 1998 | 64,042 | 63,127 | 915 | 4,002 | 60,040 | 3,914 | 59,213 | 88 | 827 |
| 1999 | 45,172 | 44,610 | 562 | 362 | 44,810 | 349 | 44,261 | 13 | 549 |
| 2000 | 58,571 | 56,867 | 1,704 | 213 | 58,358 | 148 | 56,719 | 65 | 1,639 |
| 2001 | 57,007 | 53,904 | 3,103 | 2,386 | 54,621 | 2,213 | 51,691 | 173 | 2,930 |
| 2002 | 80,782 | 77,178 | 3,604 | 1,377 | 79,404 | 1,356 | 75,821 | 21 | 3,583 |
| 2003 | 189,185 | 180,783 | 8,402 | 3,834 | 185,351 | 3,597 | 177,186 | 237 | 8,165 |
| 2004 | 440,468 | 430,271 | 10,197 | 424 | 440,044 | 395 | 431,925 | 29 | 8,119 |
| 2005 | 704,552 | 696,859 | 7,693 | 578 | 703,974 | 546 | 693,806 | 32 | 10,168 |
| 2006 | 309,630 | 308,428 | 1,202 | 1,323 | 308,307 | 1,258 | 300,646 | 65 | 7,661 |
| 2007 | 93,783 | 87,303 | 6,480 | 8,510 | 85,273 | 7,354 | 84,136 | 1,156 | 1,137 |
| 2008 | 15,267 | 14,834 | 434 | 319 | 14,948 | 246 | 9,624 | 73 | 5,324 |
| 2009 | 46,127 | 45,178 | 950 | 48 | 46,080 | 48 | 45,719 | 0 | 361 |
| 2010 | 13,222 | 12,696 | 526 | 39 | 13,183 | 39 | 12,233 | 0 | 950 |
| 2011 | 191,445 | 187,676 | 3,769 | 122 | 191,323 | 111 | 190,797 | 11 | 526 |

Non-CDQ data for 1991-2002 from bsahalx.dbf Non-CDQ data for 2003-2011 from akfish_v_gg_pscnq_estimate
CDQ data for 1992-1997 from bsahalx.dbf
CDQ data for 1998 from boatrate.dbf
CDQ data for 1999-2007 from akfish_v_cdq_catch_report_total_catch
CDQ data for 2008-2011 from akfish_v_gg_pscnq_estimate_cdq
A season - January 1 to June 10
B season - June 11 to December 31

Bycatch rates for chum salmon (chum salmon/t of pollock) from 1991-2010 are shown in Figure 5-82. Currently the Chum Salmon Savings Area as shown in Figure 5-85 is invoked in the month of August annually and when triggered in September. However, starting in 2006, the fleet has been exempt from these closures because of their participation in the salmon bycatch reduction intercooperative agreement, which was implemented in 2006 (under an exempted fishing permit) and in regulation in 2007 under Amendment 84.

Bycatch by sector from 1997-2011 is summarized in Table 5-54. Annual percentage contribution to the total amount by year and sector (non-CDQ) from 1997-2011 is summarized in Table 5-55.

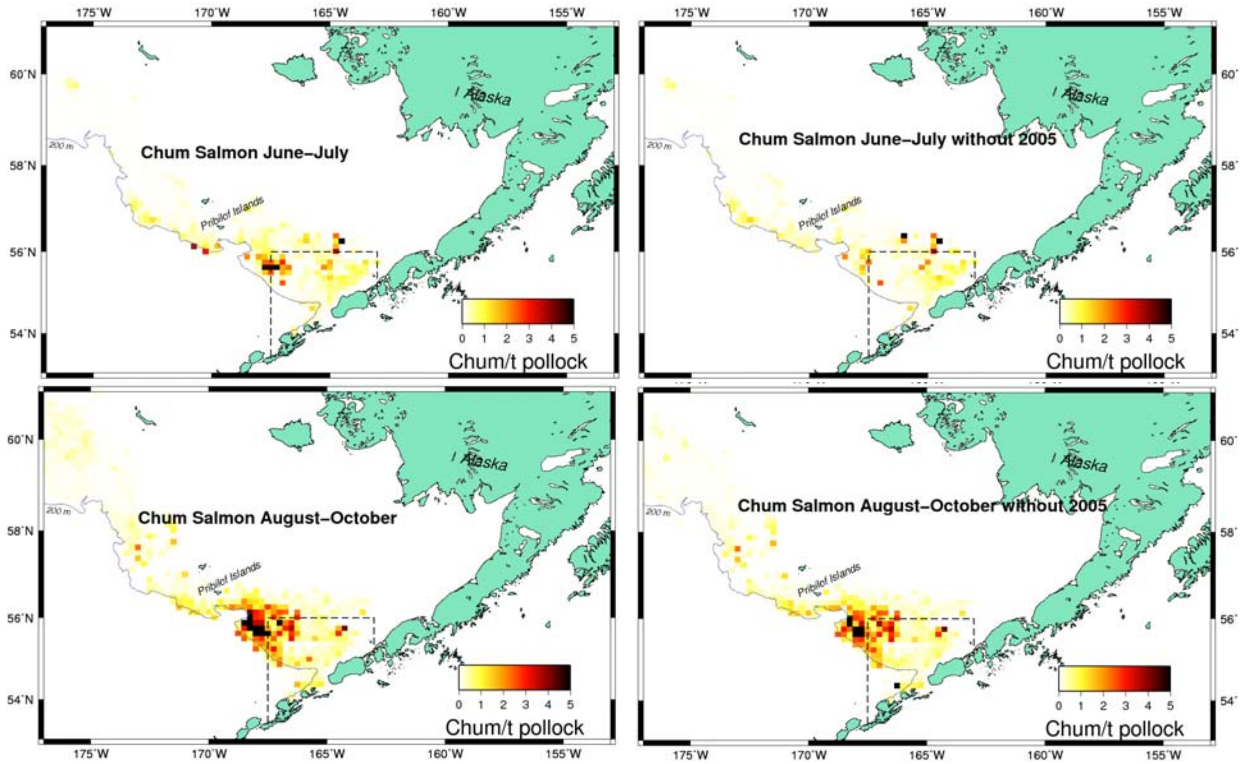



Figure 5-85. Chum salmon bycatch rates (numbers per t of pollock) for 2003-2010 data (left panels) and with the 2005 data omitted (right panels) by months within the B-season. Catcher Vessel Operational Area (CVOA) is represented by dashed line.

Table 5-54. Non-Chinook bycatch in the EBS pollock trawl fishery 1997-2011 by sector. CP = catcher processor, M= Mothership, S = Shoreside catcher vessel fleet. CDQ where available is listed separately by the sector in which the salmon was caught. For confidentiality reasons CDQ catch by sector since 2008 cannot be listed separately. Data through 01/14/2012 Source NMFS catch accounting

| Year | CP | M | S | CDQ (total) | Total |
|---|---|---|---|---|---|
| 1997 | 23,131 | 15,018 | 23,610 | 4,229 | 65,988 |
| 1998 | 8,119 | 6,750 | 49,173 | 0 | 64,042 |
| 1999 | 2,312 | 212 | 42,087 | 661 | 45,271 |
| 2000 | 4,930 | 509 | 51,428 | 1,704 | 58,571 |
| 2001 | 20,356 | 8,495 | 25,052 | 3,103 | 57,007 |
| 2002 | 9,303 | 13,873 | 54,002 | 3,474 | 80,652 |
| 2003 | 22,785 | 11,894 | 146,104 | 8,356 | 189,138 |
| 2004 | 76,134 | 13,330 | 340,807 | 10,197 | 440,468 |
| 2005 | 62,963 | 15,312 | 618,584 | 7,693 | 704,552 |
| 2006 | 18,066 | 2,010 | 288,352 | 1,202 | 309,630 |
| 2007 | 27,198 | 5,424 | 54,680 | 6,480 | 93,783 |
| 2008 | 1,562 | 641 | 12,631 | 434 | 15,267 |
| 2009 | 3,901 | 1,733 | 39,544 | 950 | 46,127 |
| 2010 | 2,101 | 1,070 | 9,525 | 526 | 13,222 |
| 2011 | 44,356 | 24,399 | 118,921 | 3,769 | 191,445 |

Table 5-55. Percent of total annual non-Chinook salmon catch by sector by year 1997-2011 (CDQ not included in sector totals) CP = catcher processor, M= Mothership, S = Shoreside catcher vessel fleet.

| Year | CP | M | S |
|---|---|---|---|
| 1997 | 35% | 23% | 36% |
| 1998 | 13% | 11% | 77% |
| 1999 | 5% | 0% | 93% |
| 2000 | 8% | 1% | 88% |
| 2001 | 36% | 15% | 44% |
| 2002 | 12% | 17% | 67% |
| 2003 | 12% | 6% | 77% |
| 2004 | 17% | 3% | 77% |
| 2005 | 9% | 2% | 88% |
| 2006 | 6% | 1% | 93% |
| 2007 | 29% | 6% | 58% |
| 2008 | 10% | 4% | 83% |
| 2009 | 8% | 4% | 86% |
| 2010 | 16% | 8% | 72% |
| 2011 | 23% | 13% | 62% |

### 5.3.1.1 Bycatch under RHS/Inter-cooperative Agreement

This analysis provides an evaluation of the status quo chum PSC reduction measures[42]. The status quo is defined in three ways: the Chum Salmon Savings Areas (SSA) only, Chum SSA and rolling hotspot system (RHS), and RHS only. Thus identifying the means to evaluate the efficacy of the rolling hotspot program helps both in defining the current status quo conditions of the fishery as well as proposing modifications to such a program to improve its effectiveness. The questions analyzed here and draft methodologies were reviewed by the Scientific and Statistical Committee (SSC) of the North Pacific Fishery Management Council (Council) in June 2009 and June 2010.

Since 2001, there has been an inter-cooperative agreement (ICA) among pollock cooperatives to impose short-term “hot spot” closures designed to limit chum salmon PSC in the Bering Sea pollock fishery. A description of the current ICA including modifications made to it since 2005 is contained in Appendix 2. Sea State, Inc. is hired by the pollock industry to analyze the National Marine Fisheries Service (NMFS) Observer Program data, vessel monitoring system (VMS) data, and other real-time data to relay information to the fleet and to implement hotspot closures. Since August 2006, following approval of Amendment 84 by the Council[43], these rolling hotspot (RHS) closures have been the only chum-related PSC restrictions on the pollock fishery. This assessment of the status quo chum salmon PSC measures gives primary attention to estimating the efficacy of the rolling hotspot (RHS) closures at reducing bycatch.

Salmon Savings Areas will also be discussed, as well as the interaction between existing chum salmon reduction measures and Amendment 91, which allows for incentive plan agreements (IPA) and created a “hard cap” for Chinook salmon beginning in 2011. Because the pollock industry has not yet reported results to the Council on the IPAs, only a limited discussion can be offered on how the Amendment 91 measures have interacted with the chum RHS measures.

[42] Note for the public review draft the methodological sections of this analysis will be moved to Chapter 3 but are currently retained within the whole impacts section presented here for the initial review draft.
[43] Note that the exemption was implemented via an EFP in the B season of 2006 and was implemented by regulation following secretarial approval of Amendment 84 in January 2007.

The three panes of Figure 5-86 show the locations of RHS closures in the Bering Sea at different points in the B Season from 2003-2011 (left panel), in the high-chum year of 2005 (middle), and the low-chum year of 2009 (right). The closures have been imposed on much of the pollock fishing grounds at different points during the period of analysis.

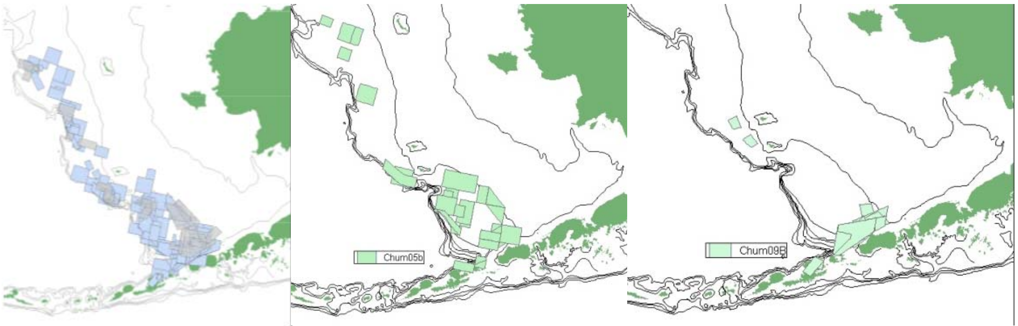



Figure 5-86. RHS B Season Closures 2003-2011 (left), 2005B (center) and 2009B (right)

As described in section 2.1.2, the rolling hotspot program serves both informational and regulatory functions. If vessels perceive a strong enough incentive to avoid chum PSC, there would be little necessity for the *regulatory* function of hotspot closures, because vessels would avoid fishing in locations where they would expect to have high PSC.

Under the existing system, the direct costs of high chum PSC – and the benefits of avoiding chum PSC – are not born by the individual vessels or companies and some vessels have had much higher chum bycatch rates than others, in part due to their choices to fish in areas where there have recently been high PSC hauls. As well as informing vessels about where bycatch rates are high, the hotspot system restricts vessels from fishing in what have recently been the highest bycatch areas, thus providing a dynamic means to regulate chum PSC in the fishery.

This analysis attempts to address the following questions. Has chum salmon been reduced by the RHS system, and if so, how much chum salmon has been avoided beyond what would have occurred without the system?

In order to evaluate these questions, we first need to identify the mechanisms though which the RHS hotspot system could lead to salmon bycatch reduction. The primary mechanisms include:

1. Closing an area causes vessels in an area to move to other areas, hopefully with lower bycatch
2. The awareness by vessel operators that an area may be closed could lead to a reduction in fishing effort in the soon-to-be closed area immediately prior to the closure.
3. Preventing additional fishing from occurring in the area during closure periods by other vessels after the closure is put in place.

The mapping and information sharing that is part of the system (as described in Section 2.1.2also facilitates more informed decision-making, though how this affects behavior is difficult to measure.

### 5.3.1.2 Overview of Status Quo Analysis

This portion of the overall analysis considers the status quo chum measures, with primary attention to the RHS program. Previous analysis had focused upon identifying reductions in chum PSC following the implementation of the VRHS. A key challenge to evaluating the total salmon avoided through the RHS program is extending the analysis to understand estimate what the total savings might be from the RHS program. We observe chum PSC levels of the current system, but to calculate the savings relative to what would have happened without the closures, it's necessary to estimate what chum PSC levels would have occurred in the parallel universe without the RHS closures.

Unfortunately, such a control group universe doesn't exist, so we have turned to evaluating the behavior of the fleet and the persistence of chum PSC prior to the first implementation of the RHS system in 2001. The benefit of examining this period is that it allows us to apply closure rules similar to the RHS system and then to observe the actual fishing in the "closures." Details are explained below, but this approach allows an estimation of "salmon saved" and an exploration of the impacts of different characteristics of the closure system on its effectiveness.

The goal is to provide a better understanding of how much salmon was saved and how much is likely to be saved per year in the future. Additionally, following the Council's June 2010 motion, we consider the potential factors that could be adjusted to potentially improve the effectiveness of the chum RHS system. This portion of the analysis is organized as follows:

- Description of status quo data
- Summary statistics about the RHS system
- Examination of daily chum PSC rates
- Examination of impacts of the RHS system on chum bycatch levels following closure implementation
- Presentation and discussion of pre-RHS chum bycatch analysis
- Consideration of the Salmon Savings Areas
- Examination and discussion of Amendment 91 Chinook measures
- Discussion of other features of the RHS System
- Possible adjustments of the RHS system to improve its effectiveness
- Presentation of summary findings
- Appendix 3: RHS B-Season Closure Periods 2003-2009.

#### *5.3.1.2.1 Data for the status quo analysis*

The data for this part of the analysis consists of the SeaState RHS reports that have been converted to an ArcGIS shapefile. The data from 2003-2006 was provided by SeaState in a tabular format for earlier Council analysis of the rolling hotspot program. Since 2006, twice-weekly SeaState reports have been provided to NMFS and Council staff and the coordinates and dates from these reports were used to define the RHS closures. The same observer data that is used in identifying potential fixed closures is used to evaluate the amount of pollock catch and PSC that occurs in each area. In summary tables in this document, the data is extrapolated from the observer data to match the NMFS Alaska Region totals in the summary table of all closures. Where appropriate such as when examining rate changes in and out of areas, the analysis is conducted with the non-adjusted numbers.

There is some ambiguity in how to define what constitutes a closure or closure period. Multiple closures (up to 3) may be in place at any time and a closure may be extended or modified on Monday or Thursday of each week when sufficient PSC is present. Here a closure is defined as an area that is closed for some length of time – if a closure is in place for 2 weeks then it is recorded as one closure that lasts 14 days. If a closure changes shape then it is designated as a new closure. The goal of defining the closures in this manner is to allow analysts to assess the impact of closures being imposed, while at the same time minimizing double counting of sequential and overlapping closures.

### *5.3.1.2.2 Rolling hotspot (RHS) summary information*

This section of the analysis provides summary information on B-Season RHS closures and data on Chum bycatch rates before and after the closure implementation. The following tables show the number of closures implemented per year since closures were first imposed beginning in 2001. To be consistent with the other data used in this analysis and because the RHS program was in a developmental phase for 2001-2002, the focus of the analysis here is 2003-2010, with some updated information included for 2011. RHS closures are designated as "Chinook" or "chum" closures, with different rules applying to each according to the terms of the inter-cooperative agreement (ICA). Beginning in 2011, the functioning of the RHS for Chinook is part of the IPAs of the different sectors and will be described in the IPA reports to the Council.

Table 5-56. Number of B-Season Closures and Average Length of Closures (days) by Closure Type

| Year | Total Closures | Days (avg) | Chum Closures | Days (avg) | Chinook Closures | Days (avg) |
|---|---|---|---|---|---|---|
| 2001 | 22 | 6.91 | 22* | 6.91 | * | * |
| 2002 | 20 | 7.00 | 20* | 7.00 | * | * |
| 2003 | 22 | 6.64 | 22* | 6.64 | * | * |
| 2004 | 22 | 6.55 | 22* | 6.55 | * | * |
| 2005 | 38 | 4.13 | 37* | 4.14 | 1 | 4.00 |
| 2006 | 36 | 4.94 | 23 | 4.65 | 13 | 5.46 |
| 2007 | 34 | 5.68 | 17 | 5.76 | 17 | 5.59 |
| 2008 | 14 | 8.36 | 9 | 9.00 | 5 | 7.20 |
| 2009 | 21 | 6.71 | 14 | 7.50 | 7 | 5.14 |
| 2010 | 20 | 6.45 | 11 | 6.64 | 9 | 6.22 |
| 2011 | 36 | 6.17 | 36 | 6.17 | ? | ? |

* Note that closures for 2001-2004 are assumed to be chum Closures based on chum rates and pers. comm. with Karl Haflinger about their general timing, while later closures are reported as Chum closures in SeaState reports. Several of the closures in 2003 & 2004 that are designated as chum may be Chinook closures. Chinook IPA-related closure data for 2011 will be included after IPA reports are presented to the Council.

The number of days per month that closures were in place increased with rising Chinook and chum PSC in the middle of the last decade but has remained high through most of the fishing season in 2008-2011 (Table 5-56).

The concentration of pollock and salmon PSC in the closures prior to their being closed gives an indication of how much of pollock fishery effort is directly impacted by the imposition of the closures because vessels were in the areas in the 5-day time period prior to the closure (Table 5-57). However, many of these vessels had already left the area when the closure was imposed, while additional vessels might have visited those areas during the closure periods if the areas had not been closed.

Vessels that fished in a closure area before the closure also fished elsewhere to differing degrees by year and sector (Table 5-58). This illustrates that, because of the high degree of movement in the pollock fishery, most vessels typically catch only a portion of their pollock in a closure area prior to closures being implemented. Vessels that are members of cooperatives with low bycatch rates relative to the "base rate" (as defined in the ICA) qualify as Tier 1 or Tier 2 Vessels. Tier 1 cooperative vessels do not have to leave chum closures while Tier 2 vessels are prohibited from fishing the RHS closures for the first 3 days of each 7-day period beginning at 6pm on Tuesday, even if the area closed changes on Thursday. Tier 3 vessels are prohibited from fishing in closures for 7 days. Nonetheless, vessels will often leave the closure areas because either it is the end of their trip, fishing conditions have changed, or in some cases vessel operators report leaving areas because of their concern about high PSC in the area. In the summer, the tier system has applied only to chum PSC—all Chinook closures apply to all vessels from 2003-2010.

The tier system provides some incentive to vessels to have lower bycatch rates so that they will be in Tier 1or 2 and therefore be allowed to fish in the closure areas. It is hard to quantify the value of being able to stay in an area when it's closed to other vessels, but at times it may be quite valuable. However, the fact that many closure areas have no fishing in them even when some cooperatives are in Tier 1 and Tier 2 suggests that, in those cases, the value of fishing in the closures is not larger than the value of fishing out of the closure areas. It is possible that in some cases some vessels may be avoiding the area out of concern about higher PSC, but if this happened all the time it would imply the tier system is unnecessary.

The Chum PSC rates of Tier 1 and Tier 2 vessels legally fishing inside of RHS closures after they are implemented shows that approximately 5 percent of CV fishing occurred in the B season closures during the time closures were in place, while less than 1 percent of the fishing for other sectors occurred in the closures (Table 5-59). In many cases this small percentage of effort by CP/MS vessels may be the result of the hotspot closures being located in the CVOA. The average Chum PSC rate for 2003-2010 for Tier 1 & 2 vessels fishing inside closures was 0.47 chum/t. At the same time, the rate outside the closures was 0.65. For other sectors, the Chum PSC rate was 0.23 inside versus 0.9 outside. For Chinook PSC, the average rate for CVs fishing in the closures over the period was 0.086 versus 0.082 outside. For other sectors, the rate was 0.03 versus 0.10. The relatively small amount of fishing that occurs in the areas can make these rates quite variable from year to year.

Table 5-57. Days per Month with Chum or Chinook Closures in Place, 2003-2011

| Year | June | July | Aug | Sept | Oct | Nov |
|---|---|---|---|---|---|---|
| 2001 | 2 | 13 | 15 | 30 | 31 | |
| 2002 | | 13 | 31 | 30 | 31 | 1 |
| 2003 | | 21 | 25 | 27 | 24 | |
| 2004 | | 30 | 31 | 15 | | |
| 2005 | 7 | 31 | 29 | 25 | 25 | |
| 2006 | 11 | 31 | 31 | 30 | 31 | |
| 2007 | | 23 | 31 | 28 | 31 | 2 |
| 2008 | | 28 | 29 | 27 | 29 | 1 |
| 2009 | 2 | 28 | 31 | 28 | 13 | |
| 2010 | 2 | 29 | 22 | 24 | 20 | 1 |
| 2011 | 14 | 31 | 31 | 30 | 29 | 1 |

Table 5-58. Average percent of total Chum, Chinook, and Pollock caught in RHS Closures during the 5 days before each closure, 2003-2010

| | Catcher Vessels | | | CPs/MS | | |
|---|---|---|---|---|---|---|
| Year | % Chum | % Chin | % Poll | % Chum | % Chin | % Poll |
| 2003 | 27% | 10% | 21% | 28% | 4% | 4% |
| 2004 | 33% | 9% | 8% | 23% | 4% | 3% |
| 2005 | 21% | 21% | 12% | 19% | 3% | 4% |
| 2006 | 19% | 28% | 9% | 15% | 1% | 1% |
| 2007 | 11% | 19% | 7% | 30% | 22% | 5% |
| 2008 | 29% | 52% | 11% | 2% | 6% | 0% |
| 2009 | 33% | 18% | 13% | 9% | 18% | 2% |
| 2010 | 33% | 47% | 9% | 13% | 35% | 2% |

Table 5-59. For Vessels that fished in the RHS during the 5 days before closures, % of their pollock caught in the RHS Area during that 5 day period by Sector and Year

| Year | CV<br>% in RHS | CP/MS<br>% in RHS |
|---|---|---|
| 2003 | 49% | 28% |
| 2004 | 37% | 17% |
| 2005 | 45% | 30% |
| 2006 | 39% | 17% |
| 2007 | 45% | 31% |
| 2008 | 63% | 15% |
| 2009 | 51% | 26% |
| 2010 | 57% | 17% |

Table 5-60 Activity inside RHS Closures by Tier 1 & 2 Vessels, 2003-2010.

| Year | CV | % Chum In | Chum In RHS | Chum Out RHS | Chum Rate In | Chum Rate Out | % Pollock In | Pollock In (t) | Pollock Out (t) |
|---|---|---|---|---|---|---|---|---|---|
| 2003 | CV | 5.2% | 4,445 | 80,887 | 0.168 | 0.433 | 14.1% | 26,394 | 186,616 |
| 2004 | CV | 2.7% | 4,161 | 148,498 | 0.573 | 0.875 | 4.3% | 7,261 | 169,661 |
| 2005 | CV | 1.4% | 5,644 | 384,980 | 0.990 | 1.812 | 2.7% | 5,700 | 212,409 |
| 2006 | CV | 2.3% | 3,696 | 158,589 | 1.673 | 0.634 | 0.9% | 2,209 | 250,166 |
| 2007 | CV | 13.1% | 4,061 | 26,921 | 0.751 | 0.170 | 3.4% | 5,405 | 158,011 |
| 2008 | CV | 13.6% | 710 | 4,506 | 0.154 | 0.039 | 4.0% | 4,600 | 115,060 |
| 2009 | CV | 19.6% | 4,076 | 16,699 | 0.654 | 0.183 | 6.8% | 6,229 | 91,107 |
| 2010 | CV | 12.0% | 542 | 3,955 | 0.688 | 0.043 | 0.8% | 788 | 92,820 |
| 2003 | CP/MS/CDQ | 0.8% | 290 | 35,311 | 0.133 | 0.108 | 0.7% | 2,177 | 326,201 |
| 2004 | CP/MS/CDQ | * | * | 64,513 | 0.935 | 0.187 | * | * | 344,340 |
| 2005 | CP/MS/CDQ | 1.5% | 898 | 58,923 | 0.817 | 0.142 | 0.3% | 1,100 | 414,048 |
| 2006 | CP/MS/CDQ | 0.0% | | 18,985 | - | 0.040 | | | 473,228 |
| 2007 | CP/MS/CDQ | 1.3% | 396 | 30,142 | 0.117 | 0.085 | 1.0% | 3,394 | 353,850 |
| 2008 | CP/MS/CDQ | 0.5% | * | 1,900 | * | 0.007 | * | * | 255,459 |
| 2009 | CP/MS/CDQ | 0.1% | 4 | 4,747 | 0.023 | 0.025 | 0.1% | 171 | 193,012 |
| 2010 | CP/MS/CDQ | 1.6% | 35 | 2,142 | 0.059 | 0.014 | 0.4% | 602 | 155,534 |
| 2003-10 | CP/MS/CDQ | 0.8% | 1,709 | 216,663 | 0.225 | 0.086 | 0.3% | 7,587 | 2,515,671 |
| Avg/Total | CV | 3.2% | 27,336 | 825,035 | 0.467 | 0.647 | 4.6% | 58,585 | 1,275,850 |

### *5.3.1.2.3 Evaluating and quantifying impacts of the RHS system*

How many total chum that are avoided because of closure areas? The amount of salmon saved or avoided is equal to the PSC that would have resulted if vessel operators had fished in a closed area minus what actually occurred when the vessels fished outside of the closures.

Some RHS closure areas are extended multiple times, for periods up to several weeks in duration. A particularly challenging part of this analysis is the estimation of how much salmon would have been caught if fishing had occurred inside of the closed areas when closures were in place for longer time periods. An additional challenge is that because this method of analysis examines changes relative to when closures are implemented, it's possible that high PSC never occurred so there's no change to pick up in a statistical analysis. However, an examination of historical PSC patterns suggests that the magnitude of this type of bycatch reduction is unlikely to be very large.

The analysis of the closures below suggests, as one would expect, that the largest benefit of the closures, on average, accrues immediately following closure implementation.

There are in1herent limitations in analyzing precisely how well the RHS system works at any given time. There were times when closures were put in place or left in place for long periods where there may have been substantial salmon avoided or saved but there is no way to demonstrate this beyond looking at average variation in the fishery. Importantly, there may be disproportionate gains in just a few of the highest bycatch periods that are not well-measured by the examination of all of the closure areas via averaging. However, there are also other times when average methods may over-estimate bycatch that would have occurred, either because salmon bycatch rates or fishing activity in an area would have declined even without the closure. Similarly, as with fixed closures, hotspot closures may, at times, cause vessels to choose to fish in areas that turn out to have higher bycatch than if they had remained in the closure.

#### *5.3.1.2.4 The impact of RHS closures on observed PSC levels*

Figure 5-84 displays the observer-derived chum PSC rates, by day for 2003-2010. The vertical lines in the figures represent days when RHS "chum" closures were implemented. The figures are intended to provide a sense of the day-to-day variation in chum salmon PSC in the fishery from 2003-2010. Note that the scale varies from year to year among the diagrams so a spike in 2005 many more chum than a spike in 2009.

Examining these figures gives several impressions. First, in both high- and low-PSC years, there are periods with relatively high and very low PSC. There are several times a year where there are days with much higher PSC than any other neighboring days. Typically chum PSC rates fall quickly from peak values. This rapid fall from peak values is also visible when observing PSC rates in the 1990s before RHS closures were utilized. The variations do not show whether or not the closures are effective, but illustrate the highly variable nature of chum PSC from day to day. Anecdotal observations of chum PSC rising or falling dramatically are not a sound basis for judging the efficacy of the RHS system.

To evaluate the success of the hotspot system, we estimate the change in the overall PSC rate for the entire fishery at the time that closures are implemented relative to the period immediately prior to the closures being implemented. This analysis draws upon a literature in economics and statistics called regression discontinuity design that focuses on evaluating the effectiveness of different programs (e.g., Thistlewaite and Campbell (1960), Davis (2008), and Lee and Lemieux (2009)). There is an extensive and active literature in economics, statistics, and other fields that is still expanding this methodology, but the basic idea is that we can focus upon the change near to closures to isolate the effect of a policy measure, in this case the imposition of the RHS closure areas. By examining the PSC rates in the days right before and right after closures have been implemented, we are able to focus on the impact of the closures in changing the PSC rates.

It should be noted that there are some limitations to this approach. First, attributing the effectiveness of the RHS system to the overall change in PSC rate may not always account for seasonality, short-term trends in the fishery, or potentially high-PSC areas that have been avoided. In periods of increasing PSC, a hotspot closure might dramatically reduce PSC relative to what would have occurred; however, due to the movement of chum salmon the rate after a given closure might nonetheless be higher than prior to the closure. If we focus on period right around closures, we can still attempt to measure the change in chum PSC that occurs when closures are implemented.

### *5.3.1.2.5 Before-after RHS closure comparison of changes in average chum PSC rates*

The changes in chum PSC that resulted after B-season closures are estimated by use of PSC data before and after all of the closure periods.[44] These changes are estimated for each closure *period* rather than each closure area to minimize double-counting. If two closures are in place at the same time, the salmon and pollock inside either closure are totaled and considered to be inside the closure area and the salmon and pollock caught outside of the areas are considered outside.

While there are long-term trends of PSC within a season that may be impacted by closures that this analysis addresses by examining the pre-RHS period, it is difficult to separate these seasonal trends from the repeated “treatments” imposed by the RHS closures when RHS closures are in place. However, if the RHS closures are effective, there should on average be some visible impact on chum PSC when we compare the PSC rates immediately before and after the closures are implemented.

There is, on average, a drop in PSC rate in the days immediately following the implementation of RHS chum closures (Table 5-60). However, the standard deviations are large. A Mann-Whitney-Wilcoxon rank sum test indicates that the means of chum bycatch are different from one another in the 3 days following a closure. This is a non-parametric statistical test appropriate for unmatched data such as chum bycatch hauls before and after closures. However, comparing rates for the 5 days before and 5 days after is *not* statistically significant. This is consistent with the extreme value nature of these data, where some observations are many thousands and a large number of the hauls have zero salmon. In a number of cases, a change in closure location may have occurred 3 or 4 days before. Seasonal factors such as changing pollock and PSC conditions could dilute the impact of the RHS closures over this longer timeframe.[45]

[44] Additionally, we limit the analysis to all closure periods in which there was a least one chum bycatch closure in place (i.e., not periods with only Chinook closures).

[45] Because of concerns that extrapolated bycatch data could change these results, we conduct the analysis here on the non-extrapolated or raised chum and pollock data. The extrapolated data and results are not dramatically different from these.

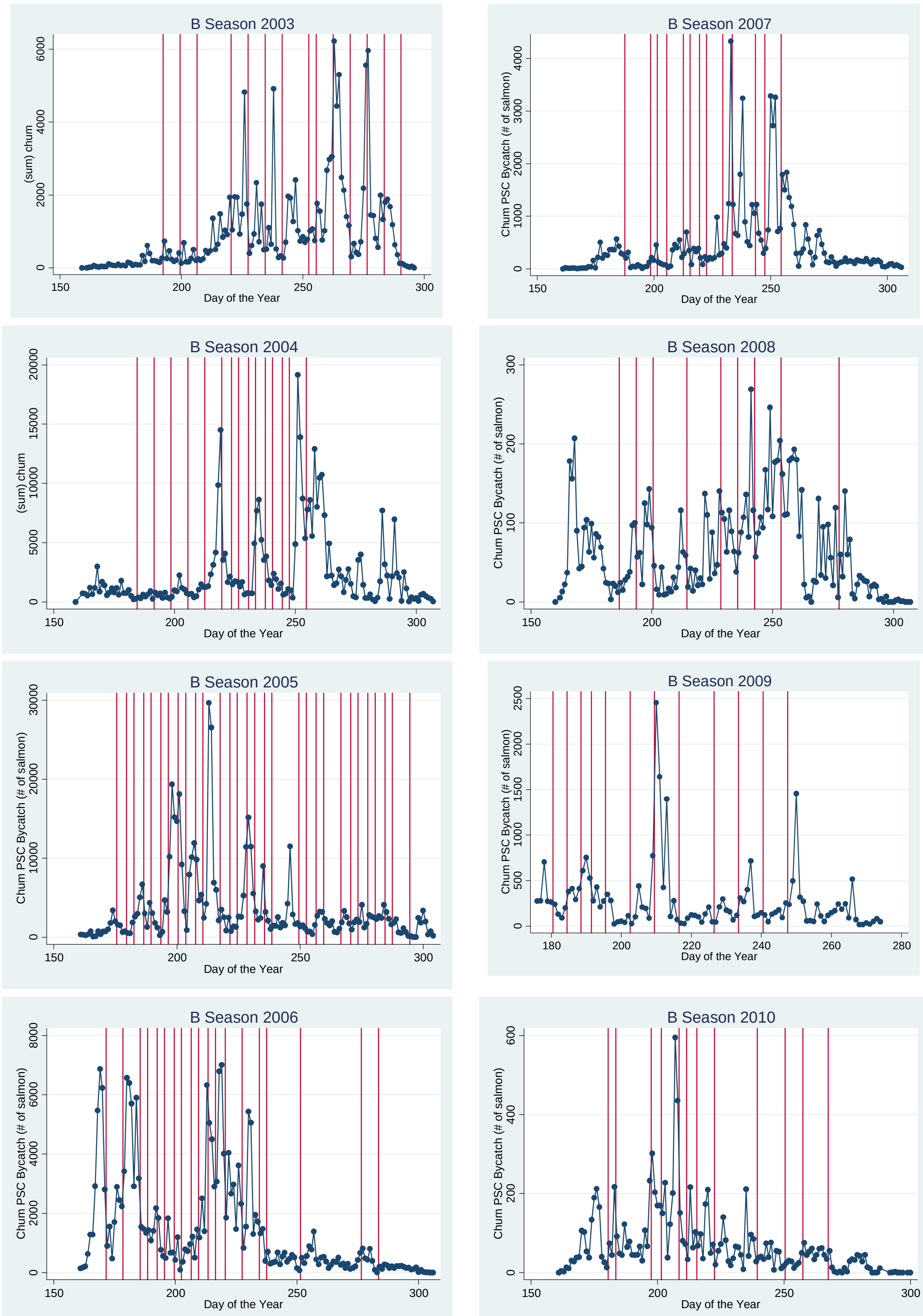



Figure 5-87. Chum PSC by day of the year, B-Seasons, 2003 – 2010. Vertical lines represent days a closure took place.

Table 5-61. Average chum PSC rate for the 5 days before and after Chum RHS closure periods, 2003-2010 B Seasons. Note that the negative numbers represent the days before the closures, with "-1," for example, representing hauls deployed from 0 to 24 hours before the closure was put in place.

| | | Mean Chum rate | Std. Dev. | Hauls |
|---|---|---|---|---|
| Days Before Closure | -5 | 0.393 | 1.71 | 8,902 |
| | -4 | 0.464 | 2.11 | 8,984 |
| | -3 | 0.412 | 1.72 | 8,811 |
| | -2 | 0.38 | 1.48 | 8,754 |
| | -1 | 0.425 | 2.07 | 8,543 |
| Days After Closure | 1 | 0.355 | 1.82 | 8,743 |
| | 2 | 0.375 | 1.67 | 8,860 |
| | 3 | 0.394 | 1.72 | 8,619 |
| | 4 | 0.465 | 1.98 | 8,861 |
| | 5 | 0.416 | 1.77 | 8,728 |
| | Total | 0.408 | 1.81 | 87,805 |

In light of there being evidence that the closures are effective, one test of robustness is to counter-factually assume that the closures were implemented 1-2 days before or after each actual closure and assess whether there is a measurable impact. This assesses whether the observed chum PSC reductions might be "false positives." In all cases, there is no statistically observable difference in chum PSC when the wrong break day is assumed. This is strong evidence that the observed impact measured at the time of closure implementation is due to the presence of closure areas.

Figure 5-85 displays the average chum PSC rates for the three days before and after chum closures are implemented. The pre-RHS analysis, below, provides a means to estimating the total salmon saved. Details on this method are discussed below.

Table 5-61 shows the most dramatic reductions observed after RHS closures appear to be in 2004 and 2006. However, the table also displays that there is no reduction on average in the days following closures for several days. Because there is on average 1/8 as much data at the annual level as in the aggregate comparison, several large increases in PSC after a closure have a larger impact on the results. Additionally, in low chum PSC years there are fewer closure periods so the impacts of any extreme event would be magnified in this table.

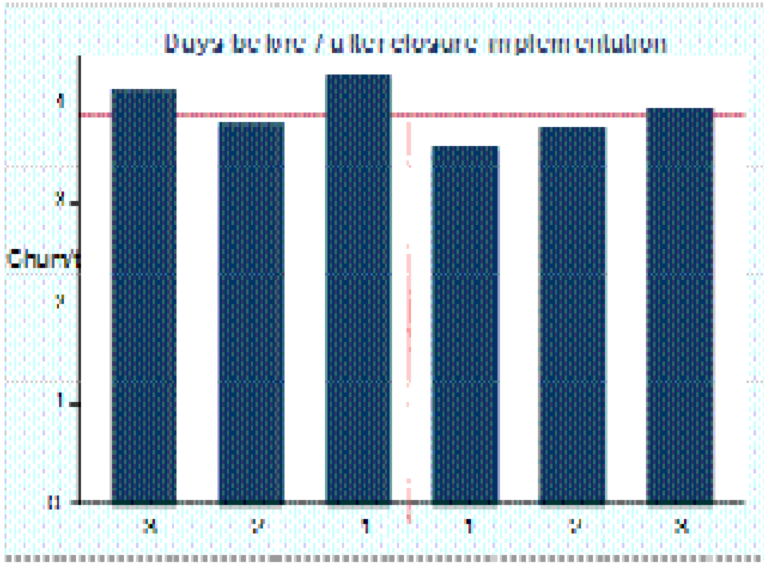


Figure 5-88. Chum PSC / MT Before & After Closures Implementation, 2003-2010

Table 5-62. Average chum PSC rate for the 3 days before and after Chum RHS closure periods, Individual Years, 2003-2010

| | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Days Before/ After RHS | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Total | Average |
| -3 | 0.239 | 0.486 | 0.863 | 0.497 | 0.141 | 0.03 | 0.104 | 0.058 | 0.439 | |
| -2 | 0.254 | 0.386 | 0.782 | 0.529 | 0.128 | 0.059 | 0.095 | 0.056 | 0.403 | |
| -1 | 0.285 | 0.465 | 0.841 | 0.544 | 0.176 | 0.053 | 0.127 | 0.054 | 0.453 | 0.406 |
| 1 | 0.39 | 0.311 | 0.713 | 0.351 | 0.147 | 0.066 | 0.192 | 0.035 | 0.379 | |
| 2 | 0.227 | 0.386 | 0.754 | 0.423 | 0.133 | 0.027 | 0.205 | 0.125 | 0.393 | |
| 3 | 0.242 | 0.418 | 0.822 | 0.473 | 0.199 | 0.033 | 0.142 | 0.033 | 0.419 | 0.375 |
| Total | 0.273 | 0.408 | 0.796 | 0.467 | 0.154 | 0.045 | 0.144 | 0.06 | 0.39 | |

### 5.3.1.3 Pre-RHS Examination of Chum PSC from 1993-2000

A major challenge of this evaluation is, of course, that it is unclear what levels of chum PSC would have occurred if there had been no RHS closures in place. From 2001-2010, one can observe how rates change around closures but it's impossible to observe how PSC behaves without the presence of closures. Therefore, to better understand chum PSC without closures the analysis examines the years from 1993-2000, prior to implementation of voluntary closures.

Figure 5-86 displays annual PSC catch 1993-2000 and Figure 5-87 shows the daily variation in Chum PSC from 1991-2002. The simulation concentrates on 1993-2000 because the hotspot program began in 2001.

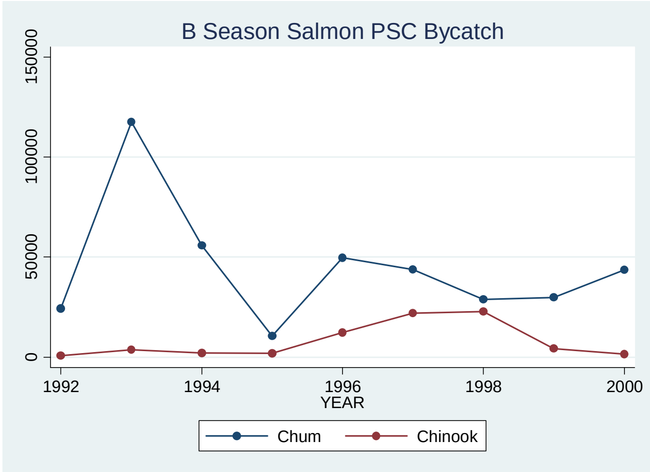



Figure 5-89. Salmon PSC catch by Bering sea pollock fishery, 1992-2000.

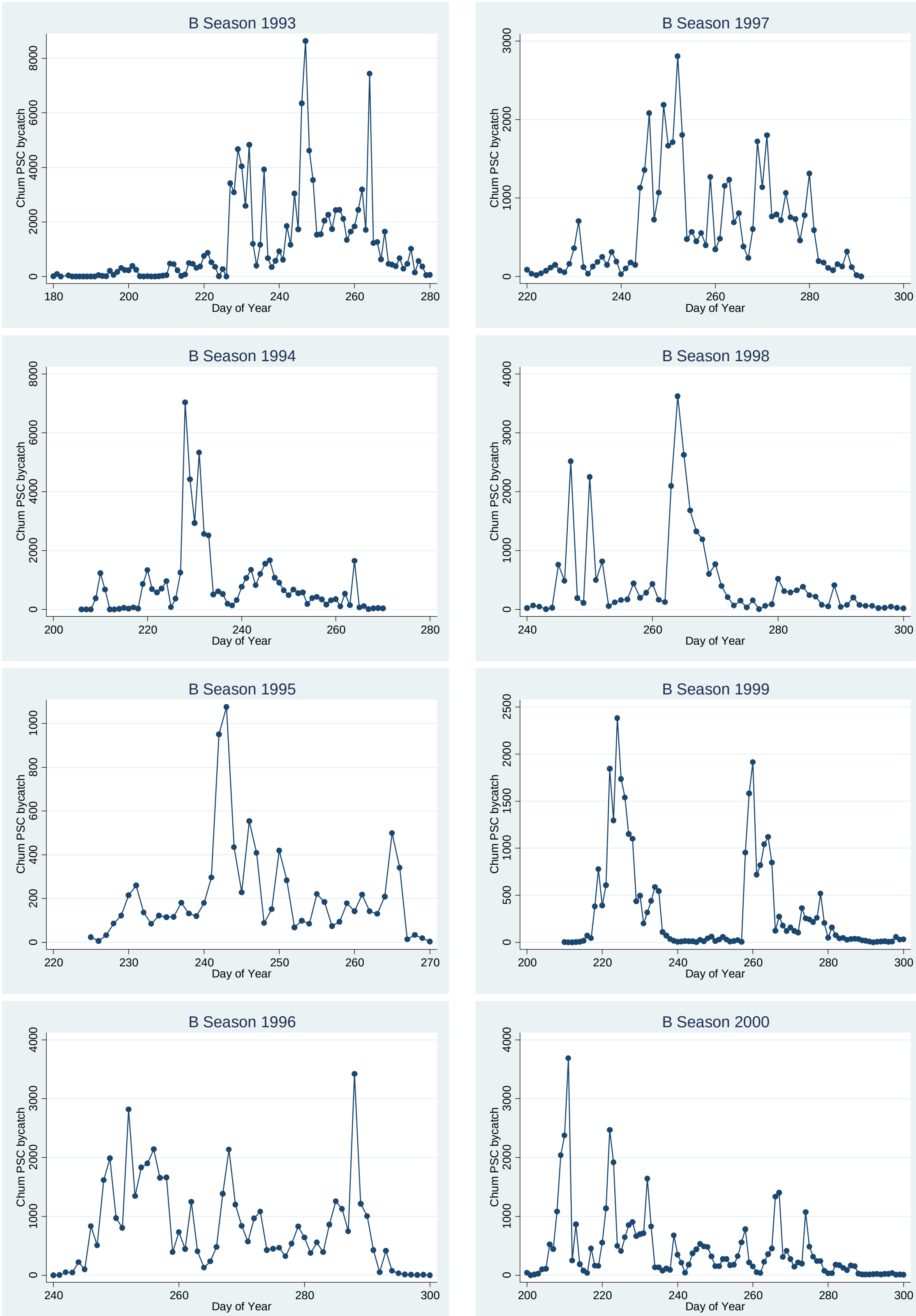



Figure 5-90. Daily chum salmon PSC in the Bering Sea pollock fishery, 1993-2000.

#### *5.3.1.3.1 Simulation of hotspot closures from 1993-2000*

Hypothetical closures were imposed on the observed fishery data from 1993-2000 using rules similar to the current RHS procedures. The advantage of using data from this period is that they are unaffected by closures. This complements the information gained from examining the current RHS system because reactions to actual closures were observed and a statistically significant reduction in chum PSC following the closures were apparent. Analysis of the earlier pre-RHS system allows estimation of season-long impacts of hypothetical RHS-like closures. So as to limit confusion with the existing RHS system, the model of the RHS closure applied to the earlier data will be referred to as the PRHS system (for pre-RHS or pseudo-RHS system).

The PRHS hotspot simulation method required developing a model that attempted to mimic the current RHS system while at the same time provided opportunities to evaluate alternative parameters including:

- The number of ADF&G statistical areas that are closed
- The number of days that closures are imposed at a time
- The threshold or “base” rate that triggers closures
- The proportion of pollock that must be in an area for it to warrant closure
- The number of days used to decide on which area(s) should be closed. SeaState flexibly adjusts this parameter but several were considered to examine sensitivity.
- The “information lag” between when information is available and when closures are imposed. This allows for the assessment of whether delays in information impact closure effectiveness.
- The day that closures are imposed (3 different days at start of season). Averaging over 3 starting days provides information about the uncertainty involved in the timing of closures, because closures can appear to do better or worse depending on how they fall relative to really large PSC events.

Three model configurations (which were averaged over a range of parameters) were labeled as “baseline,” “high end,” and “low end” (Table 5-62). The baseline PRHS configuration was intended to be most comparable to RHS program and the other configurations are included for sensitivity. Allowing the day that the first closures are implemented to vary provides some stochasticity in the application and reduces the chance that random high-bycatch days occurring before or after a closure do not drive the estimated effectiveness of the closures.

The logic behind choosing the sets of PRHS control parameters was as follows:

***Statistical areas closed:*** 1-2 chum areas are designated in the real RHS, but the areas are more targeted and typically smaller than these closures.

***Days of closures:*** 3, 7, and 12 day closures are considered. The RHS closures are put in place for 3 days and most commonly extended, but then are occasionally extended for 1-3 additional weeks if they appear to be effective.

***Base rate:*** variations in the base are evaluated below, but the models average over base rates of 0.06 and 0.19.

***Information Lag***: Sea State reports are issued approximately 1 ¼ days before they go into effect, so information is always that old, but is typically longer given the delays in reporting of shore-based deliveries.

***Days to use in decision***: the choices here provide some variety in the information used in implementing the closures.

***Starting day***: this shifts when closures start by 0, 1, or 2 days (averaged over the random possibilities of when closures begin).

Table 5-63. Description of baseline, high-end, and low-end models to evaluate the RHS for the period 1993-2000.

| | Model 1 | Model 2 | Model 3 |
|---:|---:|---:|---:|
| Model Name | Baseline | High-end | Low-end |
| Stat Areas closed | 1 or 2 | 2 | 1 |
| Days of closures | 3 or 7 | 3 | 3 or 7 or 12 |
| Base rate | 0.06, 0.19 | 0.06, 0.19 | 0.19 |
| Min pollock proportion | 0.02 | 0.02 | 0.02 |
| Information lag | 2 or 3 | 2 | 3 |
| Days to use in decision | 3, 4, 5 | 3, 4, 5 | 3,4,5 |
| Starting day | 0, 1, 2 | 0, 1, 2 | 0,1,2 |
| # of Closures per year (Avg) | 16.7 | 23.7 | 11.6 |
| Parameter combinations | 192 | 36 | 24 |

### *5.3.1.3.2 Pre-RHS hotspot simulation results*

Results are presented around a number of questions of interest for each suite of control parameters listed in Table 5-62.

*Do these hotspot closure reduce chum PSC?*

For the wide range of closure variables presented here, the net impact of almost any combination of closures is some average reduction in chum PSC. The annual and total average reduction in chum PSC resulting from the high, baseline, and low impact models are displayed in Table 5-63. The baseline model estimates 14.5 percent of chum would have been avoided with a RHS-like system in place from 1993-2000. The annual variation in average benefits is 4-28 percent, though in some PRHS configurations, the annual benefits may be close to zero or larger than the averages. Results indicate that the hypothetical PRHS system would have reduced chum PSC.

*How much pollock is moved by the hotspot closures?*

Table 5-64 displays the average amount of pollock relocated per year under the three different models. Under the different models, 4-10 percent of pollock would have been relocated in the historical RHS simulation.

*How do the hotspot closures impact Chinook PSC?*

On average, there is considerable savings in the historical simulations in Chinook PSC from an effort targeting chum PSC. During 1993-2000, targeting chum alone in designating hotspot closures appears to significantly reduce Chinook bycatch as well, with the baseline model estimating a 10 percent reduction. The average annual Chinook PSC was much lower from 1993-2000 than from 2003-2010 (Figure 5-86). It's hard to know how this is likely to affect Chinook reduction in years like 2007, though it is notable that the average reductions in Chinook from hypothetical PRHS closures are actually greater in the highest years (1996-1998) of the early period.

*How does closure size impact average chum PSC reduction?*

For the baseline PRHS configuration, more chum PSC are avoided with larger closures (Table 5-66 and Figure 5-88). However, as the number of closures exceeds three statistical areas, the benefits diminish while the amount of pollock relocated continues to increase. Also, with large closure areas uncertainty on how vessel operators will react increases.

Table 5-64. Percent chum reduced per year with different with different PRHS configurations, 1993-2000.

| | Baseline | | High-end | | Low-end | |
|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| 1993 | 0.147 | 0.062 | 0.237 | 0.028 | 0.087 | 0.04 |
| 1994 | 0.132 | 0.053 | 0.206 | 0.044 | 0.104 | 0.044 |
| 1995 | 0.044 | 0.025 | 0.048 | 0.025 | 0.043 | 0.035 |
| 1996 | 0.147 | 0.116 | 0.238 | 0.049 | 0.076 | 0.052 |
| 1997 | 0.133 | 0.049 | 0.172 | 0.024 | 0.085 | 0.027 |
| 1998 | 0.123 | 0.071 | 0.198 | 0.032 | 0.069 | 0.045 |
| 1999 | 0.159 | 0.06 | 0.245 | 0.063 | 0.077 | 0.056 |
| 2000 | 0.277 | 0.098 | 0.404 | 0.045 | 0.167 | 0.091 |
| Total | 14.5% | 0.093 | 21.9% | 0.101 | 8.9% | 0.062 |

Table 5-65. Percent pollock reallocated per year with different with different PRHS configurations, 1993-2000

| | Baseline | | High-end | | Low-end | |
|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| 1993 | 0.081 | 0.034 | 0.122 | 0.013 | 0.054 | 0.02 |
| 1994 | 0.088 | 0.046 | 0.128 | 0.02 | 0.065 | 0.039 |
| 1995 | 0.039 | 0.02 | 0.043 | 0.019 | 0.035 | 0.027 |
| 1996 | 0.066 | 0.029 | 0.095 | 0.009 | 0.04 | 0.013 |
| 1997 | 0.087 | 0.043 | 0.127 | 0.018 | 0.048 | 0.021 |
| 1998 | 0.063 | 0.026 | 0.081 | 0.017 | 0.039 | 0.016 |
| 1999 | 0.038 | 0.022 | 0.058 | 0.025 | 0.013 | 0.006 |
| 2000 | 0.09 | 0.04 | 0.124 | 0.04 | 0.048 | 0.022 |
| Total | 6.9% | 0.039 | 9.7% | 0.038 | 4.3% | 0.026 |

Table 5-66. Proportion of Chinook PSC reduced per year with different PRHS configurations, 1993-2000.

| | Baseline | | High-end | | Low-end | |
|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| 1993 | 0.059 | 0.042 | 0.104 | 0.026 | 0.029 | 0.02 |
| 1994 | 0.115 | 0.054 | 0.156 | 0.026 | 0.083 | 0.053 |
| 1995 | 0.029 | 0.027 | 0.041 | 0.03 | 0.007 | 0.007 |
| 1996 | 0.144 | 0.092 | 0.214 | 0.022 | 0.077 | 0.033 |
| 1997 | 0.109 | 0.054 | 0.17 | 0.039 | 0.062 | 0.035 |
| 1998 | 0.125 | 0.043 | 0.169 | 0.034 | 0.094 | 0.035 |
| 1999 | 0.11 | 0.054 | 0.138 | 0.056 | 0.065 | 0.024 |
| 2000 | 0.075 | 0.045 | 0.096 | 0.051 | 0.033 | 0.024 |
| Total | 9.6% | 0.065 | 13.6% | 0.062 | 5.6% | 0.042 |

Table 5-67. Estimated annual chum PSC reduction from different size hotspot closures under the baseline PRHS system, 1993-2000.

Avg. % Chum reduced per year

| | Maximum number of area(s) closed | | | | | | |
|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1993 | 0.105 | 0.188 | 0.249 | 0.279 | 0.303 | 0.32 | 0.328 |
| 1994 | 0.089 | 0.162 | 0.215 | 0.226 | 0.24 | 0.255 | 0.259 |
| 1995 | 0.037 | 0.053 | 0.069 | 0.076 | 0.082 | 0.084 | 0.088 |
| 1996 | 0.098 | 0.281 | 0.379 | 0.442 | 0.472 | 0.49 | 0.494 |
| 1997 | 0.047 | 0.139 | 0.199 | 0.228 | 0.263 | 0.296 | 0.315 |
| 1998 | 0.075 | 0.152 | 0.187 | 0.202 | 0.21 | 0.217 | 0.22 |
| 1999 | 0.134 | 0.182 | 0.219 | 0.241 | 0.25 | 0.252 | 0.252 |
| 2000 | 0.246 | 0.308 | 0.33 | 0.349 | 0.356 | 0.357 | 0.358 |
| Total | 10% | 18% | 23% | 26% | 27% | 28% | 29% |

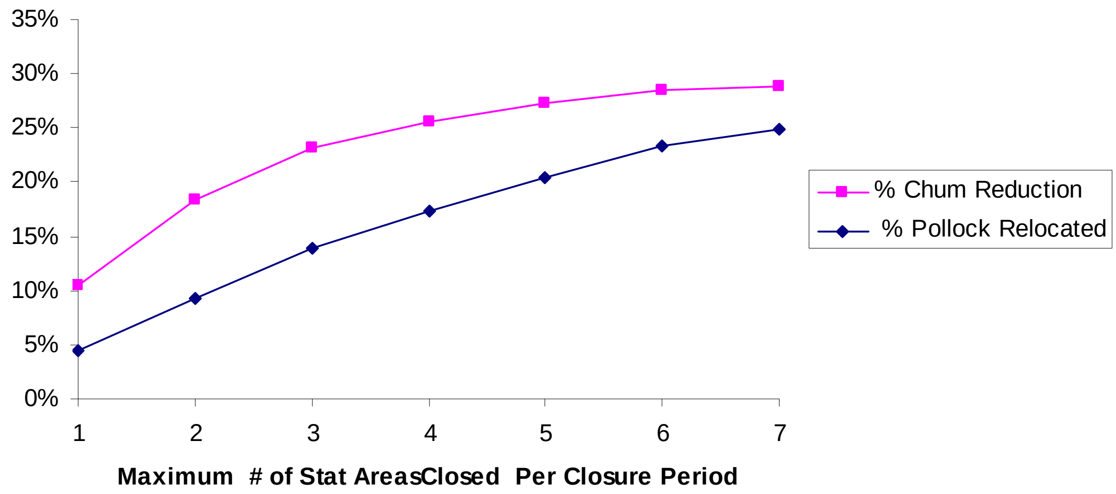



Figure 5-91. Percentage reduction in Chum bycatch and pollock reallocated with different sized closures.

*How does the base rate–the minimum chum PSC necessary to trigger a closure–impact the PSC?*
The baseline PRHS uses base rates of 0.06 and 0.19 chum/t but the model setup allows examining how average PSC changes under different base rates (Table 5-67**)**. Under the larger of the base rates examined, it is less likely to be in place when large PSC events occur.[46] Interestingly though, low base rates can at times cause more chum to be caught, as is shown for 1996 (Table 5-67). The lower reduction in this case occurs because closures are put in place that end up diverting vessels away from relatively low-PSC fishing. A super low base rate also adds costs through unnecessary reallocation of pollock effort.

[46] One caveat to note about the base rates here is that they are base on the recent window of data considered (which varies from 2-5 days), rather than the 3 weeks before.

Table 5-68. Average simulated chum PSC reductions for different base rates, for the baseline PRHS configuration, 1993-2000. Note that the base rate displayed is for the 2-5 day reference period of the model (not the 3-week window or the fixed annual level that has been features of the Sea State model).

| | Base Rate (short-term) | | | | | | |
|---|---|---|---|---|---|---|---|
| Year | 0.01 | 0.02 | 0.06 | 0.12 | 0.19 | 0.3 | 0.4 |
| 1993 | 0.147 | 0.147 | 0.147 | 0.146 | 0.146 | 0.136 | 0.135 |
| 1994 | 0.13 | 0.132 | 0.124 | 0.128 | 0.128 | 0.128 | 0.125 |
| 1995 | 0.087 | 0.069 | 0.051 | 0.044 | 0.029 | 0.027 | 0.017 |
| 1996 | 0.034 | 0.022 | 0.165 | 0.16 | 0.156 | 0.144 | 0.111 |
| 1997 | 0.104 | 0.104 | 0.104 | 0.103 | 0.099 | 0.095 | 0.085 |
| 1998 | 0.116 | 0.116 | 0.114 | 0.114 | 0.104 | 0.083 | 0.077 |
| 1999 | 0.198 | 0.197 | 0.168 | 0.157 | 0.143 | 0.128 | 0.124 |
| 2000 | 0.304 | 0.304 | 0.296 | 0.28 | 0.258 | 0.214 | 0.176 |
| Total | 0.140 | 0.136 | 0.146 | 0.141 | 0.133 | 0.119 | 0.106 |

*Is the minimum pollock requirement (2 percent of recent pollock) reasonable?*
Under the assumptions of this historical analysis, there is little impact from this choice with minimum pollock from 1-5 percent. Greater or less than this however, is considerably less effective.

*How does a time lag in using data to implement closures impact closure effectiveness?*
In order to choose which area(s) to close, recent data on bycatch are utilized. Sea State announces closures approximately 30 hours before they are put in place and there is typically a delay on inshore delivery information that can be several days, though there can also be instant communication between vessel operators and SeaState when vessel operators report observing many salmon being caught (K. Haflinger, pers. com.). The baseline model averages the results between a 2- and 3-day information lags, while the high-end model assumes a 2-day lag and the low-end assumes a 3-day lag. Figure 5-92 illustrates how the effectiveness of closures declines in a near-linear fashion as the information delay in information gets larger.

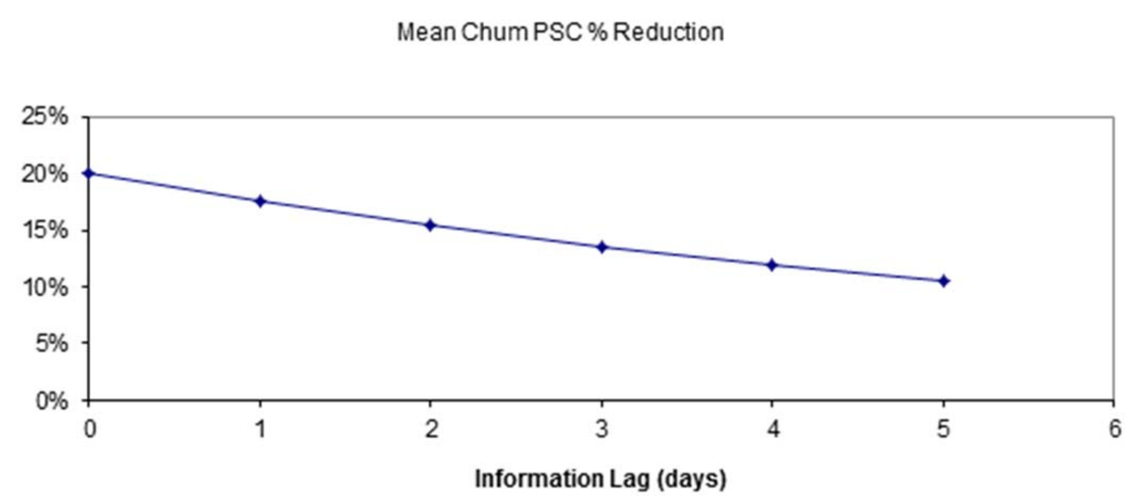



Figure 5-92. Impact on chum PSC reduction efficacy of a lag in information in implementing closures

##### *5.3.1.3.3 Caveats related to the PRHS analysis*

Several issues are worth noting about factors that potentially influence the estimated salmon reduction upwards, downwards, or in an unknown direction.

Features that have an unknown impact on the reduction estimates:

- *The smaller, targeted nature of the RHS closures.* On the one hand, the smaller closures can target hotspots that cross multiple statistical areas, but smaller areas are also closed in the current RHS system. .
- *AFA.* While this period was primarily before the American Fisheries Act (AFA), the daily bycatch variation in the fishery does not appear to have changed significantly. The RHS was only possible with intercooperative agreements (ICAs) after the AFA, but the impact on fishing behavior is unclear. The AFA allows vessels to travel further in search of more valuable fishing without losing a share of the total catch, but this has the potential to influence closure effectiveness in either direction.
- *The Steller Sea Lion Conservation Area (SCA Emergency Closure in 2000.* The highest reduction in the analysis occurred in this year, which catcher vessel effort was reallocated for much of this year.
- *Average Chinook and Chum PSC levels were much higher from 2003*-2010 than in the previous decade.

Features that could lead to an understatement of estimates of hotspot reductions:

- Sea State balances available information, historical experience, and predictions about how salmon are likely to move to implement closures, while these historical RHS-like closures uses a window of information in recent days to design closures.
- Unmeasured bycatch may occur because vessels may plan to start fishing outside of a RHS closure after it is announced, which is not accounted for in the historical RHS simulations.

Features that could lead to an overstatement of estimates of hotspot reductions:

- Bycatch rates are assumed to be the daily average rate for the sector on each day of relocation. Examining the bycatch rates from 2003-2010 of vessels that are moved out of RHS closures, they have higher than average rates. However, for CVs, an unknown portion of this increase is due to how salmon from a trip that starts and ends after a closure are divided between all hauls of a trip, so some portion of this different may be due to accounting.
- The areas closed by the simulation can be much larger at times than the RHS closures, especially when two high bycatch areas are closed in core catcher vessels fishing areas. The “low-end” estimate only closes one area to attempt to account for this.

#### 5.3.1.4 Vessel-level post-closure PSC changes

Assessing the effectiveness of the hotspot system based on subsequent bycatch rates of vessels that are forced from extremely high chum PSC areas has the potential to be misleading. Because bycatch has a random component that can be very large, one would expect to observe a “reversion to the mean” from extreme bycatch values in the data. Attributing all of the change from one period to the next when a closure is put in place following a high-PSC event may overstate the impact of the closure, because a closure by definition focuses on high-value hauls that at some point must come down. A visual examination of day-by-day PSC rates makes this point very clearly – the days with the highest PSC rates are typically much higher than even the days immediately before and afterward.

While the above measures account for the observed changes in PSC resulting from the RHS closures, closing an area also makes it unavailable to other vessels, so there is the potential for additional PSC to be avoided beyond the impact on the vessels that were fishing in an area prior to it being closed. The historical simulation attempts to capture these impacts.

One insight into the impacts of RHS closures comes from examining the PSC rates after the closures are put in place for vessels that were in closures before they were implemented. In the historical simulations and in the design of trigger closures, we assume that vessels reallocate effort proportional to their sector and receive the average bycatch. However, the following table suggests they are actually higher than average.

Table 5-69. Relative chum and Chinook bycatch rates of vessels that fished in RHS areas compared to those that did not, before and after RHS closures, 2003-2010

| | | Vessels NOT in clousure in 5 days before | | | | | | Vessels inside clousure in 5 days before | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | CV | Chum | Chin | PollWt | Duration | Chum Rate | Chin Rate | Chum | Chin | PollWt | Duration | Chum Rate | Chin Rate | Rate Ratio Chum Vessels in/out | Rate Ratio Chin Vessels in/out |
| 2003 | 0 | 25,599 | 3,314 | 215,914 | 9,587 | 0.12 | 0.02 | 3,094 | 544 | 32,759 | 1,493 | 0.094 | 0.017 | 0.80 | |
| 2004 | 0 | 47,614 | 3,530 | 290,799 | 12,528 | 0.16 | 0.01 | 9,484 | 362 | 57,648 | 2,282 | 0.165 | 0.006 | 1.00 | 0.52 |
| 2005 | 0 | 52,513 | 4,678 | 471,659 | 16,517 | 0.11 | 0.01 | 15,346 | 786 | 54,292 | 2,613 | 0.283 | 0.014 | 2.54 | 1.46 |
| 2006 | 0 | 12,859 | 864 | 393,263 | 17,753 | 0.03 | 0.00 | 2,439 | 63 | 22,422 | 1,008 | 0.109 | 0.003 | 3.33 | 1.28 |
| 2007 | 0 | 12,528 | 1,087 | 222,123 | 11,224 | 0.06 | 0.00 | 11,216 | 1,320 | 56,714 | 3,525 | 0.198 | 0.023 | 3.51 | 4.76 |
| 2008 | 0 | 811 | 156 | 117,060 | 10,234 | 0.01 | 0.00 | 3 | - | 2,264 | 240 | 0.001 | 0.000 | 0.19 | 0.00 |
| 2009 | 0 | 3,186 | 233 | 154,305 | 10,621 | 0.02 | 0.00 | 356 | 14 | 6,973 | 740 | 0.051 | 0.002 | 2.47 | 1.33 |
| 2010 | 0 | 2,089 | 35 | 122,142 | 5,508 | 0.02 | 0.00 | 235 | 4 | 13,443 | 1,093 | 0.017 | 0.000 | 1.02 | 1.04 |
| 2003 | 1 | 46,444 | 3,720 | 98,315 | 6,277 | 0.47 | 0.04 | 11,795 | 524 | 51,369 | 2,808 | 0.230 | 0.010 | 0.49 | 0.27 |
| 2004 | 1 | 113,920 | 3,588 | 149,157 | 11,235 | 0.76 | 0.02 | 38,562 | 1,135 | 32,798 | 2,724 | 1.176 | 0.035 | 1.54 | 1.44 |
| 2005 | 1 | 368,953 | 22,096 | 219,746 | 19,565 | 1.68 | 0.10 | 120,726 | 4,835 | 61,753 | 4,609 | 1.955 | 0.078 | 1.16 | 0.78 |
| 2006 | 1 | 93,970 | 5,127 | 146,398 | 12,582 | 0.64 | 0.04 | 64,825 | 911 | 44,142 | 4,770 | 1.469 | 0.021 | 2.29 | 0.59 |
| 2007 | 1 | 18,069 | 2,602 | 96,863 | 10,214 | 0.19 | 0.03 | 3,937 | 822 | 12,381 | 1,836 | 0.318 | 0.066 | 1.70 | 2.47 |
| 2008 | 1 | 2,010 | 481 | 56,480 | 8,060 | 0.04 | 0.01 | 541 | 72 | 4,688 | 927 | 0.115 | 0.015 | 3.24 | 1.80 |
| 2009 | 1 | 11,537 | 244 | 68,645 | 6,410 | 0.17 | 0.00 | 6,445 | 70 | 14,887 | 1,979 | 0.433 | 0.005 | 2.58 | 1.32 |
| 2010 | 1 | 2,550 | 536 | 70,181 | 5,511 | 0.04 | 0.01 | 383 | 55 | 9,019 | 982 | 0.042 | 0.006 | 1.17 | 0.80 |
| CPMS | | 157,199 | 13,897 | 1,987,264 | 93,972 | 0.08 | 0.007 | 42,173 | 3,093 | 246,516 | 12,994 | 0.171 | 0.013 | **2.16** | 1.79 |
| CV | | 657,453 | 38,394 | 905,784 | 79,855 | 0.73 | 0.042 | 247,214 | 8,424 | 231,038 | 20,636 | 1.070 | 0.036 | **1.47** | 0.86 |

*Does the effectiveness of RHS closures differ at high or low levels of PSC encounters?*

To provide insight into how bycatch changes from high to low conditions, here we examine the high chum bycatch year of 2005 in contrast with other years. An examination of the chum incidence rate and bycatch for all years for the shoreside, catcher/processor, and mothership sectors of the fishery is informative. The incidence rate is the proportion of time that there is any chum salmon in a haul/trip. [47] For example, an incidence rate of 0.95 means that 95% of the hauls/trips in the month encountered chum PSC. As shown in the table below, the incidence rate in 2005 for the shoreside sector remained near 1 for almost 2 months. During this time, it was extremely difficult to impossible to completely avoid chum salmon bycatch.

[47] For shoreside deliveries, salmon bycatch is only observed at the trip level, so all of the hauls in a trip have a positive incidence rate when salmon bycatch occurs in the trip.

Table 5-70. Chum Salmon Incidence and bycatch by week and year for shoreside CVs, 2003-2010

| Incidence Rate- Proportion of hauls with chum | | | | | | | | | Extrapolated Chum Bycatch | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Week | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Wk | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| 1 | | | 1.00 | | | 0.70 | 0.47 | 0.14 | 1 | | | 128 | | | 1,144 | 177 | 5 |
| 2 | 0.47 | 0.93 | 0.81 | 0.98 | 0.53 | 0.65 | 0.32 | 0.37 | 2 | 214 | 457 | 1,256 | 37,783 | 177 | 916 | 332 | 367 |
| 3 | 0.60 | 0.63 | 0.90 | 0.96 | 0.34 | 0.47 | 0.52 | 0.56 | 3 | 649 | 701 | 9,065 | 18,862 | 432 | 502 | 921 | 458 |
| 4 | 0.83 | 0.83 | 0.93 | 1.00 | 0.57 | 0.22 | 0.70 | 0.42 | 4 | 1,573 | 1,083 | 4,796 | 47,906 | 2,246 | 116 | 2,307 | 258 |
| 5 | 0.84 | 0.59 | 0.93 | 0.97 | 0.70 | 0.30 | 0.74 | 0.45 | 5 | 2,151 | 687 | 37,124 | 16,397 | 1,897 | 751 | 3,840 | 162 |
| 6 | 0.81 | 0.72 | 0.82 | 0.96 | 0.33 | 0.36 | 0.58 | 0.48 | 6 | 1,865 | 994 | 24,584 | 12,965 | 509 | 994 | 1,559 | 1,456 |
| 7 | 0.85 | 0.66 | 0.99 | 0.79 | 0.51 | 0.22 | 0.58 | 0.67 | 7 | 2,757 | 1,228 | 97,312 | 5,503 | 788 | 219 | 3,107 | 1,259 |
| 8 | 0.91 | 0.72 | 1.00 | 0.94 | 0.52 | 0.35 | 0.48 | 0.61 | 8 | 5,604 | 4,140 | 45,606 | 21,314 | 1,709 | 572 | 10,147 | 2,109 |
| 9 | 0.81 | 0.81 | 0.98 | 0.85 | 0.60 | 0.25 | 0.33 | 0.50 | 9 | 11,838 | 29,815 | 129,594 | 33,059 | 3,406 | 343 | 762 | 735 |
| 10 | 0.81 | 0.66 | 0.97 | 0.84 | 0.75 | 0.36 | 0.34 | 0.26 | 10 | 15,170 | 16,289 | 33,460 | 39,096 | 3,072 | 634 | 1,391 | 307 |
| 11 | 0.76 | 0.81 | 0.99 | 0.74 | 0.72 | 0.43 | 0.65 | 0.35 | 11 | 8,808 | 19,265 | 70,384 | 22,465 | 2,600 | 564 | 2,666 | 257 |
| 12 | 0.71 | 0.67 | 0.94 | 0.85 | 0.91 | 0.51 | 0.69 | 0.40 | 12 | 3,575 | 27,058 | 12,322 | 6,109 | 6,831 | 989 | 3,469 | 93 |
| 13 | 0.81 | 0.73 | 0.95 | 0.76 | 0.95 | 0.59 | 0.60 | 0.56 | 13 | 8,107 | 13,146 | 15,679 | 2,645 | 7,690 | 1,401 | 2,070 | 298 |
| 14 | 0.80 | 0.88 | 0.92 | 0.67 | 0.92 | 0.70 | 0.77 | 0.44 | 14 | 9,390 | 74,086 | 4,997 | 770 | 4,892 | 1,587 | 3,150 | 236 |
| 15 | 0.80 | 0.81 | 0.98 | 0.83 | 0.94 | 0.47 | 0.85 | 0.54 | 15 | 21,046 | 74,872 | 7,796 | 3,926 | 10,005 | 289 | 1,557 | 462 |
| 16 | 0.91 | 0.82 | 0.98 | 0.74 | 0.90 | 0.42 | 0.60 | 0.71 | 16 | 25,618 | 16,824 | 8,459 | 3,524 | 1,866 | 459 | 909 | 668 |
| 17 | 0.82 | 0.70 | 0.91 | 0.82 | 0.84 | 0.71 | 0.17 | 0.26 | 17 | 12,766 | 11,429 | 15,899 | 2,411 | 964 | 481 | 436 | 3 |
| 18 | 0.78 | 0.64 | 0.76 | 0.85 | 0.80 | 0.51 | 0.39 | 0.62 | 18 | 7,804 | 9,220 | 18,919 | 4,969 | 857 | 150 | 18 | 290 |
| 19 | 0.86 | 0.68 | 0.89 | 0.76 | 0.84 | 0.50 | | 0.50 | 19 | 4,642 | 23,798 | 23,603 | 1,246 | 644 | 117 | | 13 |
| 20 | | 0.77 | 0.89 | 0.76 | 0.80 | 0.63 | | | 20 | | 9,757 | 6,731 | 1,465 | 934 | 8 | | |
| 21 | | 0.93 | 0.88 | 0.86 | 0.71 | | | | 21 | | 4,558 | 17,018 | 513 | 418 | | | |
| 22 | | | | 0.84 | 0.80 | | | | 22 | | | | 2 | 263 | | | |

Vessels caught more chum more frequently and in greater numbers, on average, though the relationship between incidence and bycatch reveals that higher incidence does not always equate to higher total bycatch. Table 5-70 shows incidence and bycatch information for the CP/MS sectors.

Table 5-71. Chum salmon Incidence and bycatch by Week & Year for CPs and Motherships, 2003-2010

| Incidence Rate- Proportion of hauls with chum | | | | | | | | | Extrapolated Chum Bycatch | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Week | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Week | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| 1 | 0.39 | 0.91 | 0.75 | | | 0.06 | 0.06 | 0.06 | 1 | 117 | 1,432 | 377 | | | 12 | 10 | 1 |
| 2 | 0.30 | 0.85 | 0.36 | 0.50 | 0.08 | 0.10 | 0.03 | 0.14 | 2 | 276 | 9,601 | 1,120 | 889 | 25 | 34 | 20 | 57 |
| 3 | 0.25 | 0.78 | 0.54 | 0.18 | 0.36 | 0.08 | 0.27 | 0.28 | 3 | 262 | 6,482 | 4,626 | 124 | 472 | 66 | 586 | 652 |
| 4 | 0.16 | 0.76 | 0.13 | 0.22 | 0.16 | 0.03 | 0.10 | 0.15 | 4 | 218 | 3,049 | 248 | 942 | 617 | 34 | 116 | 119 |
| 5 | 0.17 | 0.63 | 0.21 | 0.25 | 0.29 | 0.04 | 0.12 | 0.12 | 5 | 198 | 2,137 | 396 | 1,449 | 614 | 34 | 160 | 289 |
| 6 | 0.24 | 0.55 | 0.13 | 0.15 | 0.10 | 0.05 | 0.06 | 0.10 | 6 | 497 | 2,663 | 143 | 122 | 88 | 59 | 113 | 105 |
| 7 | 0.16 | 0.67 | 0.28 | 0.29 | 0.17 | 0.03 | 0.23 | 0.13 | 7 | 248 | 6,904 | 521 | 2,343 | 805 | 44 | 178 | 164 |
| 8 | 0.24 | 0.67 | 0.26 | 0.27 | 0.08 | 0.05 | 0.33 | 0.14 | 8 | 370 | 4,121 | 741 | 1,239 | 33 | 59 | 746 | 99 |
| 9 | 0.35 | 0.60 | 0.41 | 0.22 | 0.11 | 0.10 | 0.13 | 0.13 | 9 | 1,276 | 15,995 | 1,418 | 3,334 | 300 | 132 | 113 | 64 |
| 10 | 0.31 | 0.33 | 0.53 | 0.19 | 0.16 | 0.09 | 0.12 | 0.29 | 10 | 1,004 | 3,442 | 951 | 396 | 204 | 158 | 149 | 252 |
| 11 | 0.33 | 0.51 | 0.71 | 0.11 | 0.28 | 0.10 | 0.18 | 0.23 | 11 | 1,010 | 3,631 | 3,391 | 284 | 1,912 | 195 | 268 | 177 |
| 12 | 0.51 | 0.66 | 0.75 | 0.25 | 0.36 | 0.12 | 0.25 | 0.31 | 12 | 5,108 | 7,019 | 15,446 | 634 | 5,098 | 74 | 368 | 330 |
| 13 | 0.78 | 0.64 | 0.84 | 0.30 | 0.61 | 0.12 | 0.35 | 0.14 | 13 | 2,128 | 5,714 | 18,730 | 586 | 4,641 | 135 | 273 | 77 |
| 14 | 0.75 | 0.71 | 0.89 | 0.39 | 0.61 | 0.17 | 0.32 | 0.31 | 14 | 1,826 | 3,470 | 4,860 | 1,808 | 5,736 | 123 | 257 | 50 |
| 15 | 0.65 | 0.89 | 0.88 | 0.63 | 0.61 | 0.20 | 0.37 | 0.46 | 15 | 1,176 | 3,679 | 6,803 | 2,343 | 1,408 | 321 | 215 | 115 |
| 16 | 0.57 | 0.70 | 0.83 | 0.38 | 0.50 | 0.09 | 0.58 | | 16 | 1,421 | 3,433 | 2,964 | 295 | 592 | 72 | 437 | |
| 17 | 0.51 | 0.67 | 0.68 | 0.41 | 0.52 | 0.06 | 0.42 | 0.22 | 17 | 3,007 | 1,055 | 2,286 | 324 | 949 | 8 | 124 | 14 |
| 18 | 0.61 | 0.62 | 0.79 | 0.46 | 0.43 | 0.28 | | | 18 | 656 | 341 | 459 | 430 | 271 | 85 | | |
| 19 | | | | 0.22 | 0.50 | 0.47 | | | 19 | | | | 37 | 231 | 50 | | |
| 20 | | | | 0.38 | 0.24 | 0.00 | | | 20 | | | | 137 | 100 | - | | |
| 21 | | | | | 0.15 | 0.03 | | | 21 | | | | | 67 | 1 | | |
| 22 | | | | | 0.34 | | | | 22 | | | | | 59 | | | |

For the CP/MS sectors, incidence rates were also elevated for a long period of 2005. In contrast to 2005, most other years show reduced chum bycatch incidence rates, with the maximum incidence rate being approximately 0.7 in both 2008 and 2010. For CPs and motherships, chum incidence is less than 10 percent for many weeks in 2008.

#### 5.3.1.5 How do 2003-2010 Chinook and chum PSC closures interact?

The pre-RHS historical simulation analysis suggests that targeting Chinook and chum reduction is in general complementary. Here we focus upon 2003-2010 and discuss the interaction of some of the Amendment 91 and chum PSC measures below.

In choosing where to implement RHS closures for Chinook and chum PSC reduction, SeaState recognizes that there are periods when trade-offs between and Chinook and chum PSC occur, which is occasionally noted in SeaState reports to the fleet. For example, the following description is from the 8/27/07 SeaState report to the fleet: "*The Chinook bycatch is 30% less than we had last year by this time (despite having taken 25,000 mt more pollock this season to date) and the chum bycatch is only 14% of what it was last year at this point. Unfortunately, we don't get to relax. We are not changing the Chinook closures to the north as they seem to have done a good job of reducing Chinook catches. I'm afraid that if we shifted the closures around to slow down the chum bycatch we might then see boats back in the current closures and catching more Chinook.*"

On the other hand, there are times when there are areas that have elevated levels of both species, so closing an area is expected to reduce both chum and Chinook. For example, in mid-August 2006, a closure was put in place for 4 days as a Chinook closure but was later extended as a chum closure.

To provide some additional insight into whether or not chum and Chinook RHS closures complement one another, we examine the correlation between the bycatch rate in and out of each closure period for each species. This comparison is conducted as follows:

1. The bycatch rate inside each closure is calculated for the 5-day period prior to the closure for each PSC species.
2. The bycatch rate outside each closure is calculated for the 5-day period prior to the closure for each bycatch species.
3. For each species, the ratio of bycatch inside to outside the closure is calculated.
4. The correlation of the ratios is then calculated for each closure.

The correlation for all B-season closure periods from 2003-2009 is found to be 0.57. If it were consistently necessary to trade-off chum and Chinook bycatch when creating hotspot closures, we would expect to see a negative correlation between these ratios. While more extensive analysis could reveal more information about when there are conflicts between reducing chum and Chinook bycatch, the positive correlation suggests that chum and Chinook bycatch reduction through existing RHS closures is, in general, complementary. The limits of this relationship are discussed below.

#### 5.3.1.6 Observable economic impacts of the RHS closures

In some cases vessels are forced to take much longer trips as a result of closures, resulting in additional travel costs. Following data collection efforts from Amendment 91 that will begin in 2012 and 2013, there will be cost information available to estimate these costs but currently we do not know vessel fuel costs. There are times when SeaState reports note that catcher vessels will make large shifts to the north when closures are imposed in the south (East of 168), but it is difficult to measure how frequently this is due to SeaState closures as these shifts happen to different degrees with or without closures.

We examine the changes in CPUE for the periods 1-5 days before and after the RHS closures. There is no statistically significant change in haul-level CPUE from the 0-2 days before RHS closures are implemented to the 0-2 days after. There appears to be a small decline in CPUE when examining the change in CPUE from 0-5 days before RHS closures to 0-5 days after the closures – approximately 3 percent after controlling for annual and vessel-specific effects. It appears that some of this reduction in CPUE is made up by longer fishing times in those days. Further examination is required however to explore the variation of the "duration" variable to explore what is driving this reduction. However, the lack of observed change from 0-2 days following the closure would suggests that the apparent reduction is more likely due to an unmeasured short-term trend than the closures.

There is also the potential for significant economic losses when vessels are forced off of areas where higher value products are produced. This is likely to be a more dramatic impact in the A-season fishery because of the high value of roe, but product-specific targeting and the amount of roe caught in the B-season has increased so that there can be meaningful differences in the value of fishing in one area versus another beyond what's captured in CPUE. With anecdotal input from vessel operators of specific closures inducing movement off of high-value fishing areas, it would be possible to make estimates of these impacts (subject to the limitations of having only annual price and product quality information). Additionally at times, travel costs may increase significantly with closures, especially for some catcher vessels and at time when it is difficult to locate pollock close to port.

What is the impact of limits of the maximum RHS closure size on the effectiveness of the chum bycatch hotspot system? While the size/number limit on RHS closures that can be put in place at any time prevents SeaState from closing a larger part of the grounds that might be effective in reducing bycatch, this limitation also reduces the impact of closures on the fishery and prevents "surprises" from sending people to search for pollock in areas that either are known to have high bycatch or that have an unknown amount of bycatch. The impact of closure size is explored in the pre-RHS analysis.

#### 5.3.1.7 Discussion of Chum salmon bycatch rates in the Chum Salmon Savings Areas (CSSA)

Following the Amendment 84 analysis, an examination of the bycatch rates in and out of the CSSA indicates that chum bycatch rates are generally higher outside of the CSSA than inside.

The Chum Salmon Savings Area was put into place according to the dates on the following table:

Table 5-72. Dates when Chum Salmon Savings Area (CSSA) was closed to non-CDQ Fishing

| Year | Start Date | End Date |
|---|---|---|
| 1995-2005 | 8/1 | 8/31 |
| 2002 | 9/21/2002 | 10/14/2002 |
| 2003 | 9/24/2003 | 10/14/2003 |
| 2004 | 9/14/2004 | 10/14/2004 |

For 2005, most of the PSC in the CVOA that would trigger a closure of the CSSA occurred for the week of 10/8, so by the time the Region had the PSC information to trigger the closure, it was 10/14 and the closure could not be triggered (Mary Furuness, pers. comm.).

An examination of the rates in and out of the chum SSA for the open periods from 2003-2009 shows that in less than 10 percent of B season months the observed PSC rate was higher in the Chum SSA than outside of it (these three months are indicated with gray highlighting). In each of these 3 months, the difference in chum PSC rates between inside and outside the SSA was small. As indicated in the previous table, the Chum SSA was closed in part of September and October of 2003 and 2004.

Table 5-73. Chum salmon PSC rates by Month & Year, In and Out of the Chum SSA, 2003-2009

| Year | In ChumArea? | Jun | Jul | Aug | Sep | Oct | Nov |
|---|---|---|---|---|---|---|---|
| 2003 | INSIDE Chum SSA | 0.012 | 0.009 | 0.025 | 0.204 | 0.176 | |
| | Outside Chum SSA | 0.021 | 0.060 | 0.219 | 0.393 | 0.632 | |
| 2004 | INSIDE Chum SSA | 0.255 | 0.132 | 0.134 | 0.176 | 0.181 | |
| | Outside Chum SSA | 0.218 | 0.096 | 0.583 | 1.134 | 1.237 | 0.614 |
| 2005 | INSIDE Chum SSA | 0.123 | 0.046 | 0.142 | 0.316 | 0.438 | |
| | Outside Chum SSA | 0.217 | 0.978 | 1.225 | 0.461 | 1.210 | |
| 2006 | INSIDE Chum SSA | 0.025 | 0.131 | 0.028 | 0.059 | 0.023 | |
| | Outside Chum SSA | 1.087 | 0.417 | 0.509 | 0.109 | 0.119 | 0.000 |
| 2007 | INSIDE Chum SSA | 0.009 | 0.049 | 0.080 | 0.134 | 0.034 | 0.000 |
| | Outside Chum SSA | 0.043 | 0.041 | 0.210 | 0.358 | 0.044 | 0.142 |
| 2008 | INSIDE Chum SSA | 0.008 | 0.008 | 0.010 | 0.010 | 0.005 | |
| | Outside Chum SSA | 0.033 | 0.022 | 0.027 | 0.077 | 0.055 | |
| 2009 | INSIDE Chum SSA | 0.011 | 0.018 | 0.017 | 0.034 | 0.006 | |
| | Outside Chum SSA | 0.045 | 0.147 | 0.110 | 0.244 | 0.013 | |

#### 5.3.1.8 What is the likely interaction of status quo chum measures with Amendment 91 and IPAs?

The new Amendment 91 measures provide additional incentives to the pollock fishery to avoid Chinook salmon PSC. Amendment 91 has two principal components for Chinook avoidance: a hard cap on the number of Chinook that can be caught each year, and incentive plan agreements (IPA) that provide additional incentives for Chinook PSC avoidance at all PSC levels including those well below the hard cap level.

The IPAs are different for each sector but all provide a mandate that vessels stay below the sector-specific hard cap. In addition to other measures, a Rolling Hotspot Program (RHS) for Chinook PSC is part of the IPAs for all sectors. Thus there may be closures in place for Chinook PSC reduction as well as any fixed or rolling closures intended for chum PSC reduction.

How will these measures interact with current or potential future chum PSC avoidance measures? The presence of the Amendment 91 measures mean that fixed or hotspot chum closures have the *potential* to be more expensive for the fleet and lead to higher Chinook PSC. Similarly, the Chinook PSC measures could make it more costly and/or difficult for vessels to avoid high chum PSC area. If a vessel exceeds its available Chinook salmon PSC and is unable to obtain access to additional PSC, then it will be unable to continue to fish for pollock in a given year. Similarly, there is the potential that vessels would be forced by chum area closures to fish in high Chinook areas if low Chinook PSC fishing grounds are closed by chum closures. It should be noted that vessels can also choose to not fish for periods of time which will reduce the likelihood of a short-term closure "forcing" vessels to fish in high Chinook areas. The length of time a closure is in place will impact vessels' financial ability to do this and in general this is a costly decision for a vessel to have to make. However, as discussed above, Chinook and chum PSC are positively correlated from 2003-2010 and the pre-RHS analysis also suggests that on average targeting low bycatch of one species is likely to reduce bycatch of the other species.

Sea State carefully weighs the need to reduce PSC of both species in its decision making. Any type of fixed closure system would eliminate this flexibility, which is also the case with the current Chum Salmon Savings Area. As discussed above, in general high chum and Chinook PSC areas that become RHS closures tend to be correlated.

Figure 5-93 displays one aspect of the Amendment 91 IPA that applies to the CP/MS/CDQ sectors – the implementation of a B-Season "Chinook Conservation Area." As indicated in the figure, the area will be closed from October 15-31 when the Chinook salmon PSC rate in September exceeds 0.015 salmon per metric ton of pollock.

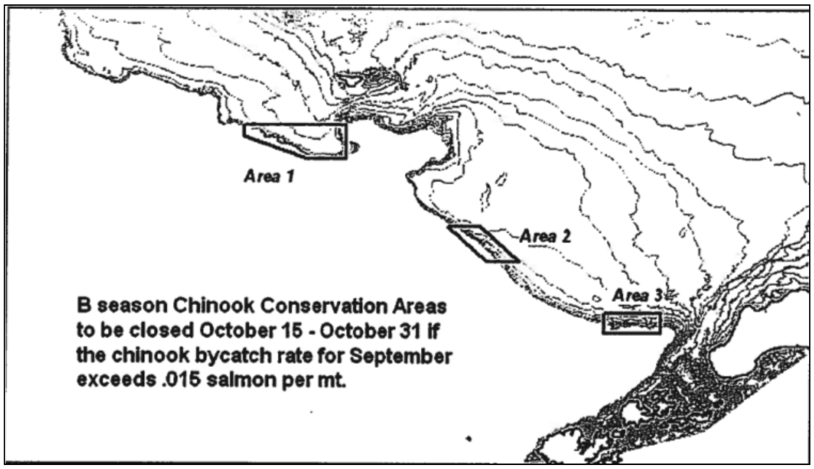



Figure 5-93. 2011 Amendment 91 IPA B Season Chinook Conservation Area

For the purposes of this chum PSC analysis, the relevant question is how high chum PSC is in these areas and whether the areas move people to areas with higher or lower chum PSC. The following table displays the chum PSC rates in and out of the B season Chinook Conservation Areas for 2003-2010.

Table 5-74. Number of hauls, Chum, and Chinook inside and outside the Amendment 91 B-Season Chinook Conservation Area by Sector and Year, 2003-2010

| Sector | In BCCA? | Year | Hauls | ChumNum | ChinNum | Pollock (t) | ChumRate | ChinRate |
|---|---|---|---|---|---|---|---|---|
| CP/MS | | 2003 | 47 | 95 | 233 | 2,079 | 0.05 | 0.11 |
| CP/MS | Yes | 2004 | 8 | 758 | 79 | 76 | 9.94 | 1.03 |
| CP/MS | | 2004 | 59 | 1,592 | 501 | 2,944 | 0.54 | 0.17 |
| CP/MS | | 2005 | 51 | 297 | 39 | 3,374 | 0.09 | 0.01 |
| CP/MS | | 2006 | 181 | 153 | 203 | 9,411 | 0.02 | 0.02 |
| CP/MS | Yes | 2007 | 30 | 14 | 633 | 1,131 | 0.013 | 0.56 |
| CP/MS | | 2007 | 468 | 529 | 2,797 | 26,523 | 0.020 | 0.11 |
| CP/MS | | 2008 | 201 | 28 | 91 | 8,872 | 0.00 | 0.01 |
| CP/MS | | 2010 | 22 | 53 | 458 | 1,020 | 0.05 | 0.00 |

These results suggest that there is little evidence to suggest the BCCA is likely to have a significant impact on chum PSC. For the two years where fishing occurred in the BCCA, there was considerably higher PSC in the area in 2004 but only 8 hauls. In 2007, there was slightly lower PSC in the area. Most years there was no fishing in this area during the closure period.

### 5.3.1.9 The Vessel Performance List

An additional aspect connected to the RHS system is the publication to the fleet of a list of vessels with high PSC rates which is regularly published in SeaState reports. The list is called the "vessel performance" list but was previously called the "Dirty 20" list. There is no financial penalty to being on the list, but vessel operators have reported that there are social pressures connected to being on the list. According to conversations with several vessel captains, captains will give other captains a hard time for being on the list and one person regularly on the list expressed feeling very bad about it. The list has been refined over time so that both seasonal and recent activity list are published in SeaState reports for both

Chinook and non-Chinook salmon. It is difficult to assess how much of a difference the list has made, but it provides transparency to the fleet about who is and is not avoiding PSC and establishes a social norm in which vessels are publicly labeled as "dirty" for having high salmon PSC.

### 5.3.1.10 Additional Flexibilities of RHS System

While the RHS system's primary purposes are to identify high PSC areas, convey PSC information to the fleet, and to close those areas with the highest rates, reading the SeaState reports reveals that SeaState attempts to use all available information to most effectively implement closures. Here are several examples that illustrate the type of information that is utilized in closure designation and how the information is interpreted.

The 8/2/07 SeaState report illustrates how near real-time VMS data is used to supplement observer data: "East of 168 we have elevated rates in 655600 and a couple of reports of high-bycatch tows from that area as well. None of this is showing up in observer data, so we are stuck with making the closure based on VMS coverage of the vessels involved."

The 8/27/07 report shows the nuance of trying to separate low-PSC fishing from higher PSC areas: "*Finally, I think boats that visited 675500 and 675530 might have picked up some chums there as well, but again they fished in multiple areas and reports from the grounds are conflicting. The amount of pollock taken in those areas is so low that the areas don't even reach the "2% of pollock catch" threshold to be included in our bycatch rates tables. However, if you do try those areas you might want to wary because fishing is almost never clean out near edge in those stat areas. It can be OK in a bit from the edge (in, say, 70 – 75 fm), and that's where the fishing took place, but the boundary between areas of high and low bycatch can be pretty abrupt.*"

Figure 5-94 below, shows the overlapping closures that were put in place from mid-August to early-October, 2009. This was a low-PSC period but the closures were repeatedly moved to close areas with the highest PSC at the time.

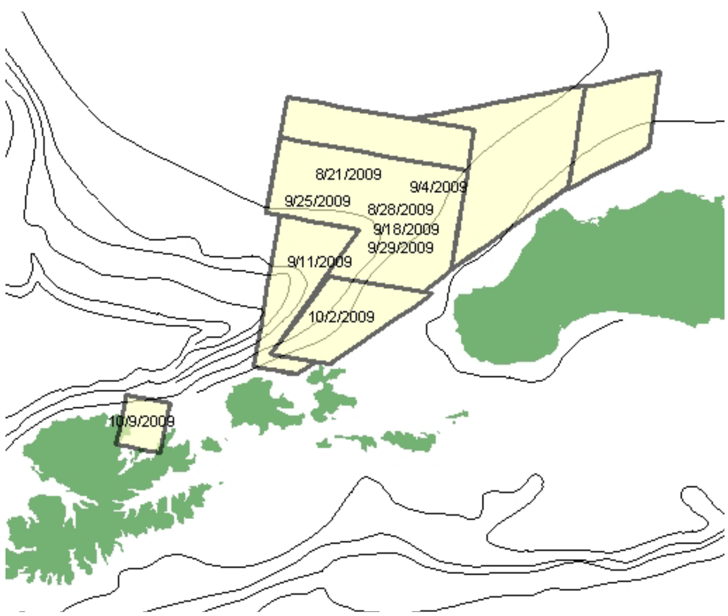



Figure 5-94. Shifts in late summer 2009 Closures illustrate SeaState efforts and ability to adjust to changing PSC hotspots

### 5.3.1.11 Summary of Findings on Status Quo Chum PSC-reduction measures

Collectively, the Chinook and chum salmon PSC measures implemented through the RHS system and Amendment 91 arguably represent the most extensive bycatch reduction efforts that have been undertaken. In this analysis, we concentrate on the RHS components of the chum reduction measures. A number of relevant findings are summarized below.

Key findings of this analysis include:

- From 2003-2010, comparing chum bycatch rates in the 1-3 days following RHS closures are approximately 8 percent lower
- Annual average chum PSC in the 5-days before closures were imposed from 2003-2010 ranged from 11-33 percent for CVs and from 2-30 percent for other sectors, with the majority of years being in the upper end of this range. The average percentage of pollock range from 7-21 percent for CVs and was less than 5 percent for other sectors.
- Evaluating the 1993-2000, an RHS-like system would likely have reduced chum PSC by 9-22 percent on average with about 4-10% percent of pollock fishing have been relocated to other areas.
- The pre-RHS analysis suggest that often 'what's good for chum is good for Chinook' with the range of Chinook savings as 6-14 percent per year.

- Based on 1993-2000 data, large closures reduce salmon PSC more but at the cost of moving additional pollock. Also, closures based on the most recent information possible leads to larger average reductions and relatively small base rates appear on average to be more effective.
- The current "tier system" of the RHS program allows cooperatives with low PSC relative to the base rate to fish inside closed areas. This provides some incentive for cooperatives to have lower chum PSC rates in order to be able to fish in closed areas, though these vessels often choose to fish elsewhere. During closure periods, 4.6 percent of CV pollock and 0.3 percent of pollock by the other sectors was taken inside the closure areas.
- An examination of the chum PSC rates in the chum Salmon Savings Area (SSA) indicates that in over 90 percent of months from 2003-2010, chum PSC rates were *lower* in the Chum SSA than outside of it, suggesting that trigger this area could be actually increase chum PSC.
- In 2011, chum RHS closures were in place throughout the B season, whereas in previous years Chinook closures were explicitly given regulatory priority.

Compared to alternative spatial management systems, the RHS system has advantages and limitations. Key advantages of the hotspot system relative to fixed closures include:

- Sea State has shown the ability to make trade-offs between chum and Chinook PSC and to consider how vessels will respond.
- Adjustments to what areas will be closed can be made regularly in response to the substantial inter-annual variability in the quantity and concentration of PSC. This prevents the possibility that fixed closures would consistently force vessels from low-PSC areas, which is a possibility with any system that cannot adjust.
- Anecdotal information from vessel operators and plant managers can be combined with observer data, VMS data, and knowledge of how seasonal PSC conditions evolve to make well-informed predictions of where salmon PSC will occur in the near-term.
- The system can adapt with new information. For example, from the 8/27/07 SeaState report – "It would be particularly useful to know if there is a temperature front associated with higher or lower PSC, as there was further up on the shelf."
- Through regular reporting to the Council and independent audits of potential violations, there is transparency in whether vessels adhere to closures. The number of violations of the closures has been very limited and seemingly generally due to honest mistakes by vessel operators.

The Council's June 2010 motion requested an analysis of potential means to modify the chum rolling hotspot system. Options for adjusting the system include:

- Modifications of the RHS program to the vessel-level would follow the current shoreside and catcher-processor Chinook RHS programs. An individual-level system would increase the likelihood that vessels face consequences for high PSC. Because there may also be some advantages to having cooperative-level incentives, a RHS system could also include *both* individual and cooperative-level incentives.
- Sea State strives to have recent information available for deciding which areas to close. There is no easy technical fix to reduce the utilization of information. Shortening the approximately 24-hour delay between when closures are announced and implemented would improve the quality of data and could provide some additional incentive to avoid high-PSC areas immediately before closures are implemented. However, this would occur at additional cost to the fleet and historical simulation results suggest that the reduction in PSC would be relatively small.
- The RHS could be adjusted to focus on benefits to Western Alaska stocks by being more active early in the B season. However, if extremely large closures are imposed in this period so that fishing is slowed down significantly, it could have the unintended consequence of pushing a larger amount of fishing effort into October, when Chinook PSC is usually highest.
- Historical simulation results indicate that larger closures are likely to further reduce bycatch, but at a decreasing rate as they get larger. Larger areas at high-bycatch periods would allow more high-PSC areas to be closed.
- When PSC rates change quickly, the current 3-week moving basis for determining the base rate means that all cooperatives or few cooperatives are subject to closures. The base rate could be based on the most recent behavior to ensure that vessels or cooperatives with relatively high PSC rates in the most recent period would be subject to closures.
- Modifying the incentives associated with the tier system has the potential to significantly strengthen the effectiveness of the RHS system. Larger and longer closures or any other reward and penalty could be incorporated into the tier system. If a more stringent chum RHS is developed, vessels could be made exempt from some of the closures if they have relatively low *Chinook* PSC, further increasing the incentive to avoid Chinook PSC as well.

In balancing the chum and Chinook PSC, the RHS system has demonstrated the ability to carefully balance the trade-offs in a manner that could not be done with fixed closures. The program has continued to evolve and learn from new challenges.

### 5.3.2 AEQ and region of origin impacts under Alternative 1

Applying the AEQ results to the available genetics data requires careful consideration of time and area of genetics sampling relative to actual bycatch. For example, should genetics sampling under-represent an area of high bycatch, then the appropriate ratios must be applied to obtain an unbiased representation of the bycatch by stock of origin. The methods used to estimate stock composition and attempt to correct for potential biases are presented in section 3.2.2.

Results indicate that on average (2005-2009 data) 11% of the AEQ came from coastal western Alaska systems and about 6% of the total bycatch mortality is attributed to the Upper Yukon fall run of chum salmon (Table 3-13). Applying these proportions to conservative run size estimates (compiled from section 5 and omitting systems which were missing run-size information; Table 5-75) indicates that the highest impact rate (chum salmon mortality due to the pollock fishery divided by run-size estimates) was less than 1.7% for the combined western Alaska stocks (Table 5-76). In only three out of 16 years was the impact rate estimated to be higher than 0.7% (Table 5-76). For the Upper Yukon stock, the estimate of the impact is higher with a peak rate of 2.73% estimated on the run that returned in 2006 (with upper 95%

confidence bound at 3.70%; Table 5-76 and Figure 5-95). For the SW Alaska region (taken to be from Area M) the estimate of impact rate is the lowest for any of the Alaska sub-regions. The average impact rate (2004-2011) by region (with ranges over this period):

| | | |
|---|---|---|
| Coastal west Alaska | 0.49% | (0.07% - 1.23%) |
| Upper Yukon | 1.26% | (0.17% - 2.73%) |
| Combined WAK | 0.63% | (0.08% - 1.31%) |
| Southwest Alaska | 0.40% | (0.07% - 1.03%) |

These impact rates would be the de facto values that might be applicable to sub-regions (or individual rivers). The historical information on stock identification at finer scales is limiting due both to the sampling and to the resolution of the genetic methods used. Overall, comparing AEQ mortality due to bycatch of chum salmon to run sizes and suggests a variable relationship (Figure 5-96). These results indicate even with uncertainties considered, that bycatch of western Alaska chum salmon is likely most affected by the magnitude of returns (Figure 5-97). Sensitivity of impact-rate uncertainty to alternative assumptions about underlying variability indicates that assumed run-size CV has a large impact followed by the precision of genetic analysis whereas uncertainty in AEQ survival rate had a relatively minor effect (Figure 5-98).

For comparison purposes, any of the alternatives which would reduce non-Chinook salmon bycatch would be affecting the impact rates to Alaska systems shown above.

Table 5-75. Estimates of chum salmon run sizes by broad regions, 1991-2011. WAK includes coastal western Alaska and Upper Yukon (Fall run). These values only include regions where estimates were available and may be considered conservative. See section 5 for details and derivation on stocks from these regions. For impact rates and uncertainty, a coefficient of variation of 10% was assumed for these estimates.

| | WAK run size | Coastal WAK | Upper Yukon | SW Alaska (escapement only) |
|---|---|---|---|---|
| 1991 | 3,994,425 | 2,964,197 | 1,030,228 | 1,029,576 |
| 1992 | 3,284,895 | 2,811,796 | 473,099 | 877,674 |
| 1993 | 2,317,635 | 1,873,932 | 443,703 | 955,646 |
| 1994 | 4,821,985 | 3,882,840 | 939,145 | 1,170,604 |
| 1995 | 7,859,471 | 6,434,764 | 1,424,707 | 1,735,854 |
| 1996 | 5,059,317 | 4,010,706 | 1,048,611 | 1,433,400 |
| 1997 | 3,070,893 | 2,419,498 | 651,395 | 1,197,250 |
| 1998 | 3,133,865 | 2,811,832 | 322,033 | 2,771,735 |
| 1999 | 2,623,213 | 2,208,252 | 414,961 | 1,391,480 |
| 2000 | 1,379,043 | 1,139,744 | 239,299 | 1,110,175 |
| 2001 | 2,789,785 | 2,408,374 | 381,411 | 1,557,147 |
| 2002 | 3,545,500 | 3,121,188 | 424,312 | 1,304,489 |
| 2003 | 3,976,035 | 3,202,539 | 773,496 | 958,277 |
| 2004 | 3,937,242 | 3,324,602 | 612,640 | 1,173,828 |
| 2005 | 8,172,150 | 5,891,716 | 2,280,434 | 1,300,567 |
| 2006 | 8,889,338 | 7,738,349 | 1,150,989 | 1,380,181 |
| 2007 | 6,320,768 | 5,204,218 | 1,116,550 | 1,401,451 |
| 2008 | 5,283,734 | 4,378,634 | 905,100 | 997,037 |
| 2009 | 4,651,320 | 4,075,589 | 575,730 | 750,821 |
| 2010 | 4,693,153 | 4,086,792 | 606,360 | |
| 2011 | 5,739,776 | 4,533,335 | 1,206,441 | |
| Median | 3,994,425 | 3,324,602 | 651,395 | 1,197,250 |

Table 5-76. Estimated median impact of the pollock fishery (based on regional AEQ estimates from Table 3-13) on chum salmon assuming run size estimates presented in Table 5-74 (with an assumed 10% CV) by broad regions, 1994-2009. WAK includes coastal western Alaska and Upper Yukon (Fall run). Italicized values are extrapolated from 2005-2009 stratum-specific mean bycatch stock composition estimates and as such have higher levels of uncertainty. They do account for the amount of bycatch that occurred within each stratum and the estimates of total run strength. Values in parentheses are the 5th and 95th percentile from the integrated combined AEQ-Genetic-run-size uncertainty model.

| | Coastal WAK | Upper Yukon | WAK (coastal + Upper Yukon) | SW Alaska[1] |
|---|---|---|---|---|
| *1994* | *0.32% (0.22%, 0.45%)* | *0.61% (0.39%, 0.93%)* | *0.38% (0.27%, 0.5%)* | *0.11% (0.00%, 0.27%)* |
| *1995* | *0.07% (0.05%, 0.1%)* | *0.14% (0.08%, 0.23%)* | *0.08% (0.06%, 0.12%)* | *0.03% (0.00%, 0.07%)* |
| *1996* | *0.12% (0.09%, 0.17%)* | *0.2% (0.12%, 0.31%)* | *0.14% (0.1%, 0.19%)* | *0.04% (0.00%, 0.09%)* |
| *1997* | *0.23% (0.16%, 0.32%)* | *0.36% (0.21%, 0.57%)* | *0.26% (0.19%, 0.34%)* | *0.05% (0.00%, 0.13%)* |
| *1998* | *0.21% (0.15%, 0.3%)* | *0.81% (0.48%, 1.28%)* | *0.28% (0.2%, 0.37%)* | *0.02% (0.00%, 0.06%)* |
| *1999* | *0.2% (0.14%, 0.28%)* | *0.46% (0.27%, 0.72%)* | *0.24% (0.17%, 0.33%)* | *0.04% (0.00%, 0.08%)* |
| *2000* | *0.44% (0.31%, 0.59%)* | *1.05% (0.7%, 1.53%)* | *0.55% (0.42%, 0.71%)* | *0.04% (0.00%, 0.10%)* |
| *2001* | *0.21% (0.14%, 0.29%)* | *0.67% (0.43%, 0.96%)* | *0.27% (0.21%, 0.35%)* | *0.03% (0.00%, 0.07%)* |
| *2002* | *0.21% (0.15%, 0.29%)* | *0.7% (0.45%, 1.05%)* | *0.27% (0.2%, 0.35%)* | *0.05% (0.00%, 0.12%)* |
| *2003* | *0.42% (0.3%, 0.56%)* | *0.8% (0.52%, 1.2%)* | *0.5% (0.38%, 0.65%)* | *0.14% (0.00%, 0.34%)* |
| *2004* | *0.92% (0.66%, 1.25%)* | *2.41% (1.59%, 3.43%)* | *1.16% (0.87%, 1.51%)* | *0.25% (0.00%, 0.62%)* |
| **2005** | **1.23% (0.93%, 1.6%)** | **1.42% (0.98%, 2.04%)** | **1.28% (1.01%, 1.63%)** | **0.81% (0.39%, 1.47%)** |
| **2006** | **0.64% (0.47%, 0.86%)** | **2.63% (1.86%, 3.65%)** | **0.9% (0.7%, 1.16%)** | **0.45% (0.25%, 0.75%)** |
| **2007** | **0.31% (0.23%, 0.41%)** | **0.99% (0.71%, 1.37%)** | **0.43% (0.33%, 0.56%)** | **0.09% (0.05%, 0.17%)** |
| **2008** | **0.09% (0.07%, 0.13%)** | **0.35% (0.25%, 0.49%)** | **0.13% (0.1%, 0.18%)** | **0.02% (0.01%, 0.07%)** |
| **2009** | **0.1% (0.08%, 0.14%)** | **0.23% (0.15%, 0.35%)** | **0.12% (0.1%, 0.16%)** | **0.18% (0.10%, 0.29%)** |

[1]SWAK uses escapement only as a proxy for total run size.

Table 5-77. Estimated historical adult equivalent mortality (AEQ) due to pollock fishery bycatch by river system with upper 95% confidence value shown in parenthesis. Italicised valus preliminary based on projections from equation 7 (chapter 3).

| | Coastal WAK | | Upper Yukon | | WAK (coastal WAK + Upper Yukon) | | SW Alaska | |
|---|---|---|---|---|---|---|---|---|
| 1994 | 12,543 | (16,781) | 5,903 | (8,533) | 18,446 | (23,556) | 2,542 | (3,062) |
| 1995 | 4,502 | (6,327) | 2,063 | (3,137) | 6,566 | (8,827) | 904 | (1,164) |
| 1996 | 5,014 | (6,582) | 2,206 | (3,258) | 7,220 | (9,042) | 992 | (1,297) |
| 1997 | 5,587 | (7,430) | 2,435 | (3,625) | 8,022 | (10,219) | 1,102 | (1,463) |
| 1998 | 6,171 | (8,192) | 2,676 | (3,993) | 8,847 | (11,215) | 1,215 | (1,628) |
| 1999 | 4,473 | (5,945) | 1,950 | (2,917) | 6,424 | (8,122) | 882 | (1,187) |
| 2000 | 5,100 | (6,513) | 2,604 | (3,542) | 7,704 | (9,321) | 1,066 | (1,114) |
| 2001 | 5,104 | (6,551) | 2,589 | (3,551) | 7,693 | (9,391) | 1,064 | (1,121) |
| 2002 | 6,558 | (8,551) | 3,081 | (4,363) | 9,639 | (11,975) | 1,328 | (1,598) |
| 2003 | 13,483 | (17,424) | 6,443 | (9,056) | 19,926 | (24,398) | 2,748 | (3,185) |
| 2004 | 31,261 | (40,162) | 15,401 | (21,263) | 46,663 | (56,804) | 6,446 | (7,116) |
| 2005 | 72,610 | (90,760) | 34,095 | (46,314) | 106,700 | (127,475) | 13,401 | (18,805) |
| 2006 | 49,776 | (63,817) | 31,440 | (41,961) | 81,216 | (98,710) | 8,562 | (10,148) |
| 2007 | 15,815 | (20,688) | 11,056 | (14,803) | 26,871 | (33,648) | 2,362 | (2,334) |
| 2008 | 4,048 | (5,401) | 3,104 | (4,291) | 7,152 | (9,311) | 708 | (708) |
| 2009 | 4,332 | (5,442) | 1,429 | (1,990) | 5,761 | (7,000) | 1,396 | (2,133) |
| 2010 | *2,748* | | *1,024* | | *3,772* | | *6,132* | |
| 2011 | *13,059* | | *9,173* | | *22,232* | | *29,245* | |
| Mean | 14,566 | | 7,704 | | 22,270 | | 4,561 | |

| | AK-BC-WA | | Japan | | Russia | | Total | |
|---|---|---|---|---|---|---|---|---|
| 1994 | 24,165 | (30,615) | 48,440 | (57,492) | 40,967 | (48,726) | 133,219 | (152,151) |
| 1995 | 8,561 | (11,587) | 17,696 | (22,271) | 14,973 | (18,880) | 48,344 | (59,264) |
| 1996 | 9,341 | (11,770) | 20,019 | (22,697) | 16,966 | (19,226) | 54,095 | (56,750) |
| 1997 | 10,349 | (13,243) | 22,390 | (25,839) | 18,983 | (22,068) | 60,389 | (65,922) |
| 1998 | 11,424 | (14,610) | 24,851 | (28,604) | 21,096 | (24,223) | 66,880 | (72,697) |
| 1999 | 8,268 | (10,641) | 17,934 | (20,963) | 15,218 | (17,802) | 48,382 | (53,725) |
| 2000 | 10,233 | (12,418) | 18,610 | (21,088) | 15,726 | (17,786) | 52,723 | (56,157) |
| 2001 | 10,217 | (12,501) | 18,737 | (21,357) | 15,794 | (18,119) | 52,932 | (57,173) |
| 2002 | 12,619 | (15,616) | 25,249 | (28,649) | 21,373 | (24,273) | 69,493 | (73,947) |
| 2003 | 26,174 | (32,180) | 51,308 | (57,835) | 43,424 | (48,861) | 142,273 | (148,123) |
| 2004 | 61,564 | (75,071) | 116,730 | (131,388) | 98,520 | (111,321) | 326,777 | (340,222) |
| 2005 | 111,183 | (132,586) | 180,100 | (206,071) | 159,038 | (185,105) | 569,091 | (602,556) |
| 2006 | 102,437 | (119,942) | 122,723 | (145,114) | 106,237 | (126,746) | 419,286 | (469,973) |
| 2007 | 33,814 | (41,702) | 46,217 | (55,548) | 42,483 | (50,542) | 150,676 | (177,152) |
| 2008 | 10,507 | (13,133) | 15,332 | (18,819) | 13,105 | (16,472) | 46,493 | (56,519) |
| 2009 | 8,109 | (9,526) | 12,012 | (13,732) | 9,325 | (10,871) | 36,520 | (39,747) |
| 2010 | *4,734* | | *811* | | *7,608* | | *23,058* | |
| 2011 | *29,342* | | *3,131* | | *35,125* | | *119,075* | |
| Mean | 27,391 | | 42,349 | | 38,665 | | 134,428 | |

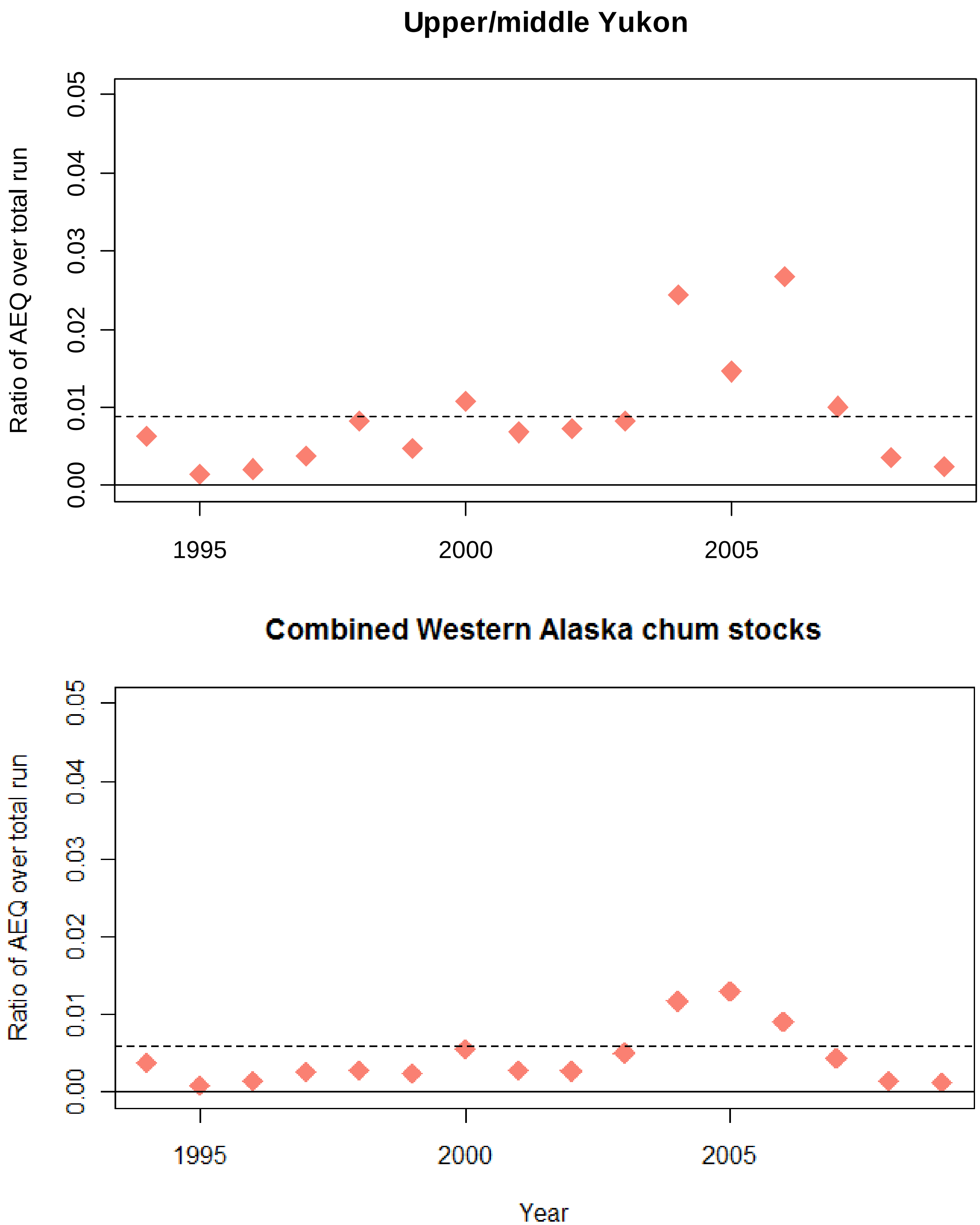



Figure 5-95. Estimated impact rates due to pollock fishery bycatch of chum salmon run sizes for Upper Yukon (top) and for western Alaska stocks (coastal west Alaska stocks plus Upper Yukon combined; bottom).

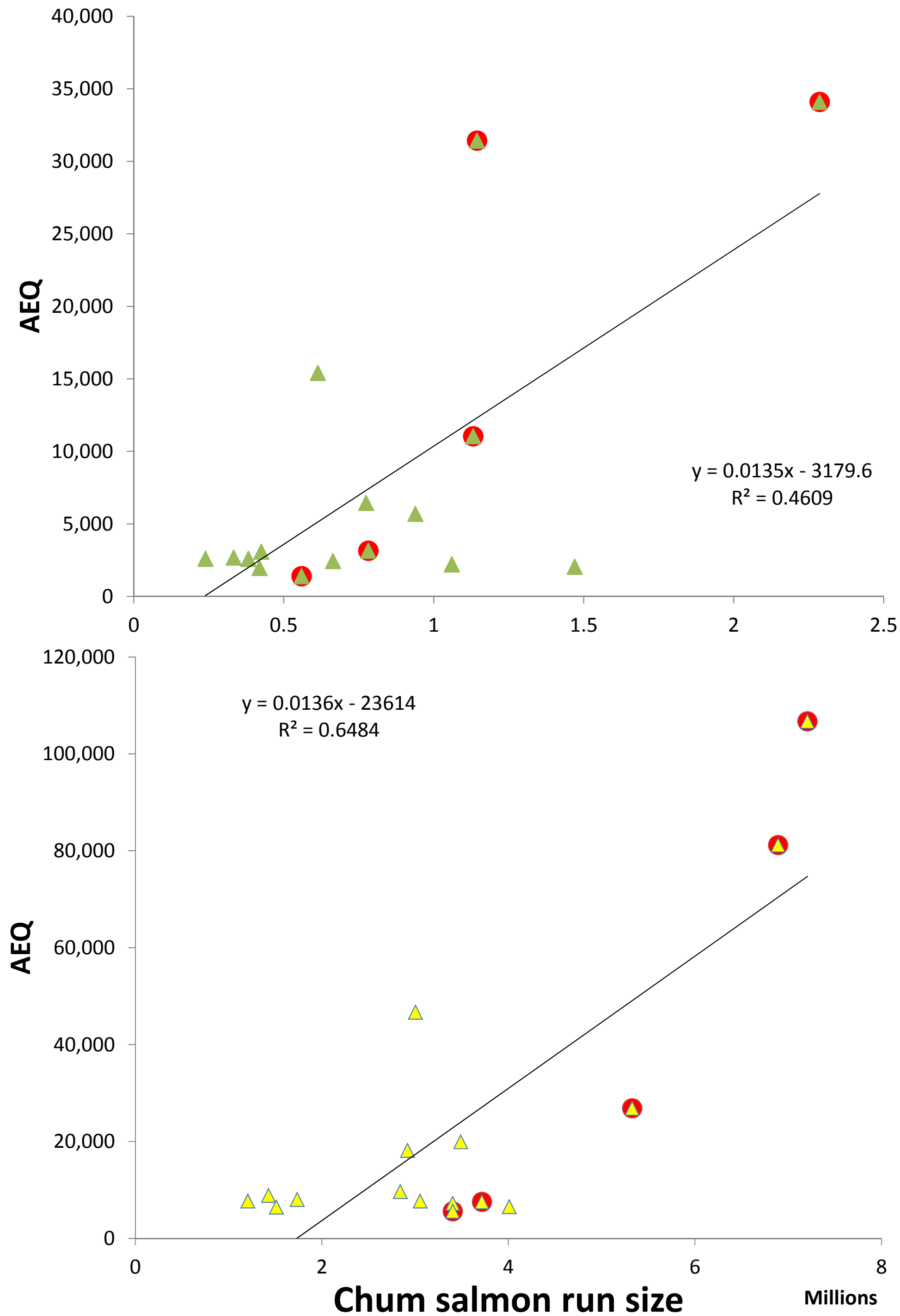



Figure 5-96. AEQ results compared to chum salmon run sizes for Upper Yukon (top) and for western Alaska stocks (coastal west Alaska stocks plus Upper Yukon combined; bottom). Filled circles represent data from years where genetics data were available and applied directly. Other points are based on mean bycatch stock composition proportions within strata and are thus more uncertain.

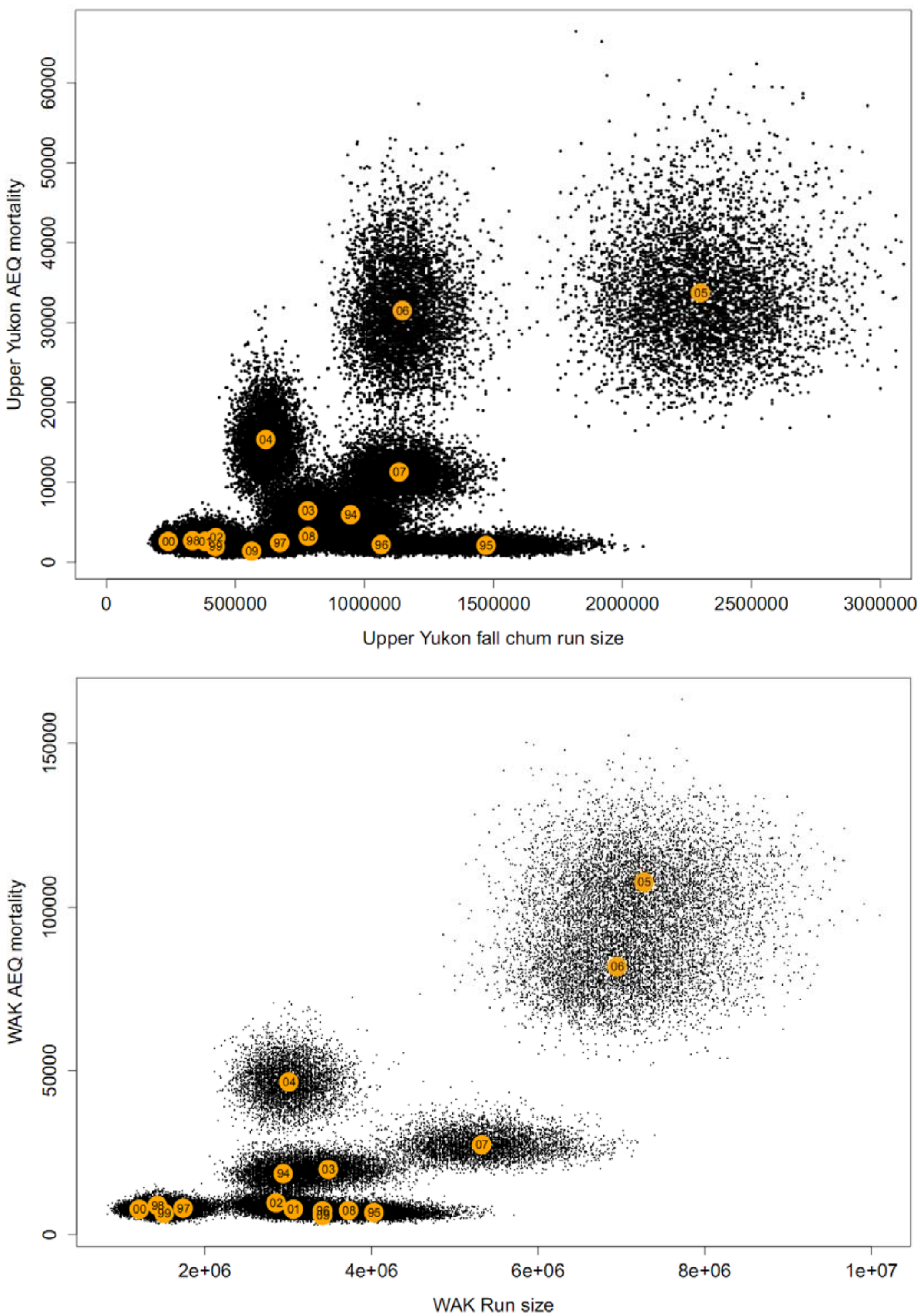



Figure 5-97. Estimated AEQ results compared to chum salmon run sizes for Upper Yukon (top) and for western Alaska stocks (coastal west Alaska stocks plus Upper Yukon combined; bottom). Circles represent mean estimates by year and concentrations of points represent relative density (probability) from the MCMC integration over uncertainty in run strength (10% CV), AEQ mortality, sampling, and genetic classification errors.

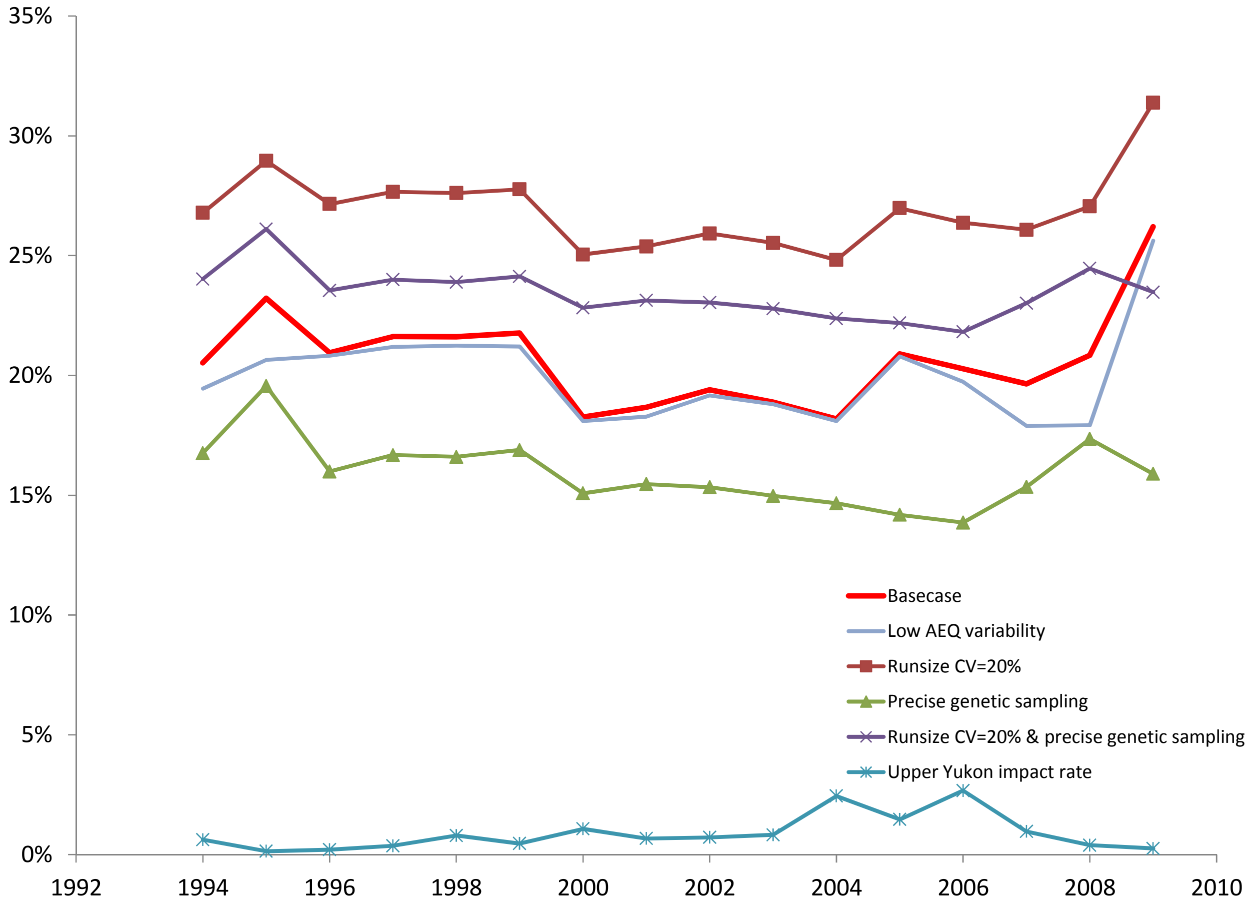



Figure 5-98 Example sensitivity analysis of impact rate uncertainty (CV of Upper Yukon impact rate—AEQ mortality divided by total run size estimate) to AEQ survival rate, run-size, and genetic sampling variability. Note for the basecase scenario AEQ survival was assigned a 20% CV and a 10% CV was assumed for run size estimates.

### 5.3.3 Summary of impacts of status quo

Following the criteria used to evaluate the impact of alternative management measures on chum salmon PSC it is clear that the status quo alternative results in adverse impacts since there are incidental takes of the prohibited species in question. However, given the low relative impact rates in most years of the status quo incidental catch levels on aggregate run sizes, even under the status quo, the relative impact of this incidental take on overall in-river returns is likely low. Nonetheless alternatives are evaluated to estimate potential means to minimize the adverse impacts of this incidental catch levels by reducing PSC catch of chum through different management strategies under Alternatives 2 and 3. Moving forward to evaluation of the other alternatives, comparison is made regarding minimizing adverse impacts by a reduction in incidental catch of chum PSC or increasing adverse impacts on chum PSC if the given alternative would result in an increase of incidental catch of chum PSC as compared with status quo.

Criteria used to estimate the significance of impacts on incidental catch of PSC and other non-target species

| | |
|---|---|
| No impact | No incidental take of the prohibited species in question. |
| Adverse impact | There are incidental takes of the prohibited species in question |
| Beneficial impact | Natural at-sea mortality of the prohibited species in question would be reduced – perhaps by the harvest of a predator or by the harvest of a species that competes for prey. |
| Significantly adverse impact | An action that diminishes protections afforded to prohibited species and forage fish in the current management of groundfish fisheries would be a significantly adverse impact. |
| Significantly beneficial impact | No benchmarks are available for significantly beneficial impact of the groundfish fishery on the prohibited species, and significantly beneficial impacts are not defined for these species. |
| Unknown impact | Not applicable |

Note these criteria were modified from those employed in the 2006-2007 groundfish harvest specifications environmental assessment/final regulatory flexibility analysis (EA/FRFA).

### 5.3.4 Alternative 2, hard caps

Under the analyzed options for the hard caps and sector allocations, the numbers of salmon saved is quite high for some years and varies by sector, especially for suboption 1b (Table 5-78). In percentage terms the low cap had the biggest chum salmon savings for most stocks (~80% but lowest savings for the SW Alaska components (Table 5-79)). This table also shows that different sector allocations had relatively minor impact on savings except for the highest hard cap level which tended to save the most salmon under sector allocation 6. The previous section presented the dates when sector specific closures would have occurred (Table 4-3).

For suboption 1b) the numbers of salmon saved was much lower but there was considerable constrast between stocks (Table 5-80). For example, the lowest cap under 1b) reduced the impact on the Upper Yukon on average by 42% but the same option actually increased the estimated AEQ impact on Asian chum salmon (Table 5-81). Scrutiny of results summed over years 2004-2011 indicate 1b) is apparently less sensitive to sector allocations than for suboption 1a (Table 5-82). For the Upper Yukon different cap levels vary by suboption with 1a at low levels saving more chum whilst at higher cap levels, the savings for 1b is higher (Figure ES-13). Table 5-83 and Table 5-84 provides contrast of results over cap levels and options by year for sector allocation 2ii. Table 5-85 and Table 5-86 provide a summary of the caps and options and sector splits summed over years (both in absolute and relative levels of chum salmon saved.

Table 5-78. A subset of estimated chum salmon saved (AEQ) by region and year under 3 different allocation schemes and hard caps for Alternative 2, component 2 **option 1a)**, 2004-2011.

| | | Estimated | 50,000 | | | 200,000 | | | 353,000 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | AEQ | 2ii | 4ii | 6 | 2ii | 4ii | 6 | 2ii | 4ii | 6 |
| Coastal WAK | 2004 | 31,261 | 26,313 | 26,504 | 26,707 | 15,150 | 14,974 | 16,148 | 5,089 | 6,994 | 11,176 |
| | 2005 | 72,610 | 65,047 | 65,158 | 65,657 | 42,504 | 46,451 | 53,199 | 20,696 | 29,955 | 38,824 |
| | 2006 | 49,776 | 45,763 | 45,381 | 47,480 | 24,159 | 29,744 | 38,473 | 9,818 | 16,574 | 23,895 |
| | 2007 | 15,815 | 11,202 | 11,159 | 11,931 | 2,927 | 4,726 | 7,442 | | 1,235 | 3,272 |
| | 2008 | 4,048 | 1,095 | 1,199 | 1,067 | | | | | | |
| | 2009 | 4,332 | | 429 | 1,175 | | | | | | |
| | 2010 | 2,748 | | 235 | 644 | | | | | | |
| | 2011 | 13,059 | 7,533 | 7,591 | 7,764 | 2,210 | 678 | 996 | 944 | 69 | |
| | Total | 193,649 | 156,952 | 157,656 | 162,426 | 86,950 | 96,573 | 116,258 | 36,547 | 54,828 | 77,167 |
| Upper Yukon | 2004 | 15,401 | 12,684 | 12,538 | 12,326 | 7,111 | 6,579 | 7,094 | 2,236 | 3,073 | 4,910 |
| | 2005 | 34,095 | 30,799 | 30,780 | 30,968 | 18,776 | 21,047 | 24,909 | 7,610 | 12,671 | 17,258 |
| | 2006 | 31,440 | 27,313 | 27,013 | 28,753 | 12,363 | 16,542 | 22,823 | 3,500 | 7,734 | 12,686 |
| | 2007 | 11,056 | 8,399 | 8,291 | 9,037 | 2,289 | 3,789 | 6,054 | | 938 | 2,577 |
| | 2008 | 3,104 | 485 | 532 | 473 | | | | | | |
| | 2009 | 1,429 | | 96 | 265 | | | | | | |
| | 2010 | 1,024 | | 53 | 145 | | | | | | |
| | 2011 | 9,173 | 4,504 | 4,599 | 4,767 | 1,085 | 298 | 438 | 415 | 30 | |
| | Total | 106,722 | 84,184 | 83,901 | 86,734 | 41,623 | 48,256 | 61,318 | 13,760 | 24,446 | 37,431 |
| SWAK | 2004 | 6,446 | 5,370 | 5,370 | 5,361 | 3,061 | 2,952 | 3,184 | 1,003 | 1,379 | 2,203 |
| | 2005 | 13401 | 11,937 | 11,947 | 12,030 | 7,574 | 8,347 | 9,667 | 3,396 | 5,197 | 6,907 |
| | 2006 | 8562 | 7,862 | 7,817 | 7,994 | 4,771 | 5,558 | 6,769 | 1,560 | 3,266 | 4,709 |
| | 2007 | 2362 | 1,703 | 1,693 | 1,732 | 836 | 1,008 | 1,267 | | 456 | 869 |
| | 2008 | 708 | 125 | 137 | 122 | | | | | | |
| | 2009 | 1396 | | 94 | 262 | | | | | | |
| | 2010 | 6132 | | 52 | 144 | | | | | | |
| | 2011 | 29245 | 1,678 | 1,701 | 1,750 | 454 | 134 | 196 | 186 | 14 | |
| | Total | 68,252 | 28,675 | 28,810 | 29,396 | 16,695 | 17,998 | 21,084 | 6,146 | 10,311 | 14,688 |
| SEAK-BC-WA | 2004 | 61,564 | 50,196 | 50,195 | 50,105 | 28,606 | 27,582 | 29,743 | 9,374 | 12,883 | 20,585 |
| | 2005 | 111,183 | 97,312 | 96,968 | 96,738 | 70,304 | 71,525 | 76,935 | 41,861 | 50,982 | 61,571 |
| | 2006 | 102,437 | 85,121 | 83,954 | 87,421 | 49,666 | 57,802 | 71,477 | 20,134 | 33,868 | 48,502 |
| | 2007 | 33,814 | 28,166 | 27,943 | 29,411 | 10,740 | 14,578 | 20,372 | | 5,367 | 11,476 |
| | 2008 | 10,507 | 2,032 | 2,227 | 1,982 | | | | | | |
| | 2009 | 8,109 | | 231 | 682 | | | | | | |
| | 2010 | 4,734 | | 127 | 374 | | | | | | |
| | 2011 | 29,342 | 15,713 | 15,928 | 16,389 | 4,246 | 1,250 | 1,835 | 1,739 | 127 | |
| | Total | 361,690 | 278,541 | 277,571 | 283,102 | 163,562 | 172,737 | 200,362 | 73,107 | 103,226 | 142,135 |
| Asia | 2004 | 215,250 | 185,271 | 188,906 | 193,291 | 108,513 | 111,563 | 120,304 | 37,915 | 52,106 | 83,262 |
| | 2005 | 339,138 | 299,162 | 299,253 | 299,362 | 233,591 | 231,197 | 237,307 | 154,570 | 173,173 | 202,084 |
| | 2006 | 228,960 | 197,658 | 195,119 | 198,787 | 137,531 | 146,532 | 166,427 | 73,350 | 101,333 | 129,350 |
| | 2007 | 88,700 | 59,536 | 60,033 | 60,699 | 22,781 | 28,584 | 37,346 | | 12,089 | 23,895 |
| | 2008 | 28,437 | 8,519 | 9,333 | 8,307 | | | | | | |
| | 2009 | 21,337 | | 2,284 | 6,222 | | | | | | |
| | 2010 | 8,419 | | 1,252 | 3,411 | | | | | | |
| | 2011 | 38,256 | 44,675 | 44,441 | 44,851 | 15,375 | 5,055 | 7,421 | 7,033 | 514 | |
| | Total | 968,497 | 794,820 | 800,621 | 814,930 | 517,792 | 522,931 | 568,806 | 272,868 | 339,216 | 438,591 |

Table 5-79. A subset of estimated relative chum salmon saved (AEQ) by region and year under 3 different allocation schemes and hard caps for Alternative 2, component 2 **option 1a)**, 2004-2011.

| | | Estimated | 50,000 | | | 200,000 | | | 353,000 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | AEQ | 2ii | 4ii | 6 | 2ii | 4ii | 6 | 2ii | 4ii | 6 |
| Coastal WAK | 2004 | 31,261 | 84% | 85% | 85% | 48% | 48% | 52% | 16% | 22% | 36% |
| | 2005 | 72,610 | 90% | 90% | 90% | 59% | 64% | 73% | 29% | 41% | 53% |
| | 2006 | 49,776 | 92% | 91% | 95% | 49% | 60% | 77% | 20% | 33% | 48% |
| | 2007 | 15,815 | 71% | 71% | 75% | 19% | 30% | 47% | | 8% | 21% |
| | 2008 | 4,048 | 27% | 30% | 26% | | | | | | |
| | 2009 | 4,332 | | 10% | 27% | | | | | | |
| | 2010 | 2,748 | | 9% | 23% | | | | | | |
| | 2011 | 13,059 | 58% | 58% | 59% | 17% | 5% | 8% | 7% | 1% | |
| | Total | 193,649 | 81% | 81% | 84% | 45% | 50% | 60% | 19% | 28% | 40% |
| Upper Yukon | 2004 | 15,401 | 82% | 81% | 80% | 46% | 43% | 46% | 15% | 20% | 32% |
| | 2005 | 34,095 | 90% | 90% | 91% | 55% | 62% | 73% | 22% | 37% | 51% |
| | 2006 | 31,440 | 87% | 86% | 91% | 39% | 53% | 73% | 11% | 25% | 40% |
| | 2007 | 11,056 | 76% | 75% | 82% | 21% | 34% | 55% | | 8% | 23% |
| | 2008 | 3,104 | 16% | 17% | 15% | | | | | | |
| | 2009 | 1,429 | | 7% | 19% | | | | | | |
| | 2010 | 1,024 | | 5% | 14% | | | | | | |
| | 2011 | 9,173 | 49% | 50% | 52% | 12% | 3% | 5% | 5% | 0% | |
| | Total | 106,722 | 79% | 79% | 81% | 39% | 45% | 57% | 13% | 23% | 35% |
| SWAK | 2004 | 6,446 | 83% | 83% | 83% | 47% | 46% | 49% | 16% | 21% | 34% |
| | 2005 | 13401 | 89% | 89% | 90% | 57% | 62% | 72% | 25% | 39% | 52% |
| | 2006 | 8562 | 92% | 91% | 93% | 56% | 65% | 79% | 18% | 38% | 55% |
| | 2007 | 2362 | 72% | 72% | 73% | 35% | 43% | 54% | | 19% | 37% |
| | 2008 | 708 | 18% | 19% | 17% | | | | | | |
| | 2009 | 1396 | | 7% | 19% | | | | | | |
| | 2010 | 6132 | | 1% | 2% | | | | | | |
| | 2011 | 29245 | 6% | 6% | 6% | 2% | 0% | 1% | 1% | 0% | |
| | Total | 68,252 | 42% | 42% | 43% | 24% | 26% | 31% | 9% | 15% | 22% |
| SEAK-BC-WA | 2004 | 61,564 | 82% | 82% | 81% | 46% | 45% | 48% | 15% | 21% | 33% |
| | 2005 | 111,183 | 88% | 87% | 87% | 63% | 64% | 69% | 38% | 46% | 55% |
| | 2006 | 102,437 | 83% | 82% | 85% | 48% | 56% | 70% | 20% | 33% | 47% |
| | 2007 | 33,814 | 83% | 83% | 87% | 32% | 43% | 60% | | 16% | 34% |
| | 2008 | 10,507 | 19% | 21% | 19% | | | | | | |
| | 2009 | 8,109 | | 3% | 8% | | | | | | |
| | 2010 | 4,734 | | 3% | 8% | | | | | | |
| | 2011 | 29,342 | 54% | 54% | 56% | 14% | 4% | 6% | 6% | 0% | |
| | Total | 361,690 | 77% | 77% | 78% | 45% | 48% | 55% | 20% | 29% | 39% |
| Asia | 2004 | 215,250 | 86% | 88% | 90% | 50% | 52% | 56% | 18% | 24% | 39% |
| | 2005 | 339,138 | 88% | 88% | 88% | 69% | 68% | 70% | 46% | 51% | 60% |
| | 2006 | 228,960 | 86% | 85% | 87% | 60% | 64% | 73% | 32% | 44% | 56% |
| | 2007 | 88,700 | 67% | 68% | 68% | 26% | 32% | 42% | | 14% | 27% |
| | 2008 | 28,437 | 30% | 33% | 29% | | | | | | |
| | 2009 | 21,337 | | 11% | 29% | | | | | | |
| | 2010 | 8,419 | | 15% | 41% | | | | | | |
| | 2011 | 38,256 | 117% | 116% | 117% | 40% | 13% | 19% | 18% | 1% | |
| | Total | 968,497 | 82% | 83% | 84% | 53% | 54% | 59% | 28% | 35% | 45% |

Table 5-80. A subset of estimated chum salmon saved (AEQ) by region and year under 3 different allocation schemes and hard caps for Alternative 2, component 2 **option 1b)**, 2004-2011.

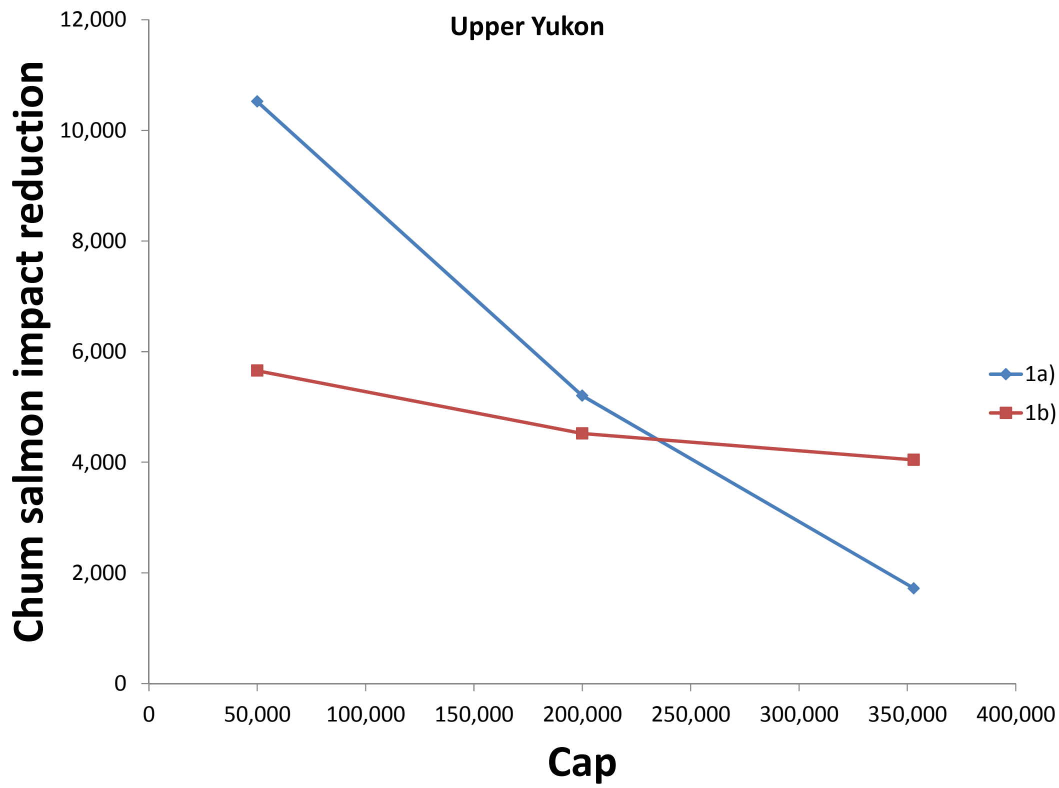
| | | Estimated | 50,000 | | | 200,000 | | | 353,000 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | AEQ | 2ii | 4ii | 6 | 2ii | 4ii | 6 | 2ii | 4ii | 6 |
| | 2004 | 31,261 | -556 | -791 | -1,790 | -404 | -675 | -400 | -688 | -46 | |
| | 2005 | 72,610 | 23,849 | 22,840 | 21,915 | 22,807 | 23,807 | 24,214 | 21,478 | 21,966 | 23,383 |
| | 2006 | 49,776 | 25,749 | 25,200 | 24,768 | 22,027 | 23,449 | 25,414 | 20,112 | 20,187 | 21,973 |
| | 2007 | 15,815 | 6,658 | 6,831 | 6,718 | 5,154 | 5,589 | 6,589 | 4,457 | 4,457 | 5,018 |
| Coastal WAK | 2008 | 4,048 | -136 | -7 | -28 | | | | | | |
| | 2009 | 4,332 | 558 | 448 | 156 | | | | | | |
| | 2010 | 2,748 | 310 | 246 | 86 | | | | | | |
| | 2011 | 13,059 | 1,216 | 1,279 | 1,575 | 134 | 534 | 384 | 370 | -103 | -289 |
| | Total | 193,649 | 57,649 | 56,047 | 53,399 | 49,718 | 52,703 | 56,201 | 45,730 | 46,462 | 50,086 |
| | 2004 | 15,401 | 1,128 | 959 | 684 | 780 | 392 | 279 | 474 | 305 | |
| | 2005 | 34,095 | 15,901 | 15,548 | 15,298 | 14,416 | 14,728 | 14,961 | 13,393 | 13,305 | 13,990 |
| | 2006 | 31,440 | 19,077 | 18,849 | 18,652 | 15,651 | 16,625 | 18,324 | 14,109 | 14,111 | 15,445 |
| | 2007 | 11,056 | 5,916 | 5,982 | 6,106 | 4,376 | 4,752 | 5,595 | 3,788 | 3,788 | 4,262 |
| Upper Yukon | 2008 | 3,104 | 28 | 94 | 197 | | | | | | |
| | 2009 | 1,429 | 207 | 199 | 162 | | | | | | |
| | 2010 | 1,024 | 119 | 109 | 89 | | | | | | |
| | 2011 | 9,173 | 2,870 | 2,890 | 3,133 | 938 | 1,206 | 1,266 | 592 | 69 | 166 |
| | Total | 106,722 | 45,245 | 44,629 | 44,322 | 36,162 | 37,703 | 40,425 | 32,355 | 31,577 | 33,863 |
| | 2004 | 6,446 | 113 | 55 | -115 | 75 | -22 | -5 | -10 | 44 | |
| | 2005 | 13401 | 5,057 | 4,893 | 4,749 | 4,699 | 4,848 | 4,933 | 4,390 | 4,433 | 4,692 |
| | 2006 | 8562 | 3,216 | 3,159 | 3,110 | 2,924 | 3,020 | 3,174 | 2,711 | 2,719 | 2,924 |
| | 2007 | 2362 | 242 | 273 | 268 | 203 | 195 | 256 | 165 | 165 | 193 |
| SWAK | 2008 | 708 | -14 | 1 | 0 | | | | | | |
| | 2009 | 1396 | 324 | 341 | 348 | | | | | | |
| | 2010 | 6132 | 179 | 187 | 191 | | | | | | |
| | 2011 | 29245 | 618 | 629 | 706 | 169 | 262 | 253 | 142 | -2 | -10 |
| | Total | 68,252 | 9,733 | 9,536 | 9,256 | 8,070 | 8,303 | 8,611 | 7,399 | 7,359 | 7,799 |
| | 2004 | 61,564 | 1,088 | 554 | -1,033 | 730 | -184 | -37 | -73 | 416 | |
| | 2005 | 111,183 | 11,189 | 8,833 | 6,864 | 14,320 | 15,508 | 14,942 | 13,989 | 14,787 | 15,365 |
| | 2006 | 102,437 | 26,806 | 25,654 | 24,671 | 23,430 | 25,307 | 28,347 | 21,198 | 21,489 | 23,726 |
| | 2007 | 33,814 | 11,125 | 11,508 | 11,326 | 8,662 | 9,183 | 11,044 | 7,405 | 7,405 | 8,389 |
| SEAK-BC-WA | 2008 | 10,507 | -244 | -3 | -32 | | | | | | |
| | 2009 | 8,109 | 2,241 | 2,578 | 3,109 | | | | | | |
| | 2010 | 4,734 | 1,242 | 1,413 | 1,705 | | | | | | |
| | 2011 | 29,342 | 5,836 | 5,939 | 6,659 | 1,601 | 2,478 | 2,395 | 1,342 | -14 | -81 |
| | Total | 361,690 | 59,284 | 56,476 | 53,269 | 48,741 | 52,293 | 56,692 | 43,862 | 44,083 | 47,398 |
| | 2004 | 215,250 | -17,296 | -18,412 | -27,432 | -12,194 | -11,630 | -7,337 | -12,564 | -3,453 | |
| | 2005 | 339,138 | -31,577 | -40,397 | -49,300 | -9,128 | -3,730 | -5,601 | -4,918 | 2,409 | 3,966 |
| | 2006 | 228,960 | 10,349 | 6,322 | 3,100 | 16,355 | 19,509 | 21,600 | 15,920 | 17,199 | 19,165 |
| | 2007 | 88,700 | 10,605 | 12,432 | 11,527 | 9,701 | 9,901 | 12,317 | 8,136 | 8,136 | 9,316 |
| Asia | 2008 | 28,437 | -1,254 | -269 | -683 | | | | | | |
| | 2009 | 21,337 | 1,801 | 976 | -995 | | | | | | |
| | 2010 | 8,419 | 974 | 535 | -545 | | | | | | |
| | 2011 | 38,256 | -13,327 | -12,779 | -11,665 | -7,424 | -5,329 | -7,656 | -1,353 | -1,855 | -4,955 |
| | Total | 968,497 | -39,725 | -51,593 | -75,994 | -2,690 | 8,722 | 13,322 | 5,222 | 22,437 | 27,492 |

Table 5-81. A subset of estimated chum salmon saved (AEQ) by region and year under 3 different allocation schemes and hard caps for Alternative 2, component 2 **option 1b)**, 2004-2011.

| | | Estimated | 50,000 | | | 200,000 | | | 353,000 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | AEQ | 2ii | 4ii | 6 | 2ii | 4ii | 6 | 2ii | 4ii | 6 |
| Coastal WAK | 2004 | 31,261 | -2% | -3% | -6% | -1% | -2% | -1% | -2% | 0% | |
| | 2005 | 72,610 | 33% | 31% | 30% | 31% | 33% | 33% | 30% | 30% | 32% |
| | 2006 | 49,776 | 52% | 51% | 50% | 44% | 47% | 51% | 40% | 41% | 44% |
| | 2007 | 15,815 | 42% | 43% | 42% | 33% | 35% | 42% | 28% | 28% | 32% |
| | 2008 | 4,048 | -3% | 0% | -1% | | | | | | |
| | 2009 | 4,332 | 13% | 10% | 4% | | | | | | |
| | 2010 | 2,748 | 11% | 9% | 3% | | | | | | |
| | 2011 | 13,059 | 9% | 10% | 12% | 1% | 4% | 3% | 3% | -1% | -2% |
| | Total | 193,649 | 30% | 29% | 28% | 26% | 27% | 29% | 24% | 24% | 26% |
| Upper Yukon | 2004 | 15,401 | 7% | 6% | 4% | 5% | 3% | 2% | 3% | 2% | |
| | 2005 | 34,095 | 47% | 46% | 45% | 42% | 43% | 44% | 39% | 39% | 41% |
| | 2006 | 31,440 | 61% | 60% | 59% | 50% | 53% | 58% | 45% | 45% | 49% |
| | 2007 | 11,056 | 54% | 54% | 55% | 40% | 43% | 51% | 34% | 34% | 39% |
| | 2008 | 3,104 | 1% | 3% | 6% | | | | | | |
| | 2009 | 1,429 | 14% | 14% | 11% | | | | | | |
| | 2010 | 1,024 | 12% | 11% | 9% | | | | | | |
| | 2011 | 9,173 | 31% | 32% | 34% | 10% | 13% | 14% | 6% | 1% | 2% |
| | Total | 106,722 | 42% | 42% | 42% | 34% | 35% | 38% | 30% | 30% | 32% |
| SWAK | 2004 | 6,446 | 2% | 1% | -2% | 1% | 0% | 0% | 0% | 1% | |
| | 2005 | 13401 | 38% | 37% | 35% | 35% | 36% | 37% | 33% | 33% | 35% |
| | 2006 | 8562 | 38% | 37% | 36% | 34% | 35% | 37% | 32% | 32% | 34% |
| | 2007 | 2362 | 10% | 12% | 11% | 9% | 8% | 11% | 7% | 7% | 8% |
| | 2008 | 708 | -2% | 0% | 0% | | | | | | |
| | 2009 | 1396 | 23% | 24% | 25% | | | | | | |
| | 2010 | 6132 | 3% | 3% | 3% | | | | | | |
| | 2011 | 29245 | 2% | 2% | 2% | 1% | 1% | 1% | 0% | 0% | 0% |
| | Total | 68,252 | 14% | 14% | 14% | 12% | 12% | 13% | 11% | 11% | 11% |
| SEAK-BC-WA | 2004 | 61,564 | 2% | 1% | -2% | 1% | 0% | 0% | 0% | 1% | |
| | 2005 | 111,183 | 10% | 8% | 6% | 13% | 14% | 13% | 13% | 13% | 14% |
| | 2006 | 102,437 | 26% | 25% | 24% | 23% | 25% | 28% | 21% | 21% | 23% |
| | 2007 | 33,814 | 33% | 34% | 33% | 26% | 27% | 33% | 22% | 22% | 25% |
| | 2008 | 10,507 | -2% | 0% | 0% | | | | | | |
| | 2009 | 8,109 | 28% | 32% | 38% | | | | | | |
| | 2010 | 4,734 | 26% | 30% | 36% | | | | | | |
| | 2011 | 29,342 | 20% | 20% | 23% | 5% | 8% | 8% | 5% | 0% | 0% |
| | Total | 361,690 | 16% | 16% | 15% | 13% | 14% | 16% | 12% | 12% | 13% |
| Asia | 2004 | 215,250 | -8% | -9% | -13% | -6% | -5% | -3% | -6% | -2% | |
| | 2005 | 339,138 | -9% | -12% | -15% | -3% | -1% | -2% | -1% | 1% | 1% |
| | 2006 | 228,960 | 5% | 3% | 1% | 7% | 9% | 9% | 7% | 8% | 8% |
| | 2007 | 88,700 | 12% | 14% | 13% | 11% | 11% | 14% | 9% | 9% | 11% |
| | 2008 | 28,437 | -4% | -1% | -2% | | | | | | |
| | 2009 | 21,337 | 8% | 5% | -5% | | | | | | |
| | 2010 | 8,419 | 12% | 6% | -6% | | | | | | |
| | 2011 | 38,256 | -35% | -33% | -30% | -19% | -14% | -20% | -4% | -5% | -13% |
| | Total | 968,497 | -4% | -5% | -8% | 0% | 1% | 1% | 1% | 2% | 3% |

Table 5-82. Estimated chum salmon AEQ saved by region, and cap, Alternative 2 options for all years combined (summed over 2004-2011) under 3 different allocation configurations. Run estimates are from Table 5-77.

| Region | Run Estimate | Estimated AEQ | Cap | Option | Allocation configuration 2ii | 4ii | 6 |
|---|---|---|---|---|---|---|---|
| Coastal WAK | 39,233,000 | 193,649 | 50,000 | 1a) | 156,952 | 157,656 | 162,426 |
| | | | | 1b) | 57,649 | 56,047 | 53,399 |
| | | | 200,000 | 1a) | 86,950 | 96,573 | 116,258 |
| | | | | 1b) | 49,718 | 52,703 | 56,201 |
| | | | 353,000 | 1a) | 36,547 | 54,828 | 77,167 |
| | | | | 1b) | 45,730 | 46,462 | 50,086 |
| Upper Yukon | 8,454,000 | 106,722 | 50,000 | 1a) | 84,184 | 83,901 | 86,734 |
| | | | | 1b) | 45,245 | 44,629 | 44,322 |
| | | | 200,000 | 1a) | 41,623 | 48,256 | 61,318 |
| | | | | 1b) | 36,162 | 37,703 | 40,425 |
| | | | 353,000 | 1a) | 13,760 | 24,446 | 37,431 |
| | | | | 1b) | 32,355 | 31,577 | 33,863 |
| SW AK | | | 50,000 | 1a) | 28,675 | 28,810 | 29,396 |
| | | | | 1b) | 9,733 | 9,536 | 9,256 |
| | | | 200,000 | 1a) | 16,695 | 17,998 | 21,084 |
| | | | | 1b) | 8,070 | 8,303 | 8,611 |
| | | | 353,000 | 1a) | 6,146 | 10,311 | 14,688 |
| | | | | 1b) | 7,399 | 7,359 | 7,799 |
| SEAK-BC-WA | | | 50,000 | 1a) | 278,541 | 277,571 | 283,102 |
| | | | | 1b) | 59,284 | 56,476 | 53,269 |
| | | | 200,000 | 1a) | 163,562 | 172,737 | 200,362 |
| | | | | 1b) | 48,741 | 52,293 | 56,692 |
| | | | 353,000 | 1a) | 73,107 | 103,226 | 142,135 |
| | | | | 1b) | 43,862 | 44,083 | 47,398 |
| Asia | | | 50,000 | 1a) | 794,820 | 800,621 | 814,930 |
| | | | | 1b) | -39,725 | -51,593 | -75,994 |
| | | | 200,000 | 1a) | 517,792 | 522,931 | 568,806 |
| | | | | 1b) | -2,690 | 8,722 | 13,322 |
| | | | 353,000 | 1a) | 272,868 | 339,216 | 438,591 |
| | | | | 1b) | 5,222 | 22,437 | 27,492 |



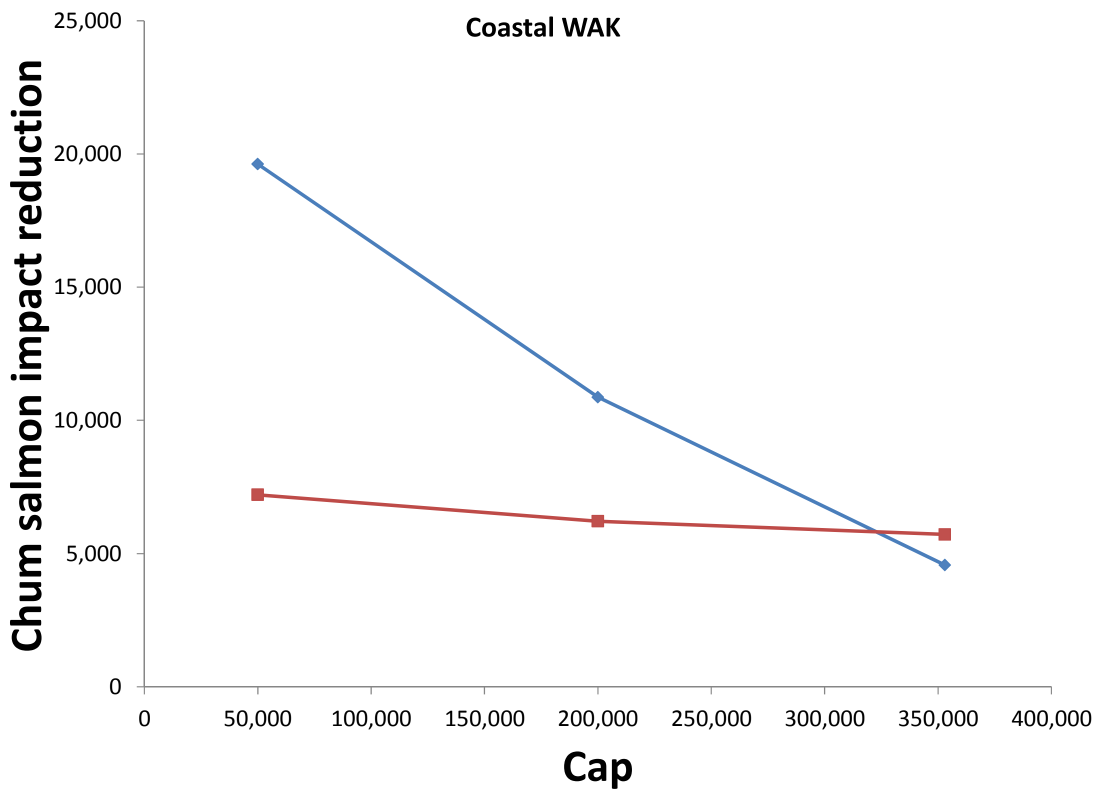




Figure 5-99. Average chum salmon impact reduction (AEQ) by suboption for Alternative 2, sector allocation 2ii, for years 2004-2011 for Upper Yukon (top) and Coastal WAK (bottom).

Table 5-83. Estimated annual chum salmon saved in AEQ terms under alternative 2 by hard cap and option for for 2004-2011 for the B season with allocation configuration 1 (2ii). The third column lists the run-size estimates from Table 5-75 whereas the 4th column is from Table 5-77.

| | | Run size | Estimated | 50,000 | | 200,000 | | 353,000 | |
|---|---|---|---|---|---|---|---|---|---|
| | Year | (if avail.) | AEQ | 1a) | 1b) | 1a) | 1b) | 1a) | 1b) |
| Coastal WAK | 2004 | 3,324,602 | 31,261 | 26,313 | -556 | 15,150 | -404 | 5,089 | -688 |
| | 2005 | 5,891,716 | 72,610 | 65,047 | 23,849 | 42,504 | 22,807 | 20,696 | 21,478 |
| | 2006 | 7,738,349 | 49,776 | 45,763 | 25,749 | 24,159 | 22,027 | 9,818 | 20,112 |
| | 2007 | 5,204,218 | 15,815 | 11,202 | 6,658 | 2,927 | 5,154 | | 4,457 |
| | 2008 | 4,378,634 | 4,048 | 1,095 | -136 | | | | |
| | 2009 | 4,075,589 | 4,332 | | 558 | | | | |
| | 2010 | 4,086,792 | 2,748 | | 310 | | | | |
| | 2011 | 4,533,335 | 13,059 | 7,533 | 1,216 | 2,210 | 134 | 944 | 370 |
| | Total | | 193,649 | 156,952 | 57,649 | 86,950 | 49,718 | 36,547 | 45,730 |
| Upper Yukon | 2004 | 612,640 | 15,401 | 12,684 | 1,128 | 7,111 | 780 | 2,236 | 474 |
| | 2005 | 2,280,434 | 34,095 | 30,799 | 15,901 | 18,776 | 14,416 | 7,610 | 13,393 |
| | 2006 | 1,150,989 | 31,440 | 27,313 | 19,077 | 12,363 | 15,651 | 3,500 | 14,109 |
| | 2007 | 1,116,550 | 11,056 | 8,399 | 5,916 | 2,289 | 4,376 | | 3,788 |
| | 2008 | 905,100 | 3,104 | 485 | 28 | | | | |
| | 2009 | 575,730 | 1,429 | | 207 | | | | |
| | 2010 | 606,360 | 1,024 | | 119 | | | | |
| | 2011 | 1,206,441 | 9,173 | 4,504 | 2,870 | 1,085 | 938 | 415 | 592 |
| | Total | | 106,722 | 71,501 | 45,245 | 41,623 | 36,162 | 13,760 | 32,355 |
| SWAK | 2004 | | 6,446 | 5,370 | 113 | 3,061 | 75 | 1,003 | -10 |
| | 2005 | | 13401 | 11,937 | 5,057 | 7,574 | 4,699 | 3,396 | 4,390 |
| | 2006 | | 8562 | 7,862 | 3,216 | 4,771 | 2,924 | 1,560 | 2,711 |
| | 2007 | | 2362 | 1,703 | 242 | 836 | 203 | | 165 |
| | 2008 | | 708 | 125 | -14 | | | | |
| | 2009 | | 1396 | | 324 | | | | |
| | 2010 | | 6132 | | 179 | | | | |
| | 2011 | | 29245 | 1,678 | 618 | 454 | 169 | 186 | 142 |
| | Total | | 68,252 | 28,675 | 9,733 | 16,695 | 8,070 | 6,146 | 7,399 |
| SEAK-BC-WA | 2004 | | 61,564 | 50,196 | 1,088 | 28,606 | 730 | 9,374 | -73 |
| | 2005 | | 111,183 | 97,312 | 11,189 | 70,304 | 14,320 | 41,861 | 13,989 |
| | 2006 | | 102,437 | 85,121 | 26,806 | 49,666 | 23,430 | 20,134 | 21,198 |
| | 2007 | | 33,814 | 28,166 | 11,125 | 10,740 | 8,662 | | 7,405 |
| | 2008 | | 10,507 | 2,032 | -244 | | | | |
| | 2009 | | 8,109 | | 2,241 | | | | |
| | 2010 | | 4,734 | | 1,242 | | | | |
| | 2011 | | 29,342 | 15,713 | 5,836 | 4,246 | 1,601 | 1,739 | 1,342 |
| | Total | | 361,690 | 228,345 | 59,284 | 163,562 | 48,741 | 73,107 | 43,862 |
| Asia | 2004 | | 215,250 | 185,271 | -17,296 | 108,513 | -12,194 | 37,915 | -12,564 |
| | 2005 | | 339,138 | 299,162 | -31,577 | 233,591 | -9,128 | 154,570 | -4,918 |
| | 2006 | | 228,960 | 197,658 | 10,349 | 137,531 | 16,355 | 73,350 | 15,920 |
| | 2007 | | 88,700 | 59,536 | 10,605 | 22,781 | 9,701 | | 8,136 |
| | 2008 | | 28,437 | 8,519 | -1,254 | | | | |
| | 2009 | | 21,337 | | 1,801 | | | | |
| | 2010 | | 8,419 | | 974 | | | | |
| | 2011 | | 38,256 | 44,675 | -13,327 | 15,375 | -7,424 | 7,033 | -1,353 |
| | Total | | 968,497 | 609,549 | -39,725 | 517,792 | -2,690 | 272,868 | 5,222 |

Table 5-84. Estimated annual relative chum salmon saved in AEQ terms under alternative 2 by hard cap and option for for 2004-2011 for the B season with allocation configuration 1 (2ii).

| | | Estimated | 50,000 | | 200,000 | | 353,000 | |
|---|---|---|---|---|---|---|---|---|
| | Year | AEQ | 1a) | 1b) | 1a) | 1b) | 1a) | 1b) |
| Coastal WAK | 2004 | 31,261 | 84% | -2% | 48% | -1% | 16% | -2% |
| | 2005 | 72,610 | 90% | 33% | 59% | 31% | 29% | 30% |
| | 2006 | 49,776 | 92% | 52% | 49% | 44% | 20% | 40% |
| | 2007 | 15,815 | 71% | 42% | 19% | 33% | | 28% |
| | 2008 | 4,048 | 27% | -3% | | | | |
| | 2009 | 4,332 | | 13% | | | | |
| | 2010 | 2,748 | | 11% | | | | |
| | 2011 | 13,059 | 58% | 9% | 17% | 1% | 7% | 3% |
| | Total | 193,649 | 81% | 30% | 45% | 26% | 19% | 24% |
| Upper Yukon | 2004 | 15,401 | 82% | 7% | 46% | 5% | 15% | 3% |
| | 2005 | 34,095 | 90% | 47% | 55% | 42% | 22% | 39% |
| | 2006 | 31,440 | 87% | 61% | 39% | 50% | 11% | 45% |
| | 2007 | 11,056 | 76% | 54% | 21% | 40% | | 34% |
| | 2008 | 3,104 | 16% | 1% | | | | |
| | 2009 | 1,429 | | 14% | | | | |
| | 2010 | 1,024 | | 12% | | | | |
| | 2011 | 9,173 | 49% | 31% | 12% | 10% | 5% | 6% |
| | Total | 106,722 | 67% | 42% | 39% | 34% | 13% | 30% |
| SWAK | 2004 | 6,446 | 83% | 2% | 47% | 1% | 16% | 0% |
| | 2005 | 13401 | 89% | 38% | 57% | 35% | 25% | 33% |
| | 2006 | 8562 | 92% | 38% | 56% | 34% | 18% | 32% |
| | 2007 | 2362 | 72% | 10% | 35% | 9% | | 7% |
| | 2008 | 708 | 18% | -2% | | | | |
| | 2009 | 1396 | | 23% | | | | |
| | 2010 | 6132 | | 3% | | | | |
| | 2011 | 29245 | 6% | 2% | 2% | 1% | 1% | 0% |
| | Total | 68,252 | 42% | 14% | 24% | 12% | 9% | 11% |
| SEAK-BC-WA | 2004 | 61,564 | 82% | 2% | 46% | 1% | 15% | 0% |
| | 2005 | 111,183 | 88% | 10% | 63% | 13% | 38% | 13% |
| | 2006 | 102,437 | 83% | 26% | 48% | 23% | 20% | 21% |
| | 2007 | 33,814 | 83% | 33% | 32% | 26% | | 22% |
| | 2008 | 10,507 | 19% | -2% | | | | |
| | 2009 | 8,109 | | 28% | | | | |
| | 2010 | 4,734 | | 26% | | | | |
| | 2011 | 29,342 | 54% | 20% | 14% | 5% | 6% | 5% |
| | Total | 361,690 | 63% | 16% | 45% | 13% | 20% | 12% |
| Asia | 2004 | 215,250 | 86% | -8% | 50% | -6% | 18% | -6% |
| | 2005 | 339,138 | 88% | -9% | 69% | -3% | 46% | -1% |
| | 2006 | 228,960 | 86% | 5% | 60% | 7% | 32% | 7% |
| | 2007 | 88,700 | 67% | 12% | 26% | 11% | | 9% |
| | 2008 | 28,437 | 30% | -4% | | | | |
| | 2009 | 21,337 | | 8% | | | | |
| | 2010 | 8,419 | | 12% | | | | |
| | 2011 | 38,256 | 117% | -35% | 40% | -19% | 18% | -4% |
| | Total | 968,497 | 63% | -4% | 53% | 0% | 28% | 1% |

Table 5-85. Estimated proportion of Alaska chum salmon saved relative to AEQ mortality year different **hard caps** and sector allocations by year for Alternative 2.

| | Sector allocation | Estimated AEQ | 50,000 1a) | 50,000 1b) | 200,000 1a) | 200,000 1b) | 353,000 1a) | 353,000 1b) |
|---|---|---|---|---|---|---|---|---|
| Coastal WAK | 2ii | | 156,952 | 57,649 | 86,950 | 49,718 | 36,547 | 45,730 |
| | 4ii | | 157,656 | 56,047 | 96,573 | 52,703 | 54,828 | 46,462 |
| | 6 | | 162,426 | 53,399 | 116,258 | 56,201 | 77,167 | 50,086 |
| | | 193,649 | | | | | | |
| Upper Yukon | 2ii | | 84,184 | 45,245 | 41,623 | 36,162 | 13,760 | 32,355 |
| | 4ii | | 83,901 | 44,629 | 48,256 | 37,703 | 24,446 | 31,577 |
| | 6 | | 86,734 | 44,322 | 61,318 | 40,425 | 37,431 | 33,863 |
| | Total | 106,722 | | | | | | |
| SWAK | 2ii | | 28,675 | 9,733 | 16,695 | 8,070 | 6,146 | 7,399 |
| | 4ii | | 28,810 | 9,536 | 17,998 | 8,303 | 10,311 | 7,359 |
| | 6 | | 29,396 | 9,256 | 21,084 | 8,611 | 14,688 | 7,799 |
| | Total | 68,252 | | | | | | |
| SEAK-BC-WA | 2ii | | 278,541 | 59,284 | 163,562 | 48,741 | 73,107 | 43,862 |
| | 4ii | | 277,571 | 56,476 | 172,737 | 52,293 | 103,226 | 44,083 |
| | 6 | | 283,102 | 53,269 | 200,362 | 56,692 | 142,135 | 47,398 |
| | Total | 361,690 | | | | | | |
| Asia | 2ii | | 794,820 | -39,725 | 517,792 | -2,690 | 272,868 | 5,222 |
| | 4ii | | 800,621 | -51,593 | 522,931 | 8,722 | 339,216 | 22,437 |
| | 6 | | 814,930 | -75,994 | 568,806 | 13,322 | 438,591 | 27,492 |
| | Total | 968,497 | | | | | | |

Table 5-86. Estimated proportion of Alaska chum salmon saved relative to AEQ mortality year different **hard caps** and sector allocations by year for Alternative 2.

| | Sector allocation | Estimated AEQ | 50,000 1a) | 50,000 1b) | 200,000 1a) | 200,000 1b) | 353,000 1a) | 353,000 1b) |
|---|---|---|---|---|---|---|---|---|
| Coastal WAK | 2ii | | 81% | 30% | 45% | 26% | 19% | 24% |
| | 4ii | | 81% | 29% | 50% | 27% | 28% | 24% |
| | 6 | | 84% | 28% | 60% | 29% | 40% | 26% |
| | | 193,649 | | | | | | |
| Upper Yukon | 2ii | | 79% | 42% | 39% | 34% | 13% | 30% |
| | 4ii | | 79% | 42% | 45% | 35% | 23% | 30% |
| | 6 | | 81% | 42% | 57% | 38% | 35% | 32% |
| | | 106,722 | | | | | | |
| SWAK | 2ii | | 42% | 14% | 24% | 12% | 9% | 11% |
| | 4ii | | 42% | 14% | 26% | 12% | 15% | 11% |
| | 6 | | 43% | 14% | 31% | 13% | 22% | 11% |
| | | 68,252 | | | | | | |
| SEAK-BC-WA | 2ii | | 77% | 16% | 45% | 13% | 20% | 12% |
| | 4ii | | 77% | 16% | 48% | 14% | 29% | 12% |
| | 6 | | 78% | 15% | 55% | 16% | 39% | 13% |
| | | 361,690 | | | | | | |
| Asia | 2ii | | 82% | -4% | 53% | 0% | 28% | 1% |
| | 4ii | | 83% | -5% | 54% | 1% | 35% | 2% |
| | 6 | | 84% | -8% | 59% | 1% | 45% | 3% |
| | | 968,497 | | | | | | |

#### 5.3.4.1 An evaluation of transferability of chum salmon among sectors

As noted in methods, the analysis assumes between cooperative transferability. Between sector transferability is evaluated here for Alternative 2, option 1a for illustrative purposes. This option assumes “perfect” transferability in that sectors would exchange allocated chum salmon PSC freely. By year, comparing with and without transferability shows that adding transferability reduces the effectiveness of saving chum salmon except for in some years for Asian stocks (Table 5-87). Compared to the sector split options (integrated over years) the hard caps with transferabilities make no difference by sector allocation scheme and is contrasted in Table 5-88. In summary, results indicate that the bycatch under sector transferability would be higher for all stocks (including Chinook salmon; compared to Alternative 2 option 1a) and even the amount of pollock foregone would be higher (Table 5-89). This increase in foregone pollock is presumably due to more sectors losing opportunities to fish due to the fact that fleet-wide in some years was met early enough.

Actual transferability options would be initially from sector specific allocations (the analysis above was as if there were no sector allocations) and then in a given year, a “clean” sector could transfer their chum salmon PSC to a sector that requires more. Logically this poses challenges for analysis because the conditions for a transfer would have to be that the “clean” sector would know in advance that they have salmon to transfer to a sector needing more PSC salmon to extend their pollock fishing. Alternatively the clean sector could finish their pollock fishing earlier than the sector needing more PSC salmon and transfer at that time. Simulating either condition would require apriori knowledge about the interaction between sectors which are unknown. Additionally, such a system will add complexity to management and enforcement, and will obviously result in higher salmon bycatch (within a cap) and less foregone pollock.

Nonetheless we examined one scenario to for Alternative 2, option 1a) with a cap of 50,000 and sector allocation 6. In 2005 had this scenario been in place all sectors would have come up against their cap so there would be no transfers (with motherships and shorebased CV sectors hitting their cap on the 2nd and 4th of July, respectively). In 2006, shorebased boats would have hit their cap on June 14th, and remarkably all other sectors stay below their cap. Assuming somehow that the other sectors would know how much salmon they would catch at the end of the year, then the difference between the remaining salmon and the sum of their caps is 7,645 chum. That amount would not be enough for the shorebased sector to fish even one more day (their initial allocation is 22,385 salmon, on June 13th they went from 13,838 salmon to 30,390). In summary, the idea of transfers would be beneficial in principle; however, “what ifs” evaluations from historical data are limited to illustrate performance benefits.

Table 5-87. A subset of estimated annual chum salmon saved (AEQ) by region for allocation 4ii (applicable for the option w/o transferability) by cap level with and without sector transferability (note for this case transferability is taken to mean no sector allocations) for Alternative 2, component 2 **option 1a)**, for 2004-2011. The shaded column represents the estimated AEQ impact that occurred whereas the other values represent the amount (in numbers of fish) that would have been saved had the measures been in place.

| | | Estimated | 50,000 | | 200,000 | | 353,000 | |
|---|---|---|---|---|---|---|---|---|
| | | | Transferability | | Transferability | | Transferability | |
| | Year | AEQ | No | Yes | No | Yes | No | Yes |
| Coastal WAK | 2004 | 31,261 | 26,504 | 25,437 | 14,974 | 13,146 | 6,994 | 4,952 |
| | 2005 | 72,610 | 65,158 | 64,050 | 46,451 | 39,759 | 29,955 | 20,001 |
| | 2006 | 49,776 | 45,381 | 44,594 | 29,744 | 21,863 | 16,574 | 9,477 |
| | 2007 | 15,815 | 11,159 | 10,605 | 4,726 | 2,202 | 1,235 | |
| | 2008 | 4,048 | 1,199 | 1,032 | | | | |
| | 2009 | 4,332 | 429 | | | | | |
| | 2010 | 2,748 | 235 | | | | | |
| | 2011 | 13,059 | 7,591 | 7,619 | 678 | | 69 | |
| | Total | 193,649 | 157,656 | 153,338 | 96,573 | 76,970 | 54,828 | 34,430 |
| Upper Yukon | 2004 | 15,401 | 12,538 | 11,213 | 6,579 | 5,776 | 3,073 | 2,176 |
| | 2005 | 34,095 | 30,780 | 29,698 | 21,047 | 16,930 | 12,671 | 7,355 |
| | 2006 | 31,440 | 27,013 | 26,410 | 16,542 | 10,595 | 7,734 | 3,379 |
| | 2007 | 11,056 | 8,291 | 7,943 | 3,789 | 1,672 | 938 | |
| | 2008 | 3,104 | 532 | 458 | | | | |
| | 2009 | 1,429 | 96 | | | | | |
| | 2010 | 1,024 | 53 | | | | | |
| | 2011 | 9,173 | 4,599 | 4,571 | 298 | | 30 | |
| | Total | 106,722 | 83,901 | 80,293 | 48,256 | 34,973 | 24,446 | 12,910 |
| SWAK | 2004 | 6,446 | 5,370 | 5,021 | 2,952 | 2,592 | 1,379 | 976 |
| | 2005 | 13401 | 11,947 | 11,645 | 8,347 | 6,967 | 5,197 | 3,283 |
| | 2006 | 8562 | 7,817 | 7,740 | 5,558 | 4,523 | 3,266 | 1,506 |
| | 2007 | 2362 | 1,693 | 1,654 | 1,008 | 813 | 456 | |
| | 2008 | 708 | 137 | 118 | | | | |
| | 2009 | 1396 | 94 | | | | | |
| | 2010 | 6132 | 52 | | | | | |
| | 2011 | 29245 | 1,701 | 1,700 | 134 | | 14 | |
| | Total | 68,252 | 28,810 | 27,878 | 17,998 | 14,895 | 10,311 | 5,765 |
| SEAK-BC-WA | 2004 | 61,564 | 50,195 | 46,912 | 27,582 | 24,214 | 12,883 | 9,122 |
| | 2005 | 111,183 | 96,968 | 95,091 | 71,525 | 67,591 | 50,982 | 40,450 |
| | 2006 | 102,437 | 83,954 | 83,148 | 57,802 | 47,226 | 33,868 | 19,436 |
| | 2007 | 33,814 | 27,943 | 27,004 | 14,578 | 9,565 | 5,367 | |
| | 2008 | 10,507 | 2,227 | 1,916 | | | | |
| | 2009 | 8,109 | 231 | | | | | |
| | 2010 | 4,734 | 127 | | | | | |
| | 2011 | 29,342 | 15,928 | 15,918 | 1,250 | | 127 | |
| | Total | 361,690 | 277,571 | 269,989 | 172,737 | 148,597 | 103,226 | 69,007 |
| Asia | 2004 | 215,250 | 188,906 | 189,157 | 111,563 | 97,941 | 52,106 | 36,896 |
| | 2005 | 339,138 | 299,253 | 300,788 | 231,197 | 231,720 | 173,173 | 149,373 |
| | 2006 | 228,960 | 195,119 | 194,937 | 146,532 | 136,905 | 101,333 | 70,807 |
| | 2007 | 88,700 | 60,033 | 57,328 | 28,584 | 21,547 | 12,089 | |
| | 2008 | 28,437 | 9,333 | 8,033 | | | | |
| | 2009 | 21,337 | 2,284 | | | | | |
| | 2010 | 8,419 | 1,252 | | | | | |
| | 2011 | 38,256 | 44,441 | 45,034 | 5,055 | | 514 | |
| | Total | 968,497 | 800,621 | 795,276 | 522,931 | 488,113 | 339,216 | 257,076 |

Table 5-88. A subset of estimated sum of chum salmon saved (AEQ) by region and year under 3 different allocation schemes and hard caps for Alternative 2, component 2 **option 1a)**, 2004-2011 with (i.e., for this case no sector allocations) and without transferability. The shaded column represents the sum of annual estimated AEQ impact that occurred due to pollock fishing whereas the other values represent the amount (in numbers of fish) that would have been saved had the measures been in place.

| | Sector allocation | Estimated AEQ | 50,000 | | 200,000 | | 353,000 | |
|---|---|---|---|---|---|---|---|---|
| | | | No | Yes | No | Yes | No | Yes |
| Coastal WAK | 2ii | | 156,952 | 153,338 | 86,950 | 76,970 | 36,547 | 34,430 |
| | 4ii | | 157,656 | 153,338 | 96,573 | 76,970 | 54,828 | 34,430 |
| | 6 | | 162,426 | 153,338 | 116,258 | 76,970 | 77,167 | 34,430 |
| | | 193,649 | | | | | | |
| Upper Yukon | 2ii | | 84,184 | 80,293 | 41,623 | 34,973 | 13,760 | 12,910 |
| | 4ii | | 83,901 | 80,293 | 48,256 | 34,973 | 24,446 | 12,910 |
| | 6 | | 86,734 | 80,293 | 61,318 | 34,973 | 37,431 | 12,910 |
| | Total | 106,722 | | | | | | |
| SWAK | 2ii | | 28,675 | 27,878 | 16,695 | 14,895 | 6,146 | 5,765 |
| | 4ii | | 28,810 | 27,878 | 17,998 | 14,895 | 10,311 | 5,765 |
| | 6 | | 29,396 | 27,878 | 21,084 | 14,895 | 14,688 | 5,765 |
| | Total | 68,252 | | | | | | |
| SEAK-BC-WA | 2ii | | 278,541 | 269,989 | 163,562 | 148,597 | 73,107 | 69,007 |
| | 4ii | | 277,571 | 269,989 | 172,737 | 148,597 | 103,226 | 69,007 |
| | 6 | | 283,102 | 269,989 | 200,362 | 148,597 | 142,135 | 69,007 |
| | Total | 361,690 | | | | | | |
| Asia | 2ii | | 794,820 | 795,276 | 517,792 | 488,113 | 272,868 | 257,076 |
| | 4ii | | 800,621 | 795,276 | 522,931 | 488,113 | 339,216 | 257,076 |
| | 6 | | 814,930 | 795,276 | 568,806 | 488,113 | 438,591 | 257,076 |
| | Total | 968,497 | | | | | | |

Table 5-89. A subset of estimated total chum salmon saved (AEQ) by region for allocation 4ii (applicable for the option w/o transferability) by cap level with and without sector transferability (i.e., for this case no sector allocations) for Alternative 2, component 2 **option 1a)**, summed over 2004-2011. The shaded column represents the sum of annual estimated AEQ impact that occurred due to pollock fishing whereas the other values represent the amount (in numbers of fish) that would have been saved had the measures been in place. Also shown are Chinook salmon reductions and foregone pollock levels for comparison.

| | | 50,000 Transferability? | | 200,000 Transferability? | | 353,000 Transferability? | |
|---|---|---|---|---|---|---|---|
| Region | AEQ | No | Yes | No | Yes | No | Yes |
| Coastal WAK | 193,649 | 157,656 | 153,338 | 96,573 | 76,970 | 54,828 | 34,430 |
| Upper Yukon | 106,722 | 83,901 | 80,293 | 48,256 | 34,973 | 24,446 | 12,910 |
| SWAK | 68,252 | 28,810 | 27,878 | 17,998 | 14,895 | 10,311 | 5,765 |
| SEAK-BC-WA | 361,690 | 277,571 | 269,989 | 172,737 | 148,597 | 103,226 | 69,007 |
| Asia | 968,497 | 800,621 | 795,276 | 522,931 | 488,113 | 339,216 | 257,076 |
| Chinook | | 156,895 | 158,237 | 80,883 | 79,337 | 69,459 | 53,026 |
| Forgone pollock | | 2,555,789 | 3,026,558 | 917,434 | 1,166,292 | 515,021 | 521,356 |

### 5.3.4.2 Summary of impacts of pollock fishery on chum salmon for Alternative 2

Under the options and suboptions for Alternative 2, in most years for all sectors there are incidental takes of the prohibited species in question therefore there is an adverse impact under this alternative. For some suboptions and combinations, this management alternative will likely decrease the bycatch of chum salmon for Alaska stocks. These suboptions and combinations would thus minimize the adverse impacts of the status quo management. However, bycatch in some options (e.g., option 1b) result in slightly higher or neglible reductions for Asian chum salmon.

Nearly every option under consideration result in reductions of chum PSC and consequently provide increased returns of adult salmon to their regions of origin. The largest reduction is estimated to occur under a hard cap of 50,000 chum, option 1a for a B-season cap which would have provided an average Coastal western Alaska increased return of 20.3 thousand chum (compared to an average AEQ mortality estimated at 24.2 thousand chum). Given that the average estimated run size for this region for this period is 4.9 million, the ratio of mortality impact is about 0.5% and it seems unlikely that in-river management would have been modified for this amount of returning fish aggregated over all rivers systems in coastal west Alaska given the intricacies of in-season, in-river management as described in Section 5.2.1. In either case, impacts are unlikely to be significantly adverse because they would not diminish protections afforded to chum salmon in the current management of the groundfish fisheries.

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## 5.3.5 Alternative 3, Triggered closure with RHS exemption

The methodology for evaluating the impact of the triggered closures is similar to the other approaches in that results are based on superimposing proposed rules on data from 2003-2011 and assuming that fishery behaviors would be unchanged. For the areas that get closed the pollock that was caught inside the region is diverted to outside and salmon bycatch accrues at the rate observed outside the area. For example, if a closure occurred on a specific data and the historical data indicated that 1,000 t of pollock was caught inside the closure after that day, then that 1,000 t would be caught in proportion to areas and times outside of that area and the added salmon bycatch would be $x \bullet 1{,}000$ where $x$ is the number of salmon caught per ton of pollock outside the closure area and after the closure occurred (accounting is done by sector). If the bycatch rate *x* is higher than the actual rate *inside* the closure that the total bycatch in that year will be higher than the observed.

### 5.3.5.1 Alternative 3, Component 1

Component 1 of alternative 3 imposes a large-scale triggered closure to which participants in the RHS program are exempt. This component is examined in two ways: 1-as a separate alternative whereby this is the only component selected and thus the RHS program provides the primary management tool while the large-scale area closure provides the incentive to participate in the RHS, and 2-as the first layer in a series of measures including components 2 through 6 as desirable to provide additional protection to minimize chum PSC.

As a first pass for Alternative 3 it was assumed that the fishery-wide bycatch level (with the trigger cap allocated only between CDQ and non-CDQ vessels) was evaluated against season-wide caps (no further sector allocations) to determine when closures would occur. This entailed simply accruing the annual bycatch by these two groups and when a group-level (CDQ or non-CDQ) cap was reached, the 80% area would be closed to that group. Results for chum salmon saved indicate approximate dates closures would have occurred in different years are shown in Table 5-90. Since this is a measure intended to provide incentives for participation, this component is not evaluated as a primary management tool, but rather it gives some idea of the magnitude of the constraint as a means to providing an incentive to participate in the RHS program.

Selection of a cap level of under this component will interact with choices made elsewhere. For example, additional closure and cap configurations may result in complexity where participation may become less desireable.

Table 5-90. Approximate week the large area closure would occur

| | 25,000 | | 75,000 | | 200,000 | |
|---|---|---|---|---|---|---|
| | **CDQ** | **Non-CDQ** | **CDQ** | **Non-CDQ** | **CDQ** | **Non-CDQ** |
| 2003 | 6-Sep | 2-Aug | 27-Sep | 23-Aug | | |
| 2004 | 29-Aug | 27-Jun | 19-Sep | 1-Aug | | 29-Aug |
| 2005 | | 28-Jun | | 5-Jul | | 19-Jul |
| 2006 | | 7-Jun | | 21-Jun | | 26-Jul |
| 2007 | 6-Sep | 16-Aug | | 6-Sep | | |
| 2008 | | | | | | |
| 2009 | | 26-Jul | | | | |
| 2010 | | | | | | |
| 2011 | 4-Oct | 21-Jun | | 19-Jul | | |

Given that the current program has 100% participation, it is likely that if this component alone were selected, and with the relative constraints estimated on the CDQ and non-CDQ fishery as shown in Table 5-90, participation would remain at 100%. Thus the impacts of this component (alone with no other components selected) are best characterized by status quo, assuming no other changes to the RHS program prior to implementation.

In June 2011, the Council requested that additional consideration be given to analyzing the parameters of the current RHS that could be modified to potentially improve performance (see June 2011 Council motion, Appendix 2). Some specific items that were requested for consideration include the following:

- Modification of RHS to operate at a vessel level, instead of at the cooperative level;
- Faster reaction/closure time (shorter delay between announcement and closure);

- Amount of closure area;
- Adjustments that would address timing and location of bycatch of Western Alaska chum stocks;
- Base rates;
- Possibilities by which the tier system may be amended to provide further incentives to reduce chum bycatch.

Discussion below focuses on these additional modifications that could be made within the existing RHS system itself in conjunction with Component 1 (alone with no other components selected) which would potentially improve the savings estimated to be realized under this program.

### 5.3.5.2 Potential modifications to improve the Rolling Hotspot Program

The historical analysis of status quo (See Section 5.3.1.2 through 5.3.1.6) examines several of the factors listed above in the Council motion in conjunction with an evaluate of the efficacy of the collective program as a whole. However in this section each of these issues are examined individually, to provide a qualitative discussion of the merits of potential future modifications of these parameters of the current RHS program. This discussion draws upon the historical simulations and information examined under Alternative 1 (Section 5.3.1).

#### *5.3.5.2.1 Modification of RHS to operate at a vessel-level, instead of at the cooperative level.*

The argument for this change is that it would make individuals more directly subject to the consequences of their actions. Under the existing system closures apply to *cooperatives* based on their average PSC rates rather than to individual vessels. This creates several situations in which vessels could have little incentive to reduce their PSC. The first is where a cooperative has very low PSC for the first part of the period before a closure, so vessels can have high PSC late in the period without their cooperative being punished in any way. The second effect is where other vessels in a cooperative have had very high PSC early in the week and good behavior later in the week will not be enough to avoid being subject to any closures. While this type of effect could also happen under a system with vessel-level incentives, for example for an individual vessel making several trips or many hauls in a week, the likelihood of the vessel's behavior not being of importance to its tier status is much lower under an individual-based system.

One member of the AP commented at the June 2010 Council meeting that there can actually be strong social pressures that come from the cooperative-level closures, because everyone is affected by an individual's behavior. So it is not unambiguous that individual-level closures will always be more impactful than cooperative-level closures.

The Amendment 91 Chinook rolling hotspot closure (RHC) systems under the inshore and catcher processor IPAs apply the closures and tier system at the individual vessel rather the cooperative level. The chum RHS system could potentially include both individual and cooperative level triggers, which would provide a greater incentive to reduce PSC than either individual or cooperative closures alone. However, how effective this is depends also on the value of access to the closure(s). If there were longer-duration or larger closures in place, the incentive from either individual- or cooperative-level incentives would be stronger.

#### *5.3.5.2.2 Faster reaction/closure time (shorter delay between announcement and closure)*

The historical simulations indicate that closures based on newer information are on average more likely to be effective than closures based on older information (Figure 5-94).

There are two factors that impact how quickly information collected is incorporated in the design of closures: 1) how quickly information on PSC is received and able to be included in deciding what areas will be closed, and 2) the time from when a closure is declared to when it is implemented.

Sea State works aggressively to obtain and utilize newer information. VMS data, delivery information, and direct contacts with vessel operators are all incorporated into closure decisions. There are not obvious ways for the Council to improve this process.

The second factor that impacts the age of information utilized when closures are implemented is the delay between when a closure is announced and when it is implemented. The delay reduces the economic costs of the closures on the pollock fleet. The approximately 24 to 30-hour advance notice of the closures provides time for vessel operators to move from or avoid traveling to an area that will be closed. Removing this advance notice would make information "fresher", but would have several additional impacts. First, it would create additional costs for vessels that have to travel out of the closures or move to another location. Second, it would create an incentive for vessels to anticipate closure areas and to avoid a high-PSC area because it could be closed and they could be forced to relocate. Vessels would be less likely to start fishing in an area that has had high PSC and this could lead to some additional PSC avoidance.

Another means to potentially further reduce salmon with RHS closures would be to incorporate "emergency closures" that would close high-PSC areas immediately, regardless of the time or day of the week. However, one of the problems with doing this effectively is the information lag from when fishing occurs and when information on PSC is received by Sea State. This lag is especially large for catcher vessels, and there is no way to make this information real-time.

One should have some concern that there could be adverse incentives for information sharing from too aggressive a policy of emergency closures. Vessel operators would have a reduced incentive to report that there appeared to be a lot of chum in a tow if the result will be that the area where they are fishing will be closed and they will have to move elsewhere immediately.

#### *5.3.5.2.3 Adjust the amount of closure area*

From the beginning of the rolling hotspot program, there has been a limit on the maximum size and number of RHS closures that can be imposed at any time. The current chum RHS system states "*the following limits shall apply to designations of "B" season Savings Areas: (i) Chum Salmon Savings Area closures in the East Region may not exceed three thousand (3,000) square miles in total area during any single closure period; (ii) Chum Salmon Savings Areas in the West Region may not exceed one thousand (1,000) square miles in total area during any single closure period; (iii) there may be up to two (2) Savings Areas per Region per closure period.*"

The historical analysis (see Figure 5-93) indicates that an increased area closed is likely to lead to increased reduction in chum PSC, but at a decreasing rate as larger areas are closed. At times Sea State is constrained by the area limitation from closing clearly identifiable PSC hotspots.

One of the flexibilities of the RHS system is that the need to have reasonably good fishing grounds can be incorporated into the decision about where to close areas. Closing very large areas has the potential to have several unintended outcomes beyond increasing the cost of fishing. First, it could push people into areas with unknown PSC levels or the only good fishing locations at a point in time could be ones known to have higher PSC rates. Second, closing the best fishing areas (that also have high chum PSC rates) could push people into lower-quality fishing areas. The current analysis suggests little or no impact on average vessel catch per unit effort (CPUE) for 2003-2010. However, if very large areas are closed, CPUE could slow which would prolong the season and increase the share of effort in October, the time of the B-Season which traditionally has the highest Chinook PSC rates. This topic is addressed further in the discussion of options for adjusting the tier system.

#### *5.3.5.2.4 Consider adjustments that would address timing and location of bycatch of Western Alaska chum stocks;*

Other parts of this analysis indicate that a larger component of the chum PSC from early in the B season is from Western Alaska chum stocks, so reducing PSC more early in the B season will have a greater benefit for these stocks. The various changes suggested in this section of the analysis could be focused on the early part of the B season.

It is unclear where the point is where this could have a significant impact, but being "too aggressive" in closing areas early in B season has the potential to push fishing into lower-CPUE areas and therefore push more effort into the end of the season when average Chinook PSC rates are higher. In addition to an expanded RHS system early in the B season, the chum RHS system could also be modified so that vessels that have very low chum PSC early in the season would be subject to less stringent closure actions later in the season. This would provide additional incentives for reducing PSC of Western Alaska chum stocks but would allow greater flexibility to vessels.

#### *5.3.5.2.5 Adjust the base rates used in the RHS program*

In the current RHS system, there is an initial base rate and then a process by which the base rate adjusts during the season that impacts whether or not hotspot closures are imposed and into what tier vessels fall from week to week. At the beginning of the B season, the non-Chinook base rate is established at 0.19 salmon/t. Beginning on July 1, this is re-adjusted every week to a three-week moving average of the fleet PSC rate.

The 3-week moving average in-season adjustments of the base rate allow the system to adjust and still be relevant to the current fishing conditions. If the base rate is very high and the actual PSC rate is very low, then there are no closures or they do not apply to anyone. If the base rate is very low relative to the PSC rate, then closures apply to all cooperatives (so exclude people but do not provide an incentive to be in one tier versus another).

The historical analysis suggests that lowering base rate from 0.19 chum/t would not have a significant impact on RHS effectiveness. Raising the rate to 0.4 would led to more PSC in the historical simulations, but this was at lower average annual levels than the 2011 rate, for example, when chum closures were in effect for virtually all of the B season.

Why else is the lowest possible base rate not always the best? At low chum-encounter periods, an area may have the highest PSC, but closing it will not have much expected benefit in terms of salmon PSC reduction and may lead to good, relatively low-PSC areas being closed, potentially forcing the fleet to fish in areas that actually have higher PSC. The absolute reduction in PSC at low encounter levels is also likely to be low.

One caveat to note is that the simulation evaluates different fixed base-rate levels rather than a dynamic one like is employed in the current RHS system. The dynamic rate could be modified so that the rate would always be relative to other vessels, above a minimum base rate that was seen to be necessary for closure effectiveness. This would ensure that the highest PSC vessels in a period are always subject to closures (except at low-PSC conditions when this is not likely to be effective).

#### *5.3.5.2.6 Possibilities by which the tier system may be amended to provide further incentives to reduce chum bycatch.*

There are two primary means through which the existing RHS system reduces PSC. First, the RHS closures reduce PSC by excluding vessels from fishing during the next period in current high-PSC areas. Second, the tier system and the threat of the closures provide some incentive to have a lower PSC rate before areas are closed to avoid being subject to the closure in subsequent periods.

The current tier system allows some vessels to fish inside of the RHS closures to provide an incentive for vessels to avoid high PSC, because the closures do not apply to lower-PSC vessels. However, the small amount of fishing that Tier 1 and 2 vessels do inside of current closures suggests that this incentive is not very strong, as most vessels choose to fish elsewhere during the closure period. Clearly if the areas to be closed were larger, the importance of being in a better tier would be greater.

There are, however, many ways that the tier system could be adjusted to provide stronger incentives to have lower chum PSC rates. For example, the new CP sector Chinook IPA makes high-PSC vessels potentially subject to longer closures when their aggregate PSC level is high, relative to other vessels. Or at the extreme, a vessel that has persistently extreme PSC rates could be forced by an alternative tier system to "stand down" for a period of time (or this could be interpreted as the vessel being subject to a Bering Sea – wide closure). Some variety of this approach could be implemented for chum.

The tier system in the RHS is tied to spatial closures, but it could be tied to any incentive. Many options exist for the types of incentives that can be tied to a tier system, but the range of possible incentives that could be incorporated includes:

- Larger or longer-term closures for high-PSC vessels
- Periods of no fishing
- Fines or fees, that could pay for RHS monitoring or could fund research
- Areas could be placed in a 'warning list' so that vessels fishing in areas that were known to be high-PSC would make vessels subject to larger or longer-term spatial closures.

It should be noted that the draft "Financial Incentive Plan" (FIP) developed by the members of the catcher-processor sector would also share some of the characteristics of such a tier system. In a manner similar to the FIP, vessels could contribute money to a pool that would be returned to the fleet in proportion to PSC performance to provide an incentive for vessels to avoid chum without using spatial closures.

A modified tier-system could have several means for assigning vessels to different tiers, including the following:

1. **The aggregate PSC rate.** As in the catcher processor Chinook IPA, more significant closures could be imposed on vessels with on-going high PSC in high-PSC periods. This would give the RHS system stronger incentives for PSC avoidance in high-PSC periods, but would not close the fishery.
2. **A vessel's (or cooperative's) relative weekly PSC performance could always be used to determine if closures apply**. As discussed earlier in this section, the base rate could be adjusted weekly to ensure that above a minimum threshold, closures always apply to vessels with relatively high PSC rates.
3. **PSC in areas that were recently high-PSC areas would increase the penalty for PSC**. This would create "soft closures," where vessel operators could choose to fish in above-average areas if they can do so and avoid PSC, but they would be subject other closures or penalties if they have very high PSC as a result. This could also be customized so that vessels cannot return to areas where they previously had high chum PSC.

4. **Larger closures could be applied in periods with more high-PSC areas**. Subject to a maximum share of fishing grounds to avoid closing pushing people into high-PSC areas, a larger number of closing areas could be closed.
5. **More flexibility in the system could be allowed for vessels with low *Chinook* PSC**.To the degree that Chinook is held as a priority and the Council has expressed concern about the impacts of its chum action on Chinook PSC, allowing additional flexibility in the chum RHS system for vessels with low Chinook PSC would be an additional incentive to reduce *Chinook* PSC. For example, vessels could receive an adjustment in their estimated chum rate if their Chinook rate is low, making them less likely to be subject to a chum closure. This could potentially balance or outweigh the consequences of chum closures redirecting people in a manner that might at times have the potential to increase Chinook PSC.

The tier system can be utilized as an alternative to a hard cap to ensure that there are strong incentives to avoid PSC, and it would have several advantages over a hard cap. First, an RHS system is flexible in a manner that hard cap is not. An RHS system can provide incentives under the different levels of abundance that have been experienced with chum in the Bering Sea pollock fishery.

One of the challenges of designing a system like this is to balance the desire to limit the amount of salmon PSC that might occur with the desire to maintain flexibility. In a manner similar to how draft incentive plan agreements were developed and evaluated prior to Amendment 91, the Council could request that members of industry design a RHS that would have certain performance goals that could be evaluated by the SSC and stakeholders prior to Final Action.

### 5.3.5.3 Alternative 3, Components 2-6

Under Components 2-6, additional layered management is placed on the participants of the RHS program by virtue of triggered closure areas[48]. Here whatever cap level is selected under Component 1 does not need to be equivalent to one selected under these components. Once these components are selected, a specified trigger area, cap and time frame are imposed on the fleet (either by CDQ and non-CDQ fleet or by individual sector) *in addition* to closures imposed by virtue of participation in the RHS program. Since RHS closures were already imposed on the fleet over the analytical time frame used here, it is assumed that imposing additional triggered closures by sector would best approximate this alternative, however it should be noted that no changes in fleet behavior as a result of the threat of the additional closures are included for analysis but it is assumed that some modification in fleet behavior would be likely to occur. Thus this analysis represents a worst-case scenario for contraints by sector as fleets would likely make behavioral changes to try to avoid reaching specified cap levels.

The methods for evaluating component 2 under alternative 3 require some notation and is included here rather than the methods section because of how diverted pollock fishing from a closed area by season requires extra consideration. Let $C_{i,j}$ be the bycatch of salmon (chum or Chinook) with index *i* be an indicator variable related to observerations within the closure area (a value of 0 means outside, 1 means inside) and index *j* indicates period within a year: 0=before closure, 1=after closure but before Aug 1st, and 2=Aug 1st (or closure date if later than Aug 1st) to October 31st. Accounting for bycatch by these periods allows incorporation of genetics information which showed differences in chum stock compositions. Similarly, pollock catch ($P_{i,j}$) can be tallied from the observer data by the same indices. The total bycatch for a given year $C'$ is thus estimated as:

[48] Note that as discussed in Chapter 2, component 6, cooperative provisions are treated qualitatively and all analysis quantitatively is focused on the sector-level allocations only.

$$C^{'} = C_{0,0} + C_{0,1} + P_{1,1}r_{0,1} + P_{1,2}r_{0,2} \text{ with } r_{0,j} = \frac{C_{0,j}}{P_{0,j}}$$

In words, this is simply the bycatch outside the closure area before and after a cap was reached plus the pollock caught inside the closure area after the cap was reached multiplied by the bycatch rate outside the area after the cap was reached.

An Alternative 3 option closes an area only in the June July period. This presents a challenge for analysis because the potential reaction by the fleet to such closures could vary. For example, vessels restricted by the closure in the June-July period may choose to fish outside the closure during that period or choose divert their pollock to fish after the end of July or some combination of these strategies. Consequently, we analyzed this type of closure by introducing a uniform 0,1 variable $\lambda$ which when set to 1.0 assumes the pollock that was caught inside the closed area was diverted to outside the area for the remainder of the June-July period or if set to zero assumes the pollock that was caught inside the closed area was diverted to after the end of July. Intermediate values of $\lambda$ allow some pollock to occur in both periods.

$$C^{'} = C_{0,0} + C_{0,1} + \lambda P_{1,1}r_{0,1} + (1-\lambda) P_{1,1}r_{0.2}$$

where the 2nd index for $r_{0,2}$ value of 2 indicates that bycatch rates computation extends from August 1st through October 31st (with no closure area). An added complication is to monitor the chum salmon that comes from the different periods. For analysis, values selected for $\lambda$ were 0.0, 0.5, and 1.0. The following describes the options and the closure area and period used for analysis:

| Option* | Closure area | Period/closure size basis |
|---|---|---|
| 1a) | 80% | B season |
| 1b) | 80% | June-July |
| 2a) | 60% | B season |
| 2b) | 60% | June-July |

*Note staff reorganized components and options under Alternative 3 to be consistent with structure and order under Alternative 2

As with the results from Alternative 2, presentation over all combinations of caps (3), allocations (3), options (4), sectors (4), alternative $\lambda$ values (3; for a subset of options), years (9), species and/or stocks of interest (8) would result in presenting nearly 30,000 values. Consequently, tables below are intended to highlight the different dimensions of the problem rather than show all results. As noted above, extra accounting is required to evaluate the within-B season impacts of the different components and alternative specifications. For this reason values are presented expanded to the genetics information on chum salmon (available for 2005-2009 and using seasonal average proportions in other years).

For an appreciation of the interannual variability over options there is a broad range of results. For example, the chum salmon saved for a cap of 25,000 and sector split 2ii, option 1b) outperforms the other options in all years except for in 2007 (where it is estimated to have a slightly negative impact, i.e., more bycatch; Table 5-91). It should be noted that in 2007 the overall chum bycatch was quite low and such fine scale differences are minor. As expected, higher cap levels result in reduced overall chum salmon savings (Table 5-91 through Table 5-93). Imposing closures in June-July has definite consequences for Asian AEQ chum bycatch (much lower savings) compared 1a) or 2a) and varied by sector split (Table 5-94). The dates of closures across options and sector allocations and caps indicate that higher cap levels result in closures that occur later in the season (for options 1a) and 2a) and for the June-July period, generally occur near the end of July (Table 5-95-Table 5-97).

The impact of different $\lambda$ values on closures across caps and for an intermediate sector allocation (4ii) shows that for coastal west-Alaska stocks the best option for saving chum salmon is when it's value is zero (indicating that pollock diverted due to closures in June-July be taken later on in the year when there are no closures; Figure 5-100). This figure also reveals that this comes at the expense of worse Chinook salmon bycatch (i.e., negative Chinook salmon savings due to increased fishing activity later in the year when Chinook bycatch rates generally increase).

Over all options and sector splits for Alternative 3, component 2, the sector split configurations had the least contrast (except for the 200,000 cap and option 2a); Table 5-94). These results also indicate that the most effective option for saving chum is indicated by option 1b) and the lowest cap level (25,000). Note however that this option generally increases the date of closure (compared to 1a) and would likely result in higher Chinook salmon bycatch (see below). Dates of closures by option are shown in Table 5-95-Table 5-97 for each cap level and indicate that closures occur sooner for lower caps.

Table 5-91. Estimated annual chum salmon AEQ saved for years 2003-2011 for **Alternative 3 with cap set at 25,000 and sector split 2ii (allocation 1)** and $\lambda$=0 by region for different cap levels (apportioned by sector and where appropriate in option 1b) and 2b) by June-July) and allocations.

| | | Option | | | |
|---|---|---|---|---|---|
| **Cap=25,000** | **Year** | **1a)** | **1b)** | **2a)** | **2b)** |
| Coastal WAK | 2004 | 16,083 | -917 | 13,836 | -1,005 |
| | 2005 | 38,164 | 21,501 | 29,697 | 20,929 |
| | 2006 | 31,135 | 23,920 | 23,729 | 21,498 |
| | 2007 | 7,827 | 6,619 | 5,992 | 5,381 |
| | 2008 | -69 | 53 | -143 | 18 |
| | 2009 | 1,422 | 890 | 958 | 703 |
| | 2010 | 780 | 502 | 525 | 400 |
| | 2011 | 4,543 | 2,508 | 915 | 1,701 |
| | Total | 99,886 | 55,078 | 75,509 | 49,626 |
| Upper Yukon | 2004 | 7,089 | 147 | 6,098 | -39 |
| | 2005 | 18,174 | 13,863 | 13,777 | 12,990 |
| | 2006 | 19,951 | 17,611 | 15,120 | 15,376 |
| | 2007 | 6,457 | 5,843 | 4,989 | 4,637 |
| | 2008 | -31 | 188 | -64 | 72 |
| | 2009 | 372 | 321 | 268 | 251 |
| | 2010 | 204 | 190 | 147 | 152 |
| | 2011 | 2,675 | 3,060 | 887 | 1,916 |
| | Total | 47,802 | 41,223 | 41,224 | 35,356 |
| SWAK | 2004 | 3,175 | -92 | 2,731 | -133 |
| | 2005 | 7,042 | 4,474 | 5,443 | 4,267 |
| | 2006 | 5,188 | 3,202 | 4,019 | 3,006 |
| | 2007 | 1,178 | 411 | 966 | 349 |
| | 2008 | -8 | 8 | -16 | 3 |
| | 2009 | 445 | 495 | 343 | 386 |
| | 2010 | 244 | 276 | 188 | 216 |
| | 2011 | 1,006 | 812 | 259 | 525 |
| | Total | 18,269 | 9,586 | 13,933 | 8,619 |
| SEAK-BC-WA | 2004 | 29,660 | -842 | 25,515 | -1,232 |
| | 2005 | 54,128 | 9,927 | 44,533 | 12,013 |
| | 2006 | 59,088 | 27,721 | 47,323 | 25,304 |
| | 2007 | 20,235 | 12,291 | 16,076 | 10,132 |
| | 2008 | -129 | 113 | -265 | 38 |
| | 2009 | 2,054 | 3,373 | 1,803 | 2,617 |
| | 2010 | 1,126 | 1,887 | 989 | 1,473 |
| | 2011 | 9,413 | 7,635 | 2,432 | 4,933 |
| | Total | 145,914 | 62,105 | 138,406 | 55,280 |
| Asia | 2004 | 119,598 | -12,100 | 102,890 | -11,352 |
| | 2005 | 166,867 | -22,866 | 143,673 | -8,718 |
| | 2006 | 125,292 | 18,882 | 103,567 | 22,163 |
| | 2007 | 35,064 | 15,690 | 27,700 | 13,238 |
| | 2008 | -538 | 45 | -1,111 | -8 |
| | 2009 | 6,794 | 2,993 | 4,321 | 2,392 |
| | 2010 | 3,725 | 1,673 | 2,369 | 1,344 |
| | 2011 | 27,345 | -80 | 2,174 | 1,477 |
| | Total | 364,549 | 4,237 | 385,581 | 20,536 |

Table 5-92. Annual chum salmon saved for years 2003-2011 for **Alternative 3 with cap set at 75,000 and sector split 2ii (allocation 1)** and $\lambda$=0 by region for different cap levels (apportioned by sector and where appropriate in option 1b) and 2b) by June-July) and allocations.

| | | Option | | | |
|---|---|---|---|---|---|
| **Cap 75,000** | **Year** | **1a)** | **1b)** | **2a)** | **2b)** |
| Coastal WAK | 2004 | 14,830 | -64 | 13,458 | -108 |
| | 2005 | 30,930 | 22,643 | 19,850 | 22,014 |
| | 2006 | 24,192 | 24,303 | 16,112 | 21,856 |
| | 2007 | 6,147 | 6,507 | 4,950 | 5,347 |
| | 2008 | -3 | 0 | -2 | 0 |
| | 2009 | 0 | 468 | 0 | 483 |
| | 2010 | 0 | 256 | 0 | 265 |
| | 2011 | 2,420 | 1,696 | -284 | 1,204 |
| | Total | 78,516 | 55,809 | 54,084 | 51,060 |
| Upper Yukon | 2004 | 6,535 | 251 | 5,911 | 131 |
| | 2005 | 14,294 | 13,877 | 8,434 | 13,067 |
| | 2006 | 15,221 | 17,543 | 10,289 | 15,342 |
| | 2007 | 5,010 | 5,489 | 4,021 | 4,504 |
| | 2008 | -1 | 1 | -1 | 0 |
| | 2009 | 0 | 157 | 0 | 162 |
| | 2010 | 0 | 86 | 0 | 89 |
| | 2011 | 1,154 | 2,159 | -36 | 1,349 |
| | Total | 35,677 | 39,563 | 28,618 | 34,644 |
| SWAK | 2004 | 2,927 | 33 | 2,653 | 8 |
| | 2005 | 5,654 | 4,598 | 3,555 | 4,397 |
| | 2006 | 4,173 | 3,232 | 2,788 | 3,036 |
| | 2007 | 1,020 | 395 | 871 | 344 |
| | 2008 | 0 | 0 | 0 | 0 |
| | 2009 | 0 | 233 | 0 | 240 |
| | 2010 | 0 | 128 | 0 | 132 |
| | 2011 | 492 | 563 | -42 | 370 |
| | Total | 14,265 | 9,181 | 9,825 | 8,526 |
| SEAK-BC-WA | 2004 | 27,345 | 312 | 24,787 | 75 |
| | 2005 | 46,627 | 14,067 | 34,742 | 15,743 |
| | 2006 | 48,529 | 29,608 | 37,182 | 26,958 |
| | 2007 | 16,613 | 12,054 | 13,779 | 10,057 |
| | 2008 | -5 | 0 | -4 | 0 |
| | 2009 | 0 | 1,507 | 0 | 1,555 |
| | 2010 | 0 | 826 | 0 | 852 |
| | 2011 | 4,597 | 5,300 | -386 | 3,481 |
| | Total | 116,361 | 63,673 | 110,100 | 58,722 |
| Asia | 2004 | 110,298 | -3,151 | 100,290 | -2,522 |
| | 2005 | 150,669 | -3,100 | 124,525 | 8,684 |
| | 2006 | 108,083 | 27,632 | 86,460 | 29,672 |
| | 2007 | 30,185 | 15,560 | 25,495 | 13,243 |
| | 2008 | -22 | -4 | -19 | -2 |
| | 2009 | 0 | 1,732 | 0 | 1,789 |
| | 2010 | 0 | 950 | 0 | 981 |
| | 2011 | 17,168 | -915 | -2,971 | 1,114 |
| | Total | 306,082 | 38,704 | 333,781 | 52,958 |

Table 5-93. Annual chum salmon saved for years 2003-2011 for **Alternative 3 with cap set at 200,000 and sector split 2ii (allocation 1)** and $\lambda$=0 by region for different cap levels (apportioned by sector and where appropriate in option 1b) and 2b) by June-July) and allocations.

| | | Option | | | |
|---|---|---|---|---|---|
| **Cap 200,000** | **Year** | **1a)** | **1b)** | **2a)** | **2b)** |
| Coastal WAK | 2004 | 11,256 | -13 | 10,203 | -134 |
| | 2005 | 16,700 | 20,935 | 3,314 | 20,727 |
| | 2006 | 10,259 | 20,412 | 3,018 | 18,309 |
| | 2007 | 2,440 | 4,896 | 2,314 | 3,786 |
| | 2008 | 0 | 0 | 0 | 0 |
| | 2009 | 0 | 0 | 0 | 0 |
| | 2010 | 0 | 0 | 0 | 0 |
| | 2011 | 1,225 | 353 | 808 | 392 |
| | Total | 41,880 | 46,583 | 19,657 | 43,081 |
| Upper Yukon | 2004 | 5,013 | 251 | 4,515 | 82 |
| | 2005 | 6,700 | 12,598 | -398 | 12,089 |
| | 2006 | 5,681 | 14,353 | 1,770 | 12,409 |
| | 2007 | 1,918 | 4,124 | 1,823 | 3,183 |
| | 2008 | 0 | 0 | 0 | 0 |
| | 2009 | 0 | 0 | 0 | 0 |
| | 2010 | 0 | 0 | 0 | 0 |
| | 2011 | 541 | 631 | 358 | 465 |
| | Total | 14,841 | 31,956 | 8,068 | 28,227 |
| SWAK | 2004 | 2,230 | 39 | 2,017 | -4 |
| | 2005 | 2,929 | 4,212 | 386 | 4,103 |
| | 2006 | 2,144 | 2,873 | 732 | 2,735 |
| | 2007 | 659 | 315 | 612 | 266 |
| | 2008 | 0 | 0 | 0 | 0 |
| | 2009 | 0 | 0 | 0 | 0 |
| | 2010 | 0 | 0 | 0 | 0 |
| | 2011 | 242 | 147 | 160 | 125 |
| | Total | 8,204 | 7,586 | 3,906 | 7,224 |
| SEAK-BC-WA | 2004 | 20,837 | 371 | 18,843 | -30 |
| | 2005 | 31,860 | 14,360 | 17,506 | 15,961 |
| | 2006 | 27,043 | 24,572 | 18,795 | 22,076 |
| | 2007 | 8,648 | 9,216 | 8,099 | 7,301 |
| | 2008 | 0 | 0 | 0 | 0 |
| | 2009 | 0 | 0 | 0 | 0 |
| | 2010 | 0 | 0 | 0 | 0 |
| | 2011 | 2,261 | 1,382 | 1,494 | 1,173 |
| | Total | 69,811 | 49,901 | 64,737 | 46,480 |
| Asia | 2004 | 83,211 | -2,550 | 75,705 | -2,341 |
| | 2005 | 118,153 | 4,230 | 86,466 | 14,345 |
| | 2006 | 73,022 | 25,244 | 55,742 | 26,647 |
| | 2007 | 18,085 | 12,149 | 16,850 | 9,912 |
| | 2008 | 0 | 0 | 0 | 0 |
| | 2009 | 0 | 0 | 0 | 0 |
| | 2010 | 0 | 0 | 0 | 0 |
| | 2011 | 9,098 | -1,931 | 5,996 | 116 |
| | Total | 218,358 | 37,142 | 240,759 | 48,678 |

Table 5-94. Combined chum salmon saved (AEQ) over years 2004-2011 for **Alternative 3**, by region for different cap levels (apportioned by sector and where appropriate in option 1b) and 2b) by June-July) and allocations. The second column lists the run-size estimates summed from Table 5-75 whereas the 3rd column is from Table 5-77.

| Region | Run Estimate | Estimated AEQ | Cap | Option | Allocation configuration 2ii | 4ii | 6 |
|---|---|---|---|---|---|---|---|
| Coastal WAK | 39,233,000 | 193,649 | 25000 | 1a) | 99,886 | 99,177 | 97,647 |
| | | | | 1b) | 55,078 | 53,051 | 49,461 |
| | | | | 2a) | 75,509 | 77,335 | 74,473 |
| | | | | 2b) | 49,626 | 47,640 | 44,847 |
| | | | 75000 | 1a) | 78,516 | 86,004 | 83,687 |
| | | | | 1b) | 55,809 | 55,928 | 54,589 |
| | | | | 2a) | 54,084 | 59,058 | 62,818 |
| | | | | 2b) | 51,060 | 51,222 | 49,661 |
| | | | 200000 | 1a) | 41,880 | 49,834 | 71,196 |
| | | | | 1b) | 46,583 | 49,459 | 53,430 |
| | | | | 2a) | 19,657 | 22,130 | 49,358 |
| | | | | 2b) | 43,081 | 45,576 | 49,308 |
| Upper Yukon | 8,454,000 | 106,722 | 25000 | 1a) | 54,892 | 54,581 | 53,631 |
| | | | | 1b) | 41,223 | 40,737 | 39,527 |
| | | | | 2a) | 41,224 | 42,274 | 40,723 |
| | | | | 2b) | 35,356 | 34,853 | 34,031 |
| | | | 75000 | 1a) | 42,212 | 46,410 | 45,482 |
| | | | | 1b) | 39,563 | 39,852 | 39,784 |
| | | | | 2a) | 28,618 | 31,537 | 33,840 |
| | | | | 2b) | 34,644 | 34,811 | 34,745 |
| | | | 200000 | 1a) | 19,854 | 24,980 | 38,591 |
| | | | | 1b) | 31,956 | 33,946 | 37,157 |
| | | | | 2a) | 8,068 | 10,038 | 26,331 |
| | | | | 2b) | 28,227 | 29,917 | 32,952 |
| SW AK | | | 25000 | 1a) | 18,269 | 18,190 | 17,983 |
| | | | | 1b) | 9,586 | 9,107 | 8,549 |
| | | | | 2a) | 13,933 | 14,328 | 13,819 |
| | | | | 2b) | 8,619 | 8,146 | 7,735 |
| | | | 75000 | 1a) | 14,265 | 15,693 | 15,151 |
| | | | | 1b) | 9,181 | 9,274 | 9,247 |
| | | | | 2a) | 9,825 | 10,747 | 11,481 |
| | | | | 2b) | 8,526 | 8,607 | 8,459 |
| | | | 200000 | 1a) | 8,204 | 9,407 | 12,856 |
| | | | | 1b) | 7,586 | 7,916 | 8,357 |
| | | | | 2a) | 3,906 | 4,140 | 8,892 |
| | | | | 2b) | 7,224 | 7,457 | 7,848 |
| SEAK-BC-WA | | | 25000 | 1a) | 175,575 | 174,999 | 174,744 |
| | | | | 1b) | 62,105 | 58,392 | 52,216 |
| | | | | 2a) | 138,406 | 140,334 | 138,202 |
| | | | | 2b) | 55,280 | 51,565 | 46,912 |
| | | | 75000 | 1a) | 143,706 | 152,835 | 152,309 |
| | | | | 1b) | 63,673 | 63,502 | 61,303 |
| | | | | 2a) | 110,100 | 114,644 | 119,141 |
| | | | | 2b) | 58,722 | 58,737 | 55,740 |
| | | | 200000 | 1a) | 90,649 | 102,060 | 130,086 |
| | | | | 1b) | 49,901 | 53,779 | 60,116 |
| | | | | 2a) | 64,737 | 70,095 | 101,208 |
| | | | | 2b) | 46,480 | 49,423 | 56,444 |

Table 5-94. (continued) Combined chum salmon saved over years 2003-2011 for **Alternative 3**, by region for different cap levels (apportioned by sector and where appropriate in option 1a) and 2a) by June-July) and allocations.

| Region | Cap | Option | Allocation 2ii | 4ii | 6 |
|---|---|---|---|---|---|
| Asia | 25000 | 1a) | 484,147 | 481,900 | 482,661 |
| | | 1b) | 4,237 | -15,131 | -43,975 |
| | | 2a) | 385,581 | 388,475 | 384,678 |
| | | 2b) | 20,536 | 1,755 | -21,567 |
| | 75000 | 1a) | 416,380 | 437,011 | 436,272 |
| | | 1b) | 38,704 | 35,033 | 18,659 |
| | | 2a) | 333,781 | 338,621 | 345,180 |
| | | 2b) | 52,958 | 51,690 | 33,936 |
| | 200000 | 1a) | 301,569 | 322,610 | 367,934 |
| | | 1b) | 37,142 | 43,243 | 50,095 |
| | | 2a) | 240,759 | 250,586 | 301,382 |
| | | 2b) | 48,678 | 53,179 | 63,204 |

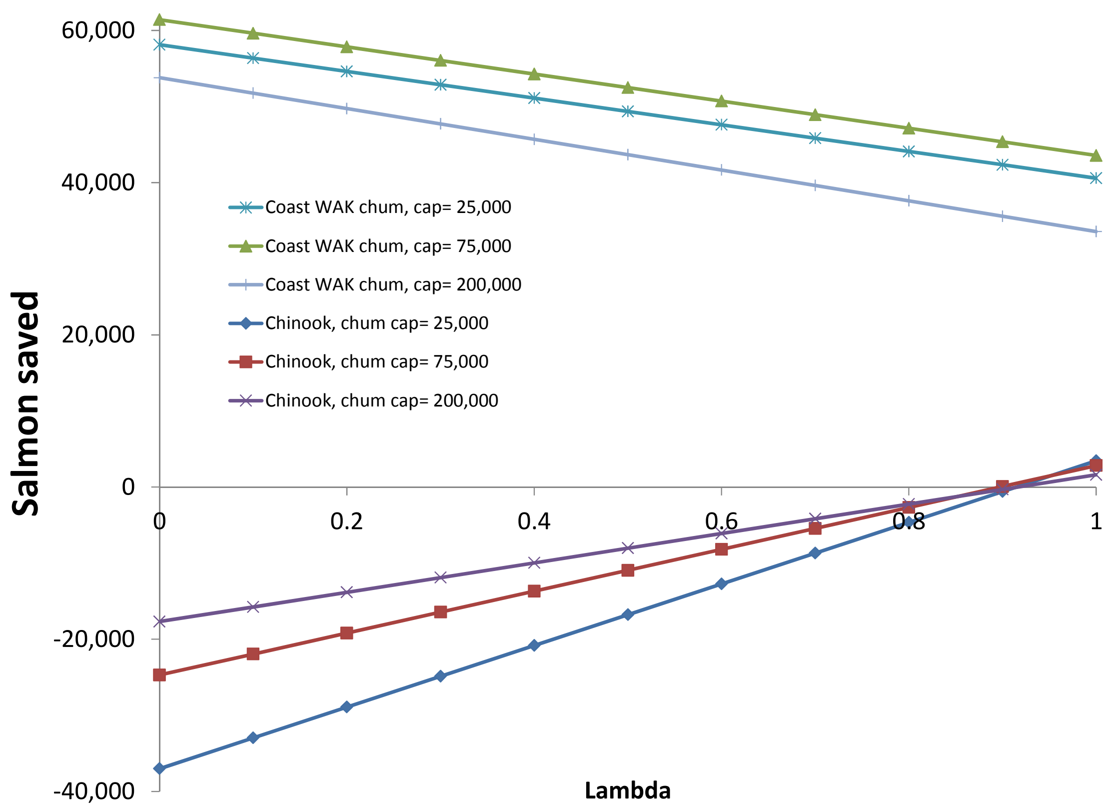


Figure 5-100. Contrast in salmon saved for different values of Lambda ($\lambda$) for option 1b (2b yielded similar patterns) for different cap levels. Values represent the sum over 9 years of data as if Alternative 3, component 2, options 1b had been applied. A value of $\lambda$= 1 simply implies that the pollock excluded from closures in June-July would be caught outside the closure in that period whereas a value of $\lambda$=0 means that the pollock diverted would be caught *after* July 31st in all areas (under this option there are no closure areas after July 31st).

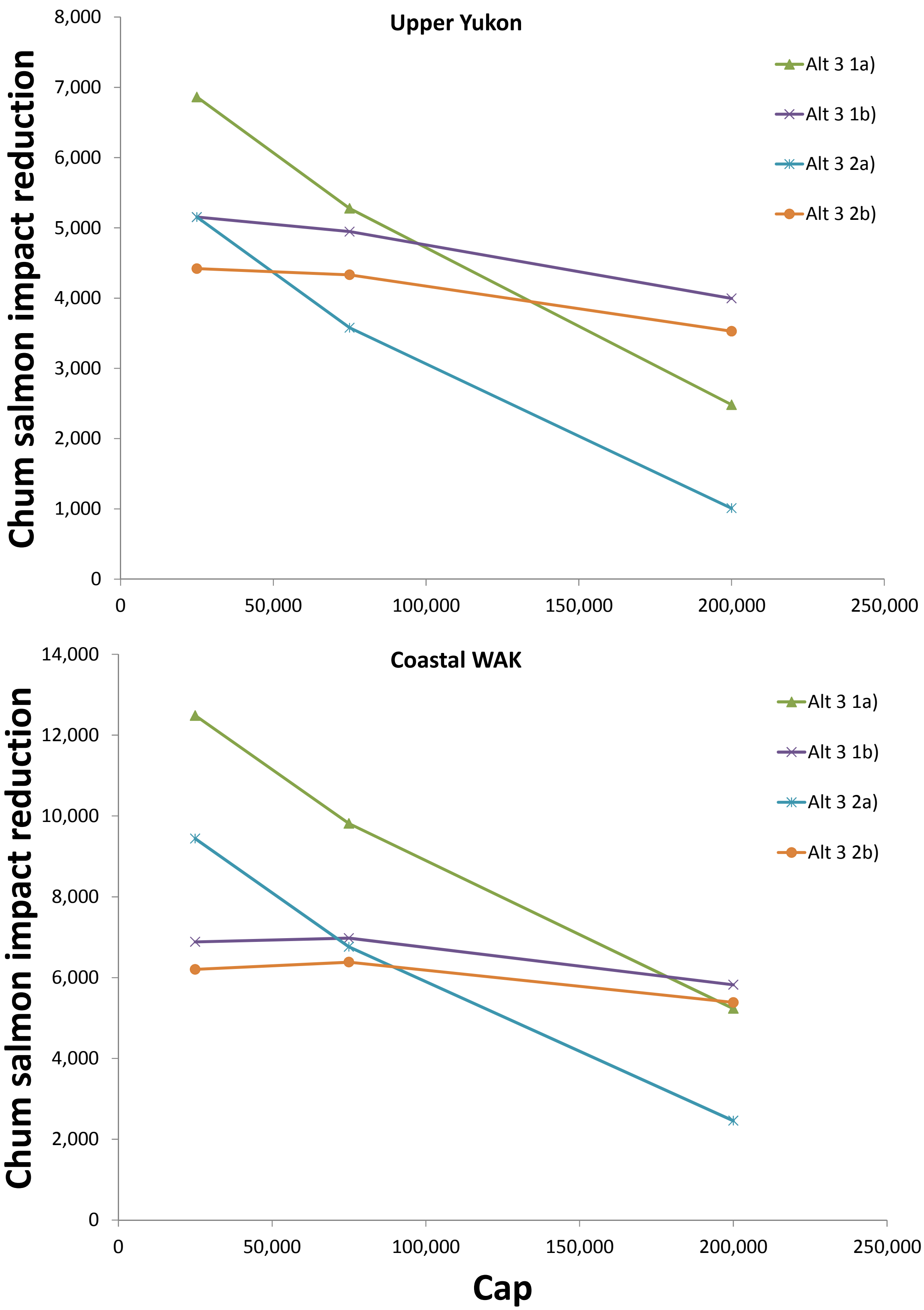


Figure 5-101. Average chum salmon impact reduction (AEQ) by suboption for Alternative 3, sector allocation 2ii, for years 2004-2011 for Upper Yukon (top) and Coastal WAK (bottom).

Table 5-95. Alternative 3 component 2 closure dates by sector and allocation scheme for each of the 4 options (1a, 1b, 2a, and 2b) for the **25,000 cap** level.

| | | CDQ Allocation | | | CP Allocation | | | M Allocation | | | S Allocation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Opt | Year | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| 1a) | 2003 | 27-Aug | 3-Sep | 10-Sep | 6-Aug | 27-Aug | 27-Aug | 30-Jul | 30-Jul | 20-Aug | 30-Jul | 30-Jul | 23-Jul |
| | 2004 | 22-Jul | 19-Aug | 26-Aug | 17-Jun | 17-Jun | 17-Jun | 8-Jul | 15-Jul | 22-Jul | 29-Jul | 29-Jul | 29-Jul |
| | 2005 | | | | 25-Jun | 25-Jun | 6-Aug | 25-Jun | 25-Jun | 25-Jun | 2-Jul | 25-Jun | 25-Jun |
| | 2006 | | | | 2-Jul | 23-Jul | 30-Jul | 20-Aug | | | 11-Jun | 11-Jun | 11-Jun |
| | 2007 | 20-Aug | 20-Aug | 27-Aug | 13-Aug | 20-Aug | 20-Aug | 23-Jul | 13-Aug | 13-Aug | 20-Aug | 13-Aug | 6-Aug |
| | 2008 | | | | | | | | | | | | 16-Sep |
| | 2009 | | | | | | | 23-Jul | 6-Aug | | 30-Jul | 30-Jul | 23-Jul |
| | 2010 | | | | | | | | | | | | |
| | 2011 | 23-Jul | 20-Aug | 1-Oct | 25-Jun | 2-Jul | 16-Jul | 18-Jun | 18-Jun | 18-Jun | 25-Jun | 18-Jun | 18-Jun |
| 1b) | 2003 | 16-Jul | | | 2-Jul | 30-Jul | | 23-Jul | 23-Jul | 23-Jul | 16-Jul | 9-Jul | 9-Jul |
| | 2004 | 15-Jul | 15-Jul | 22-Jul | 10-Jun | 10-Jun | 17-Jun | 1-Jul | 1-Jul | 8-Jul | 29-Jul | 22-Jul | 15-Jul |
| | 2005 | | | | 18-Jun | 18-Jun | 25-Jun | 25-Jun | 25-Jun | 25-Jun | 25-Jun | 25-Jun | 18-Jun |
| | 2006 | 16-Jul | | | 11-Jun | 25-Jun | 2-Jul | 16-Jul | 23-Jul | 30-Jul | 11-Jun | | |
| | 2007 | 9-Jul | | | 2-Jul | 16-Jul | | 2-Jul | 2-Jul | 16-Jul | 23-Jul | 9-Jul | 2-Jul |
| | 2008 | | | | | | | | | | | 29-Jul | 8-Jul |
| | 2009 | | | | 16-Jul | | | 25-Jun | 2-Jul | 9-Jul | 9-Jul | 9-Jul | 2-Jul |
| | 2010 | | | | 23-Jul | | | 16-Jul | 16-Jul | 30-Jul | | 30-Jul | 23-Jul |
| | 2011 | 2-Jul | 9-Jul | 23-Jul | 25-Jun | 25-Jun | 25-Jun | 18-Jun | 18-Jun | 18-Jun | 18-Jun | 18-Jun | 18-Jun |
| 2a) | 2003 | 27-Aug | 3-Sep | 10-Sep | 6-Aug | 27-Aug | 27-Aug | 30-Jul | 30-Jul | 20-Aug | 30-Jul | 30-Jul | 23-Jul |
| | 2004 | 22-Jul | 19-Aug | 26-Aug | 17-Jun | 17-Jun | 17-Jun | 8-Jul | 15-Jul | 22-Jul | 29-Jul | 29-Jul | 29-Jul |
| | 2005 | | | | 25-Jun | 25-Jun | 6-Aug | 25-Jun | 25-Jun | 25-Jun | 2-Jul | 25-Jun | 25-Jun |
| | 2006 | | | | 2-Jul | 23-Jul | 30-Jul | 20-Aug | | | 11-Jun | 11-Jun | 11-Jun |
| | 2007 | 20-Aug | 20-Aug | 27-Aug | 13-Aug | 20-Aug | 20-Aug | 23-Jul | 13-Aug | 13-Aug | 20-Aug | 13-Aug | 6-Aug |
| | 2008 | | | | | | | | | | | | 16-Sep |
| | 2009 | | | | | | | 23-Jul | 6-Aug | | 30-Jul | 30-Jul | 23-Jul |
| | 2010 | | | | | | | | | | | | |
| | 2011 | 23-Jul | 20-Aug | 1-Oct | 25-Jun | 2-Jul | 16-Jul | 18-Jun | 18-Jun | 18-Jun | 25-Jun | 18-Jun | 18-Jun |
| 2b) | 2003 | 16-Jul | | | 2-Jul | 30-Jul | | 23-Jul | 23-Jul | 23-Jul | 16-Jul | 9-Jul | 9-Jul |
| | 2004 | 15-Jul | 15-Jul | 22-Jul | 10-Jun | 10-Jun | 17-Jun | 1-Jul | 1-Jul | 8-Jul | 29-Jul | 22-Jul | 15-Jul |
| | 2005 | | | | 18-Jun | 18-Jun | 25-Jun | 25-Jun | 25-Jun | 25-Jun | 25-Jun | 25-Jun | 18-Jun |
| | 2006 | 16-Jul | | | 11-Jun | 25-Jun | 2-Jul | 16-Jul | 23-Jul | 30-Jul | 11-Jun | | |
| | 2007 | 9-Jul | | | 2-Jul | 16-Jul | | 2-Jul | 2-Jul | 16-Jul | 23-Jul | 9-Jul | 2-Jul |
| | 2008 | | | | | | | | | | | 29-Jul | 8-Jul |
| | 2009 | | | | 16-Jul | | | 25-Jun | 2-Jul | 9-Jul | 9-Jul | 9-Jul | 2-Jul |
| | 2010 | | | | 23-Jul | | | 16-Jul | 16-Jul | 30-Jul | | 30-Jul | 23-Jul |
| | 2011 | 2-Jul | 9-Jul | 23-Jul | 25-Jun | 25-Jun | 25-Jun | 18-Jun | 18-Jun | 18-Jun | 18-Jun | 18-Jun | 18-Jun |

Table 5-96. Alternative 3 component 2 closure dates by sector and allocation scheme for each of the 4 options (1a, 1b, 2a, and 2b) for the **75,000 cap** level.

| | | CDQ Allocation | | | CP Allocation | | | M Allocation | | | S Allocation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Opt | Year | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| | 2003 | 10-Sep | 24-Sep | 1-Oct | 27-Aug | 1-Oct | | 3-Sep | 10-Sep | 17-Sep | 3-Sep | 20-Aug | 6-Aug |
| | 2004 | 26-Aug | 16-Sep | 23-Sep | 17-Jun | 24-Jun | 22-Jul | 5-Aug | 2-Sep | 23-Sep | 12-Aug | 12-Aug | 5-Aug |
| | 2005 | | | | 6-Aug | 20-Aug | 27-Aug | 2-Jul | 2-Jul | | 9-Jul | 9-Jul | 9-Jul |
| | 2006 | | | | 30-Jul | | | | | | 25-Jun | 18-Jun | 11-Jun |
| 1a) | 2007 | 27-Aug | 24-Sep | | 20-Aug | 3-Sep | | 27-Aug | | | | 17-Sep | 3-Sep |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | 10-Sep |
| | 2010 | | | | | | | | | | | | |
| | 2011 | 1-Oct | | | 16-Jul | 6-Aug | 10-Sep | 25-Jun | 2-Jul | 2-Jul | 13-Aug | 16-Jul | 9-Jul |
| | 2003 | | | | | | | 30-Jul | 30-Jul | | 30-Jul | 30-Jul | 23-Jul |
| | 2004 | 22-Jul | | | 17-Jun | 17-Jun | 17-Jun | 8-Jul | 8-Jul | 15-Jul | 29-Jul | 29-Jul | 29-Jul |
| | 2005 | | | | 25-Jun | 25-Jun | | 25-Jun | 25-Jun | 25-Jun | 2-Jul | 25-Jun | 25-Jun |
| | 2006 | | | | 2-Jul | 23-Jul | 30-Jul | | | | 11-Jun | 11-Jun | 11-Jun |
| 1b) | 2007 | | | | | | | 23-Jul | | | | | 30-Jul |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | 16-Jul | | | 30-Jul | 30-Jul | 23-Jul |
| | 2010 | | | | | | | | | | | | |
| | 2011 | 16-Jul | | | 25-Jun | 2-Jul | 16-Jul | 18-Jun | 18-Jun | 18-Jun | 25-Jun | 18-Jun | 18-Jun |
| | 2003 | 10-Sep | 24-Sep | 1-Oct | 27-Aug | 1-Oct | | 3-Sep | 10-Sep | 17-Sep | 3-Sep | 20-Aug | 6-Aug |
| | 2004 | 26-Aug | 16-Sep | 23-Sep | 17-Jun | 24-Jun | 22-Jul | 5-Aug | 2-Sep | 23-Sep | 12-Aug | 12-Aug | 5-Aug |
| | 2005 | | | | 6-Aug | 20-Aug | 27-Aug | 2-Jul | 2-Jul | | 9-Jul | 9-Jul | 9-Jul |
| | 2006 | | | | 30-Jul | | | | | | 25-Jun | 18-Jun | 11-Jun |
| 2a) | 2007 | 27-Aug | 24-Sep | | 20-Aug | 3-Sep | | 27-Aug | | | | 17-Sep | 3-Sep |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | 10-Sep |
| | 2010 | | | | | | | | | | | | |
| | 2011 | 1-Oct | | | 16-Jul | 6-Aug | 10-Sep | 25-Jun | 2-Jul | 2-Jul | 13-Aug | 16-Jul | 9-Jul |
| | 2003 | | | | | | | 30-Jul | 30-Jul | | 30-Jul | 30-Jul | 23-Jul |
| | 2004 | 22-Jul | | | 17-Jun | 17-Jun | 17-Jun | 8-Jul | 8-Jul | 15-Jul | 29-Jul | 29-Jul | 29-Jul |
| | 2005 | | | | 25-Jun | 25-Jun | | 25-Jun | 25-Jun | 25-Jun | 2-Jul | 25-Jun | 25-Jun |
| | 2006 | | | | 2-Jul | 23-Jul | | | | | 11-Jun | 11-Jun | 11-Jun |
| 2b) | 2007 | | | | | | | 23-Jul | | | | | 30-Jul |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | 30-Jul | 30-Jul | 23-Jul |
| | 2010 | | | | | | | | | | | | |
| | 2011 | 16-Jul | | | 25-Jun | 2-Jul | 16-Jul | 18-Jun | 18-Jun | 18-Jun | 25-Jun | 18-Jun | 18-Jun |

Table 5-97. Alternative 3 component 2 closure dates by sector and allocation scheme for each of the 4 options (1a, 1b, 2a, and 2b) for the **200,000 cap** level.

| | | CDQ Allocation | | | CP Allocation | | | M Allocation | | | S Allocation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Opt | Year | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| c1a) | 2003 | 24-Sep | | | | | | 24-Sep | | | | 1-Oct | 17-Sep |
| | 2004 | 16-Sep | | | 8-Jul | 29-Jul | 9-Sep | 30-Sep | | | 9-Sep | 2-Sep | 19-Aug |
| | 2005 | | | | 20-Aug | 3-Sep | | | | | 23-Jul | 16-Jul | 9-Jul |
| | 2006 | | | | | | | | | | 30-Jul | 9-Jul | 25-Jun |
| | 2007 | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | |
| | 2011 | | | | 27-Aug | | | 16-Jul | 20-Aug | 17-Sep | | | 10-Sep |
| 1b) | 2003 | | | | | | | | | | | | |
| | 2004 | | | | 17-Jun | 24-Jun | 8-Jul | 29-Jul | | | | | |
| | 2005 | | | | 23-Jul | | | 25-Jun | 2-Jul | | 9-Jul | 9-Jul | 9-Jul |
| | 2006 | | | | 30-Jul | | | | | | 18-Jun | 11-Jun | 11-Jun |
| | 2007 | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | |
| | 2011 | | | | 9-Jul | 30-Jul | | 18-Jun | 25-Jun | 2-Jul | 16-Jul | 16-Jul | 2-Jul |
| 2a) | 2003 | 24-Sep | | | | | | 24-Sep | | | | 1-Oct | 17-Sep |
| | 2004 | 16-Sep | | | 8-Jul | 29-Jul | 9-Sep | 30-Sep | | | 9-Sep | 2-Sep | 19-Aug |
| | 2005 | | | | 20-Aug | 3-Sep | | | | | 23-Jul | 16-Jul | 9-Jul |
| | 2006 | | | | | | | | | | 30-Jul | 9-Jul | 25-Jun |
| | 2007 | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | |
| | 2011 | | | | 27-Aug | | | 16-Jul | 20-Aug | 17-Sep | | | 10-Sep |
| 2b) | 2003 | | | | | | | | | | | | |
| | 2004 | | | | 17-Jun | 24-Jun | 8-Jul | 29-Jul | | | | | |
| | 2005 | | | | 23-Jul | | | 25-Jun | 2-Jul | | 9-Jul | 9-Jul | 9-Jul |
| | 2006 | | | | | | | | | | 18-Jun | 11-Jun | 11-Jun |
| | 2007 | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | |
| | 2011 | | | | 9-Jul | 30-Jul | | 18-Jun | 25-Jun | 2-Jul | 16-Jul | 16-Jul | 2-Jul |

### 5.3.5.1 Impacts of pollock fishery on chum salmon for Alternative 3

Based on the analysis of Alternative 3 and the assumptions inherent in evaluating the relative participation in the RHS program and constraints imposed by area closures (and thus the amount of chum salmon 'saved' under various closures and PSC cap levels), there are nonetheless incidental takes of chum salmon PSC and therefore there is an adverse impact under this alternative. For some suboptions and combinations, this management alternative will likely decrease the bycatch of chum salmon for Alaska stocks. These suboptions and combinations would thus minimize the adverse impacts of the status quo management. However, bycatch in some options (e.g., option 1b) results in slightly higher or neglible reductions for Asian chum salmon. The impacts under any of the options and suboptions of Alternative 3 impacts are unlikely to be significantly adverse because they would not diminish protections afforded to chum salmon in the current management of the groundfish fisheries.

Component 1 would impose a revised CSSA on non-participants of the RHS system. Taken on it's own with no other components selected, the impacts of component 1 are best characterized by status quo given the current level (100%) of participation in the RHS program. Some considerations by the Council in conjunction with Component 1 may modify parameters of the current RHS program. While it is difficult to examined the potential impacts of these modifications quantitatively, qualitative discussion of the merits of modifying individual parameters was summarized to provide an overview of the likely impacts. It is likely that modification of some of the RHS parameters has the potential to improve the performance of this system in minimizing the adverse impacts of status quo on chum salmon and possibly Chinook salmon as well.

Components 2-6 would impose additional constraints on the RHS participants in addition to the area closures imposed under the RHS system itself. Based on the analysis of the triggered closures, caps and allocations, some options in some years may be very constraining on the pollock fleet. While this analysis focusses on the amount of chum salmon potentially saved by virtue of the constraints applied by additional area closures, it is important to note that if participation in the RHS program itself becomes increasingly constraining and complicated by layered triggered closures on top of the RHS program, the incentive to participate in the program itself may be undermined. The intent of Component 1 is to provide a strong enough incentive to encourage participation in the RHS program. Under this alternative this is done by imposing a large-scale triggered area closure at a range of cap levels. The magnitude of the incentive to participate in the RHS program will depend upon the level of constraint of the cap level selected in conjunction with this provision, particularly if additional components are selected to layer constraints on the participants. If participation in the program becomes equally or nearly as constraining as the risk of non-participation, then the assumptions inherent in this evaluation (of 100% participation) will be invalid.

### 5.3.6 Summary of the impacts of the alternatives on Chum

Estimates of historical bycatch represent actual numbers of chum salmon taken and include benefits of existing management measures. The status quo analysis estimates are provided to understand the effectiveness of the current system relative to one which lacked any salmon bycatch avoidance program. The reduction due to this program is estimated to range from 4-28% based on estimation of imposing the system in years prior to its operation. Comparing alternatives against status quo requires understanding that the relative benefits are in addition to the current status quo measures.

Relative impacts of bycatch to individual river systems depend on where and when the bycatch occurs. This can add to the inter-annual variability in results for the same caps, closures, and allocations between sectors. On average (based on 2005-2009 data) approximately 12% of the AEQ is attributed to the coastal western Alaskan regional grouping while ~7% is attributed to the Upper Yukon (Fall chum). For the Southwest Alaska Peninsula stocks, the average AEQ over this period is ~2%, while for the combined PNW (including regions from Prince William Sound all the way to WA/OR), the average is 22%. Combined estimated Asian contribution is ~58% on average (for Russian stocks and Japanese stocks combined).

Combining these results with conservative estimates of run sizes where available for the aggregate coastal western Alaska stocks indicate that the highest impact rate (chum salmon mortality due to the pollock fishery divided by run-size estimates) was less than 1.7% for the combined western Alaska stocks.

Under Alternative 2, the hard cap options, estimates indicate a tradeoff between chum salmon saved (in AEQ terms) and foregone pollock under option 1a which performed the best for western Alaska stocks but also had the highest cost in terms of averaging a closure that would have foregone over 300 thousand t (Table 5-98). This table also shows that an intermediate result which saved an additional 15-19 thousand chum salmon to western Alaska (but also conserved relatively about three times as many Asian chum salmon) are Alternative 3, option 1a) at cap levels of 25,000 or 75,000. Another examination involved seeing if there were differences in the maximum values that could be attained in a given historical year (2003-2011). The results were similar in relative benefits over alternatives and options (Table 5-99).

Table 5-98. Summary over alternatives using sector split of 2ii, $\lambda$ =0 for different cap levels alternatives and their options. Chum AEQ are estimates of the adult equivalent annual **average** (2004-2011) improvements by alternative and option. Western Alaska is Upper Yukon combined with Coastal west Alaska, Asia include chum from Russia and Japan, the total adds these two groups and the remaining stocks.

| | | | Chum salmon | | |
|---|---|---|---|---|---|
| | | | Western Alaska | Asian | Total chum |
| Alt 2 | 1a) | 50,000 | 30,142 | 99,352 | 167,897 |
| | | 200,000 | 16,072 | 64,724 | 103,328 |
| | | 353,000 | 6,288 | 34,109 | 50,304 |
| | 1b) | 50,000 | 12,862 | -4,966 | 16,523 |
| | | 200,000 | 10,735 | -336 | 17,500 |
| | | 353,000 | 9,761 | 653 | 16,821 |
| Alt 3 | 1a) | | | | |
| | | 25,000 | 19,347 | 60,518 | 104,096 |
| | | 75,000 | 15,091 | 52,048 | 86,885 |
| | | 200,000 | 7,717 | 37,696 | 57,769 |
| | 1b) | | | | |
| | | 25,000 | 12,038 | 530 | 21,529 |
| | | 75,000 | 11,922 | 4,838 | 25,866 |
| | | 200,000 | 9,817 | 4,643 | 21,646 |
| | 2a) | | | | |
| | | 25,000 | 14,592 | 48,198 | 81,832 |
| | | 75,000 | 10,338 | 41,723 | 67,051 |
| | | | 3,466 | 30,095 | 42,141 |
| | 2b) | | | | |
| | | 25,000 | 10,623 | 2,567 | 21,177 |
| | | 75,000 | 10,713 | 6,620 | 25,739 |
| | | 200,000 | 8,913 | 6,085 | 21,711 |

Table 5-99. Summary over alternatives using sector split of 2ii, $\lambda$ =0 for different cap levels alternatives and their options. Chum AEQ are estimates of the adult equivalent annual **maximum values** from 2003-2011 by alternative and option. Western Alaska is Upper Yukon combined with Coastal west Alaska, Asia include chum from Russia and Japan, the total adds these two groups and the remaining stocks.

| | | | Chum AEQ | | |
|---|---|---|---|---|---|
| | | Cap | Western Alaska | Asia | Total |
| **Alt 2** | **1a) B-season** | **50,000** | 95,846 | 299,162 | 504,256 |
| | | **200,000** | 61,280 | 233,591 | 372,749 |
| | | **353,000** | 28,306 | 154,570 | 228,133 |
| | **1b) June-July** | **50,000** | 44,826 | 10,605 | 85,198 |
| | | **200,000** | 38,458 | 16,355 | 80,387 |
| | | **353,000** | 35,586 | 15,920 | 74,051 |
| **Alt 3** | **1a) B-season** | **25,000** | 58,115 | 166,867 | 284,375 |
| | | **75,000** | 46,151 | 150,669 | 248,174 |
| | | **200,000** | 23,400 | 118,153 | 176,341 |
| | **1b) June-July** | **25,000** | 41,530 | 18,882 | 91,335 |
| | | **75,000** | 41,846 | 27,632 | 102,318 |
| | | **200,000** | 35,288 | 25,244 | 87,454 |
| | **2a) B-season** | **25,000** | 44,817 | 143,673 | 237,124 |
| | | **75,000** | 30,139 | 124,525 | 191,107 |
| | | **200,000** | 14,717 | 86,466 | 111,282 |
| | **2b) June-July** | **25,000** | 36,874 | 22,163 | 87,347 |
| | | **75,000** | 37,356 | 29,672 | 96,863 |
| | | **200,000** | 33,136 | 26,647 | 82,176 |

# 6 Chinook salmon

Seasonal bycatch totals are presented in Table 6-7 and by pollock fishing sector in Table 6-8.

## 6.1 Overview of Chinook salmon biology and distribution

Overview information in this section is extracted from Delaney (1994). Other information on Chinook salmon may be found at the ADF&G website, http://www.cf.adfg.state.ak.us/geninfo/finfish/salmon/salmhome.php.

The Chinook salmon (*Oncorhynchus tshawytscha*) is the largest of all Pacific salmon, with weights of individual fish commonly exceeding 30 pounds. In North America, Chinook salmon range from the Monterey Bay area of California to the Chukchi Sea area of Alaska. In Alaska, it is abundant from the southeastern panhandle to the Yukon River. Major populations return to the Yukon, Kuskokwim, Nushagak, Susitna, Kenai, Copper, Alsek, Taku, and Stikine rivers. Important runs also occur in many smaller streams.

Like all species of Pacific salmon, Chinook salmon are anadromous. They hatch in fresh water, spend part of their life in the ocean, and then spawn in fresh water. All Chinooks die after spawning. Chinook salmon may become sexually mature from their second through seventh year, and as a result, fish in any spawning run may vary greatly in size. For example, a mature 3-year-old will probably weigh less than 4 pounds, while a mature 7-year-old may exceed 50 pounds. Females tend to be older than males at maturity. In many spawning runs, males outnumber females in all but the 6- and 7-year age groups. Small Chinooks that mature after spending only one winter in the ocean are commonly referred to as "jacks" and are usually males. Alaska streams normally receive a single run of Chinook salmon in the period from May through July.

Chinook salmon migrate through coastal areas as juveniles and returning adults; however, immature Chinook salmon undergo extensive migrations and can be found inshore and offshore throughout the North Pacific and Bering Sea. In summer, Chinook salmon concentrate around the Aleutian Islands and in the western Gulf of Alaska (Eggers 2004).

Juvenile Chinook salmon in freshwater feed on plankton and then later eat insects. In the ocean, they eat a variety of organisms including herring, pilchard, sand lance, squid, and crustaceans. Salmon grow rapidly in the ocean and often double their weight during a single summer season.

North Pacific Chinook salmon are the subject of commercial, subsistence, personal use, and sport fisheries, as discussed in more detail in Chapters 9 and 10. The majority of the Alaska commercial catch is made in Southeast Alaska, Bristol Bay, and the Arctic-Yukon-Kuskokwim areas. Fish taken commercially average about 18 pounds. The majority of the catch is made with troll gear and gillnets. Approximately 90 percent of the subsistence harvest is taken in the Yukon and Kuskokwim rivers.

The Chinook salmon is perhaps the most highly prized sport fish in Alaska and is extensively fished by anglers in the Southeast and Cook Inlet areas. The sport fishing harvest of Chinook salmon is over 76,000 annually, with Cook Inlet and adjacent watersheds contributing over half of the catch.

Unlike “other salmon” species, Chinook salmon rear in inshore marine waters and are, therefore, available to commercial and sport fishermen all year.

### 6.1.1 Food habits/ecological role

Western Alaskan salmon runs experienced dramatic declines from 1998 through 2002 with a record low in stocks in 2000. Weak runs during this time period have been attributed to reduced productivity in the marine environment rather than an indication of low levels of parent year escapements (Bue and Lingnau 2005). Recent Bering-Aleutian Salmon International Survey (BASIS) evaluations have examined the food habits from Pacific salmon in the Bering Sea in an attempt to evaluate potential interactions between salmon species as well as their dependence upon oceanographic conditions for survival.

Ocean salmon feeding ecology is highlighted by the BASIS program given the evidence that salmon are food limited during their offshore migrations in the North Pacific and Bering Sea (Rogers 1980; Rogers and Ruggerone 1993; Aydin et al. 2000, Kaeriyama et al. 2000). Increases in salmon abundance in North America and Asian stocks have been correlated to decreases in body size of adult salmon which may indicate a limit to the carrying capacity of salmon in the ocean (Kaeriyama 1989; Ishida et al. 1993; Helle and Hoffman 1995; Bigler et al. 1996; Ruggerone et al. 2003). International high seas research results suggest that inter and intra-specific competition for food and density-dependant growth effects occur primarily among older age groups of salmon particularly when stocks from different geographic regions in the Pacific Rim mix and feed in offshore waters (Ishida et al. 1993; Ishida et al 1995; Tadokoro et al. 1996; Walker et al. 1998; Azumaya and Ishida 2000; Bugaev et al. 2001; Davis 2003; Ruggerone et al. 2003).

Results of a fall study to evaluate food habits data in 2002 indicated Chinook salmon consumed predominantly small nekton and did not overlap their diets with sockeye and chum (Davis et al. 2004). Shifts in prey composition of salmon species between seasons, habitats and among salmon age groups were attributed to changes in prey availability (Davis et al. 2004).

Stomach sample analysis of ocean age .1 and .2 fish from basin and shelf area Chinook salmon indicated that their prey composition was more limited than chum salmon (Davis et al. 2004). This particular study did not collect many ocean age .3 or .4 Chinook, although those collected were located predominantly in the basin (Davis et al. 2004). Summer Chinook samples contained high volumes of euphausiids, squid and fish while fall stomach samples in the same area contained primarily squid and some fish (Davis et al. 2004). The composition of fish in salmon diets varied with area with prey species in the basin primarily northern lamp fish, rockfish, Atka mackerel, Pollock, sculpin and flatfish while shelf samples contained more herring, capelin, Pollock, rockfish and sablefish (Davis et al. 2004). Squid was an important prey species for ocean age .1, .2, and .3 Chinook in summer and fall (Davis et al. 2004). The proportion of fish was higher in summer than fall as was the relative proportion of euphausiids (Davis et al. 2004). The proportion of squid in Chinook stomach contents was larger during the summer in years (even numbered) when there was a scarcity of pink salmon in the basin (Davis et al. 2004).

Results from the Bering Sea shelf on diet overlap in 2002 indicated that the overlap between chum and Chinook salmon was moderate (30%), with fish constituting the largest prey category, results were similar in the basin (Davis et al. 2004). However notably on the shelf, both chum and Chinook consumed juvenile walleye pollock, with Chinook salmon consuming somewhat larger (60-190 mm SL) than those consumed by chum salmon (45-95 mm SL) (Davis et al. 2004). Other fish consumed by Chinook salmon included herring and capelin while chum salmon stomach contents also included sablefish and juvenile rockfish (Davis et al. 2004).

General results from the study found that immature chum are primarily predators of macrozooplankton while Chinook tend to prey on small nektonic prey such as fish and squid (Davis et al. 2004). Prey compositions shifts between species and between seasons in different habitats and a seasonal reduction in diversity occurs in both chum and Chinook diets from summer to fall (Davis et al. 2004). Reduction in prey diversity was noted to be caused by changes in prey availability due to distribution shifts, abundance changes or progression of life-history changes which could be the result of seasonal shift in environmental factors such as changes in water temperature and other factors (Davis et al. 2004).

Davis et al. (2004) found that diet overlap estimates between Chinook and sockeye salmon and Chinook and chum salmon were lower than the estimates obtained for sockeye and chum salmon, suggesting a relatively low level of inter-specific food competition between immature Chinook and immature sockeye or chum salmon in the Bering Sea because Chinook salmon were more specialized consumers. In addition, the relatively low abundance of immature Chinook salmon compared to other species may serve to reduce intra-specific competition at sea. Consumption of nektonic organisms (fish and squid) may be efficient because they are relatively large bodied and contain a higher caloric density than zooplankton, such as pteropods and amphipods (Tadokoro et al. 1996, Davis et al. 1998). However, the energetic investment required of Chinook to capture actively swimming prey is large, and if fish and squid prey abundance are reduced, a smaller proportion of ingested energy will be available for salmon growth (Davis et al. 1998). Davis et al. (2004) hypothesized that inter- and intra-specific competition in the Bering Sea could negatively affect the growth of chum and Chinook salmon, particularly during spring and summer in odd-numbered years, when the distribution of Asian and North American salmon stocks overlap. Decreased growth could lead to reduction in salmon survival by increasing predation (Ruggerone et al. 2003), decreasing lipid storage to the point of insufficiency to sustain the salmon through winter when consumption rates are low (Nomura et al. 2002), and increasing susceptibility to parasites and disease due to poor salmon nutritional condition.

### 6.1.2 Hatchery releases

Commercial salmon fisheries exist around the Pacific Rim with most countries releasing salmon fry in varying amounts by species. The North Pacific Anadromous Fish Commission summarizes information on hatchery releases by country and by area where available. Reports submitted to the NPAFC were used to summarize hatchery information by Country and by US state below (Table 6-1, Table 6-2). For more information see the following: Russia (Akinicheva et al. 2008; Anon. 2007; TINRO-centre 2006, 2005); Canada (Cook et al. 2008); USA (Josephson 2008; Josephson 2007; Eggers 2006, 2005; Bartlett 2007, 2006, 2005).

Chinook salmon hatchery releases by country are shown below in Table 6-1. There are no hatchery releases of Chinook salmon in Japan and Korea and only a limited number in Russia.

Table 6-1 Hatchery releases of juvenile Chinook salmon, in millions of fish

| Year | Russia | Japan | Korea | Canada | USA | TOTAL |
|---|---|---|---|---|---|---|
| 1999 | 0.6 | - | - | 54.4 | 208.1 | 263.1 |
| 2000 | 0.5 | - | - | 53.0 | 209.5 | 263.0 |
| 2001 | 0.5 | - | - | 45.5 | 212.1 | 258.1 |
| 2002 | 0.3 | - | - | 52.8 | 222.1 | 275.2 |
| 2003 | 0.7 | - | - | 50.2 | 210.6 | 261.5 |
| 2004 | 1.17 | - | - | 49.8 | 173.6 | 224.6 |
| 2005 | 0.84 | - | - | 43.5 | 184.0 | 228.3 |
| 2006 | 0.78 | - | - | 40.9 | 181.2 | 223.7 |
| 2007 | 0.78 | - | - | 44.6 | 182.2 | 227.6 |
| 2008 | 1.0 | | | 38.0 | 201.4 | 240.4 |
| 2009 | 0.78 | - | - | 41.6 | 201.0 | 243.4 |
| 2010 | 0.88 | - | - | 44.1 | 201.9 | 246.9 |

For Chinook salmon fry, the United States has the highest number of annual releases (80% of total in 2007), followed by Canada (~20%). In Canada, enhancement projects have been on-going since 1977 with approximately 300 different projects for all salmon species (Cook and Irvine 2007). Maximum production for Chinook releases was reached in 1991 with 66 million fish in that year (Cook and Irvine 2007). Releases of Chinook in 2006 occurred in the following regions: Yukon and Transboundary River, Skeena River, North Coast, Central Coast, West Coast and Vancouver Island, Johnstone Strait, Straits of Georgia, and the Lower and Upper Fraser rivers. Of these the highest numbers were released in the West Coast Straits of Georgia (20 million fish) followed by Vancouver Island area (12.4 million fish) the Lower Fraser River (3.3 million fish) (Cook and Irvine 2007).

Of the US releases however, a breakout by area shows that the highest numbers are coming from the State of Washington (63% in 2007), followed by California (19% in 2007), and then Oregon (7% in 2007) (Table 6-2). Hatcheries in Alaska are located in southcentral and southeast Alaska; there are no enhancement efforts for the AYK region. Since 2004 the number of hatcheries has ranged from 33 (2004–2005) to 31 (2006) with the majority of hatcheries (18–22) located in southeast Alaska, while 11 hatcheries are in Cook Inlet and 2 in Kodiak (Eggers 2005, 2006; Josephson 2007).

Table 6-2. USA west coast hatchery releases of juvenile Chinook salmon, in millions of fish.

| Year | Alaska | Washington | Oregon | California | Idaho | WA/OR/CA/ID (combined) | TOTAL |
|---|---|---|---|---|---|---|---|
| 1999 | 8.0 | 114.5 | 30.5 | 45.4 | 9.7 | | 208.1 |
| 2000 | 9.2 | 117.4 | 32.3 | 43.8 | 6.8 | | 209.5 |
| 2001 | 9.9 | 123.5 | 28.4 | 45.0 | 5.4 | | 212.1 |
| 2002 | 8.4 | | | | | 213.6 | 222.0 |
| 2003 | 9.3 | | | | | 201.3 | 210.6 |
| 2004 | 9.35 | 118.2 | 17.0 | 27.4 | 1.7 | 164.2 | 173.6 |
| 2005 | 9.46 | 117.7 | 19.2 | 28.8 | 8.7 | 174.5 | 184.0 |
| 2006 | 10.2 | 110.5 | 19.2 | 29.4 | 12.0 | 171.0 | 181.2 |
| 2007 | 10.5 | 114.5 | 13.2 | 34.8 | 9.2 | 171.7 | 182.2 |
| 2008 | 11.4 | | | | | 201.4 | 212.4 |
| 2009 | 10.5 | | | | | 201.0 | 211.5 |
| 2010 | 11.0 | | | | | 201.9 | 212.9 |

### 6.1.3 Chinook salmon stock of origin

Chinook salmon stock of origin has been extensively summarized in the FEIS for Amendment 91 (NMFS, 2009). A brief overview of that information is provided here as well as an update on recent genetic information from bycatch samples taken in the 2010 Bering Sea trawl fisheries.

Table 6-3 shows a comparision of historical stock composition estimates for three studies on Chinook bycatch samples taken from trawl fisheries in the Bering Sea. These studies were similar in general findings of the preponderance of western Alaskan stocks in the bycatch. The Seeb et al. (2008) results were employed in the Chinook EIS analysis (NMFS 2009) in order to estimate bycatch stock composition historically to best evaluate the impacts to western Alaskan river systems of different management alternatives under consideration. In order to do so, the stock composition results on the samples were corrected for when and where the bycatch occurred by season.

Table 6-4 shows the mean values of catch-weighted stratified proportions of stock composition used in the Chinook EIS analysis based on genetic sampling by season, and region (SE=east of 170°W, NW=west of 170°W). These results indicate the change in stock composition by area in the B season with increased proportions of some stocks (e.g. Upper Yukon in the NW portion of the Bering Sea and PNW in the SE). This shows the potential for increasing the proportion of one stock of origin over another in the bycatch as the fishery moves to the NW in some years.

Table 6-3. Comparison of stock composition estimates for three different studies on Chinook bycatch samples taken from trawl fisheries in the eastern Bering Sea.

| Study | | Myers and Rogers (1988) | | | Myers et al (2003) | | | Seeb et al. 2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Years sampled | | 1979-1982 | | | 1997-1999 | | | 2005-2007[1] | | |
| Stocks and estimated aggregate % composition in bycatch | Western AK | 60% | | | 56% | | | | | |
| | | Yukon | Bristol Bay | Kusko-kwim | Yukon | Bristol Bay | Kusko-kwim | | | |
| | | 17% | 29% | 24% | 40% | 34% | 26% | | | |
| Smaller scale breakouts (where available) listed to the right (with associated % contrib. of aggregate below) | Coastal WAK (also includes Norton Sound) | | | | | | | 48% | | |
| | | | | | | | | Lower Yukon | Kusko-kwim | Bristol Bay |
| | | | | | | | | Na | Na | Na |
| | Middle Yukon | | | | | | | 3% | | |
| | Upper Yukon | | | | | | | 3% | | |
| | NAK Penin | | | | | | | 13% | | |
| | Cook Inlet | 17% | | | 31% | | | 4% | | |
| | SEAK/Can | 9% | | | 8% | | | | | |
| | TBR | | | | | | | 2% | | |
| | PNW[2] | | | | | | | 23% | | |
| | Russia | 14% | | | 5% | | | 2% | | |
| | Other[3] | | | | | | | 3% | | |

[1]note for purposes of comparison, only 2006 stock composition estimates *averaged annually and across regions* are shown here.

[2]PNW is an aggregate of 54 stocks from British Columbia, Washington, Oregon and California. For a full list of stocks included see FEIS.

[3]'other' is comprised of minor components after aggregation to major river systems as described in FEIS.

Table 6-4. Mean values of catch-weighted stratified proportions of stock composition based on genetic sampling by season, and region (SE=east of 170°W, NW=west of 170°W). Standard errors of the estimates (in parentheses) were derived from 200 simulations based on the estimates from FEIS and weighting annual results as explained in the text.

| Season / Area | PNW | Coast W AK | Cook Inlet | Middle Yukon | N AK Penin | Russia | TBR | Upper Yukon | Other |
|---|---|---|---|---|---|---|---|---|---|
| B SE | 45.0% | 34.7% | 5.1% | 0.1% | 8.6% | 0.6% | 3.4% | 0.0% | 2.4% |
| | (0.025) | (0.024) | (0.017) | (0.002) | (0.016) | (0.004) | (0.014) | (0.001) | (0.014) |
| B NW | 6.4% | 68.9% | 2.6% | 6.6% | 4.4% | 2.7% | 1.8% | 5.6% | 1.0% |
| | (0.010) | (0.023) | (0.012) | (0.011) | (0.019) | (0.007) | (0.006) | (0.012) | (0.008) |
| A All | 12.1% | 67.7% | 0.1% | 0.6% | 16.0% | 0.4% | 0.2% | 0.6% | 2.3% |
| | (0.012) | (0.021) | (0.003) | (0.004) | (0.019) | (0.002) | (0.002) | (0.003) | (0.010) |

New genetics results are available for 2010 BSAI trawl fishery (ref for Tech memo). These results indicate that for the A season approximately 94% of the samples taken in the fishery originate from Alaskan rivers draining into the Bering Sea. Further details on the relative proportion by stock or origin and season for these samples are as follows:

A season: 41% Coastal WAK, 24% Upper Yukon, 16% North Alaska Peninsula, 12% Middle Yukon
B season: 47% from Bering Sea rivers, with the majority (42%) from Coastal WAK.

Both the overall level of bycatch as well as the sample sizes were low in 2010. The total bycatch in all BSAI groundfish fisheries in 2011 was 26,672 of this 95.6% was from the pollock fishery. The 2010 genetics report analyzes additional fisheries bycatch of Chinook as well as the pollock fishery but does not differentiate between these. Direct comparison of this study with previous estimates is not possible at this time absent correcting the samples to when and where the bycatch was occurring in that year as with the analysis done on the genetics from 2006-2007 for the EIS (NMFS 2009). Furthermore, sampling differed in 2010 from previous years. Previously bycatch was opportunistically sampled for genetics. In 2010 a more systemaic protocol was employed but because new salmon census sampling had not yet been instituted this sampling design is different from 2011 when the new systemaic sampling in conjunction with the census of salmon occurred. Genetic results from 2011 are unavailable as of Feb 29, 2012.

## 6.2 Chinook salmon assessment overview by river system or region

This section provides a brief overview of the status of western Alaskan Chinook salmon stocks. Western Alaska includes the Bristol Bay, Kuskokwim, Yukon, and Norton Sound management areas. Nushagak, Goodnews, Kanektok, Kuskokwim, Yukon, and Unalakleet rivers comprise the Chinook salmon index stocks for this region. Comprehensive information by region can be found in the environmental impact statement prepared for the Bering Sea Chinook Salmon Bycatch Management action by the Council (NPFMC/NOAA 2009) and is incorporated by reference. The EIS can be downloaded online at: http://www.fakr.noaa.gov/sustainablefisheries/bycatch/salmon/chinook/feis/eis_1209.pdf

The Alaska Board of Fisheries (board) designated the Yukon and Kuskokwim river stocks as a "Yield Concern" in September 2000 based on a chronic inability, despite the use of specific management measures, to maintain expected yields, or harvestable surpluses, above each stock's escapement needs (Table 6-3). In January 2004, the board also designated Chinook salmon in Subdistricts 5 (Shaktoolik) and 6 (Unalakleet) of Norton Sound as a "Yield Concern". Based on improved abundance, that designation was lifted for Kuskokwim River stocks in January 2007, but remained for the Yukon River and Subdistricts 5 (Shaktoolik) and 6 (Unalakleet) of Norton Sound. The Alaska Department of Fish and Game (department) recommended and the board concurred in continuing these designations at the 2010 board meeting.

In general, these western Alaska Chinook salmon stocks declined sharply in 2007 and remained low in 2008–2010. For the more northerly of these stocks, the 2008 Chinook salmon run was one of the poorest on record. On the heels of the below average 2007–2009 Chinook salmon runs in western Alaska, management of the 2010 fisheries was conservative. All of the Chinook salmon runs to western Alaska started late and most were four to six days late in run timing. The late run combined with inclement weather in early June resulted in a delayed start to most fisheries. No directed Chinook salmon commercial fisheries occurred in the Yukon River, Kuskokwim River, or in Norton Sound in 2011, and only small commercial fisheries occurred in the Nushagak and Kuskokwim Bay (Table 6-3). Sport fisheries were restricted or closed in the Nushagak River, Yukon (Chena River), Kuskokwim (Kwethluk and Tuluksak rivers), and Unalakleet and Shaktoolik rivers of Norton Sound Area. More significantly, subsistence fisheries in tributaries of the Kuskokwim River (Kwethluk and Tuluksak rivers; USFWS federal closure), and Norton Sound (Unalakleet and Shaktoolik rivers) were restricted or closed. In spite of conservative management strategies, which in some cases were at great cost to the people who rely on these resources for food and income, only some escapement goals were achieved in western Alaska.

An overview of Chinook stock performance across the State including regions outside of western Alaska is shown in Table 6-5. For comparison with 2010, stock performance information is presented for that year in Table 6-6.

Table 6-5. Overview of Alaskan Chinook salmon stock performance, 2011.

| Chinook salmon stock | Total run size? | Escapement goals met?[a] | Subsistence fishery? | Commercial fishery? | Sport fishery? | Stock of concern? |
|---|---|---|---|---|---|---|
| Bristol Bay | Poor | 1 of 1[b] (4 not surveyed) | Yes | Limited in Nushagak District | Restricted on Nushagak | No |
| Kuskokwim | Poor | 3 of 9 | Yes, 3 tributaries closed, restrictions in mainstem District 1 | None on Kuskokwim River, limited in Bay | 3 tributaries closed | No |
| Yukon | Poor | 4 of 5 | Yes, restricted fishing schedule | No directed, small incidental take with chum but not sold | Bag limit reduced to 1 all tributaries, no retention mainstem and Tanana R., no bait allowed Tanana R. tributaries | Yield |
| Norton Sound | Poor | 0 of 4 | Yes, with restrictions | No | No | Yield |
| Alaska Peninsula | Below average | 0 of 1 | Yes | Yes | Yes | No |
| Kodiak | Below average | 2 of 2 | Yes | Restricted, nonretention in Karluk and Ayakulik areas | Restricted, nonretention in Karluk, reduced bag and annual limits in Ayakulik | Management (Karluk) |
| Chignik | Average | 1 of 1 | Yes | Yes | Yes | No |
| Upper Cook Inlet | Below average | 8 of 21[c] | Yes | Restricted in Northern District | Various restrictions including complete closure | 6 stocks of concern |
| Lower Cook Inlet | Below average | 2 of 3 | Yes | Yes | Restricted; closed Anchor river | No |
| Prince William Sound | Below average | 1 of 1 | Yes | Yes | Yes | No |
| Southeast | Average | 9 of 11 | Yes | Yes | Yes | No |

[a] Some aerial survey-based escapement goals were not assessed due to inclement weather or poor survey conditions, therefore we do not know if the escapement goals were met for these systems.

[b] The Chinook salmon escapement goal of 40,000 – 80,000 was met on the Nushagak River in 2011. However, the inriver goal of 75,000 was not met on the Nushagak River in 2011.

Table 6-6 Overview of Alaskan Chinook salmon stock performance, 2010.

| Chinook salmon stock | Total run size? | Escapement goals met?[a] | Subsistence fishery? | Commercial fishery? | Sport fishery? | Stock of concern? |
|---|---|---|---|---|---|---|
| **Bristol Bay** | Poor | 0 of 1[b] (4 not surveyed) | Restricted on Nushagak | Limited in Nushagak District | Restricted, closed on Nushagak | No |
| **Kuskokwim** | Poor | 3 of 7 (7 not surveyed) | Yes, 2 tributaries closed | None on Kuskokwim River, limited in Bay | 2 tributaries closed | No |
| **Yukon** | Poor | 3 of 7 | Yes | No directed, some incidental take with chum | 1 Tributary closed | Yield |
| **Norton Sound** | Poor | 1 of 3 (2 not surveyed) | Yes, with restrictions | No | No | Yield |
| **Alaska Peninsula** | Below average | 1 of 1 | Yes | Yes | Yes | No |
| **Kodiak** | Below average | 1 of 2 | Karluk closed | Restricted in Karluk and Ayakulik areas | Karluk closed | Management |
| **Chignik** | Average | 1 of 1 | Yes | Yes | Yes | No |
| **Upper Cook Inlet** | Below average | 4 of 19 (2 not surveyed) | Yes | Restricted in Northern District | Various restrictions | 6 stocks of concern |
| **Lower Cook Inlet** | Below average | 2 of 3 | Yes | Yes | Yes | No |
| **Prince William Sound** | Below average | 0 of 1 | Yes | Yes | Yes | No |
| **Southeast** | Average | 9 of 11 | Yes | Yes | Yes | No |

[a] Some aerial survey-based escapement goals were not assessed due to inclement weather or poor survey conditions, therefore we do not know if the escapement goals were met for these systems.
[b] The Chinook salmon escapement goal was not met on the Nushagak River in 2010.

## 6.3 Impacts of alternatives on Chinook salmon

The following criteria are used to evaluate the impact of alternative management measures on Chinook salmon PSC in comparison to the status quo management.

Criteria used to estimate the significance of impacts on incidental catch of PSC and other non-target species

| | |
|---|---|
| No impact | No incidental take of the prohibited species in question. |
| Adverse impact | There are incidental takes of the prohibited species in question |
| Beneficial impact | Natural at-sea mortality of the prohibited species in question would be reduced – perhaps by the harvest of a predator or by the harvest of a species that competes for prey. |
| Significantly adverse impact | An action that diminishes protections afforded to prohibited species and forage fish in the current management of groundfish fisheries would be a significantly adverse impact. |
| Significantly beneficial impact | No benchmarks are available for significantly beneficial impact of the groundfish fishery on the prohibited species, and significantly beneficial impacts are not defined for these species. |
| Unknown impact | Not applicable |

Seasonal bycatch totals are presented in Table 6-7 and by pollock fishing sector in Table 6-8.

Table 6-7. Chinook salmon bycatch from the pollock fishery, 1991-2011 (Jan 16, 2012) by season.

| Year | A-season | B-Season | Total |
|---|---|---|---|
| 1991 | 38,791 | 2,114 | 40,906 |
| 1992 | 25,691 | 10,259 | 35,950 |
| 1993 | 17,264 | 21,252 | 38,516 |
| 1994 | 28,451 | 4,686 | 33,136 |
| 1995 | 10,579 | 4,405 | 14,984 |
| 1996 | 36,068 | 19,554 | 55,623 |
| 1997 | 10,935 | 33,973 | 44,909 |
| 1998 | 15,193 | 36,130 | 51,322 |
| 1999 | 6,352 | 5,627 | 11,978 |
| 2000 | 3,422 | 1,539 | 4,961 |
| 2001 | 18,484 | 14,961 | 33,444 |
| 2002 | 21,794 | 12,701 | 34,495 |
| 2003 | 32,609 | 12,977 | 45,586 |
| 2004 | 23,104 | 28,595 | 51,699 |
| 2005 | 27,285 | 40,050 | 67,335 |
| 2006 | 58,287 | 24,306 | 82,592 |
| 2007 | 69,139 | 52,350 | 121,488 |
| 2008 | 16,574 | 4,842 | 21,415 |
| 2009 | 9,683 | 2,718 | 12,401 |
| 2010 | 7,624 | 2,067 | 9,692 |
| 2011 | 7,136 | 18,363 | 25,499 |

Table 6-8. Chinook bycatch by sector for the Bering Sea pollock fleet, 1991-2011.

| | A-season | | | A | B-season | | | B | Annual |
|---|---|---|---|---|---|---|---|---|---|
| YEAR | M | P | S | Total | M | P | S | Total | Total |
| 1991 | 9,001 | 17,645 | 10,192 | 36, 38 | 152 | 397 | 1,667 | 2,216 | 39,054 |
| 1992 | 4,057 | 12,631 | 6,725 | 23,413 | 1,766 | 6,889 | 1,604 | 10,259 | 33,672 |
| 1993 | 3,529 | 8,869 | 3,017 | 15,415 | 6,657 | 11,932 | 2,615 | 21,204 | 36,619 |
| 1994 | 1,790 | 17,149 | 8,346 | 27,285 | 572 | 2,826 | 1,207 | 4,605 | 31,890 |
| 1995 | 971 | 5,971 | 2,040 | 8,982 | 667 | 2,973 | 781 | 4,421 | 13,403 |
| 1996 | 5,481 | 15,276 | 15,228 | 35,985 | 6,322 | 3,222 | 9,944 | 19,488 | 55,472 |
| 1997 | 1,561 | 3,832 | 4,954 | 10,347 | 5,702 | 5,721 | 22,550 | 33,973 | 44,320 |
| 1998 | 4,284 | 6,500 | 4,334 | 15,118 | 6,361 | 2,547 | 27,218 | 36,127 | 51,244 |
| 1999 | 554 | 2,694 | 3,103 | 6,352 | 374 | 2,590 | 2,662 | 5,627 | 11,978 |
| 2000 | 19 | 2,525 | 878 | 3,422 | 253 | 568 | 717 | 1,539 | 4,961 |
| 2001 | 1,664 | 8,264 | 8,555 | 18,484 | 1,319 | 9,863 | 3,779 | 14,961 | 33,444 |
| 2002 | 1,976 | 9,481 | 10,336 | 21,794 | 1,755 | 1,386 | 9,560 | 12,701 | 34,495 |
| 2003 | 2,881 | 14,361 | 15,367 | 32,609 | 1,940 | 4,039 | 6,998 | 12,977 | 45,586 |
| 2004 | 2,076 | 9,453 | 11,576 | 23,104 | 2,076 | 4,288 | 22,231 | 28,595 | 51,699 |
| 2005 | 2,106 | 11,382 | 13,797 | 27,285 | 888 | 4,336 | 34,826 | 40,050 | 67,335 |
| 2006 | 5,395 | 17,253 | 35,638 | 58,287 | 200 | 1,532 | 22,573 | 24,306 | 82,592 |
| 2007 | 5,859 | 27,889 | 35,390 | 69,139 | 3,543 | 7,137 | 41,670 | 52,350 | 121,488 |
| 2008 | 1,270 | 4,551 | 10,752 | 16,574 | 175 | 413 | 4,254 | 4,842 | 21,415 |
| 2009 | 601 | 3,042 | 6,040 | 9,683 | 152 | 333 | 2,233 | 2,718 | 12,401 |
| 2010 | 493 | 3,401 | 3,730 | 7,624 | 84 | 51 | 1,932 | 2,067 | 9,692 |
| 2011 | 459 | 2,236 | 4,441 | 7,136 | 2,426 | 1,986 | 13,951 | 18,363 | 25,499 |

For evaluating impacts, it is necessary to translate how different catch restrictions may affect salmon stocks. For these analyses, the adult-equivalency (AEQ) of the bycatch was estimated. This is distinguished from the annual bycatch numbers that are recorded by observers and tallied in each year for management purposes. Not all Chinook that is caught as bycatch would otherwise have survived to return as an adult to its spawning stream. The AEQ methodology applies the extensive observer datasets on the length frequencies of Chinook salmon caught in the pollock fishery and convert these to ages, appropriately accounting for the time of year that catch occurred. The age data is coupled with information on the proportion of salmon that return to different river systems at various ages, and the bycatch-at-age data is used to pro-rate how any given year of bycatch affects future potential spawning runs of salmon. General results suggest that for Chinook salmon, the AEQ estimates are variable with the impact on run sizes (due to bycatch) showing a lagged effect (Fig. 6-1).

Based on analyses presented in the FEIS (NPFMC/NOAA 2009) the adult equivalent mortality due to bycatch (AEQ) for coastal western Alaska Chinook stocks ranged from below 10,000 to about 45,000 Chinook salmon during 1993-2007 (Fig. 6-2).

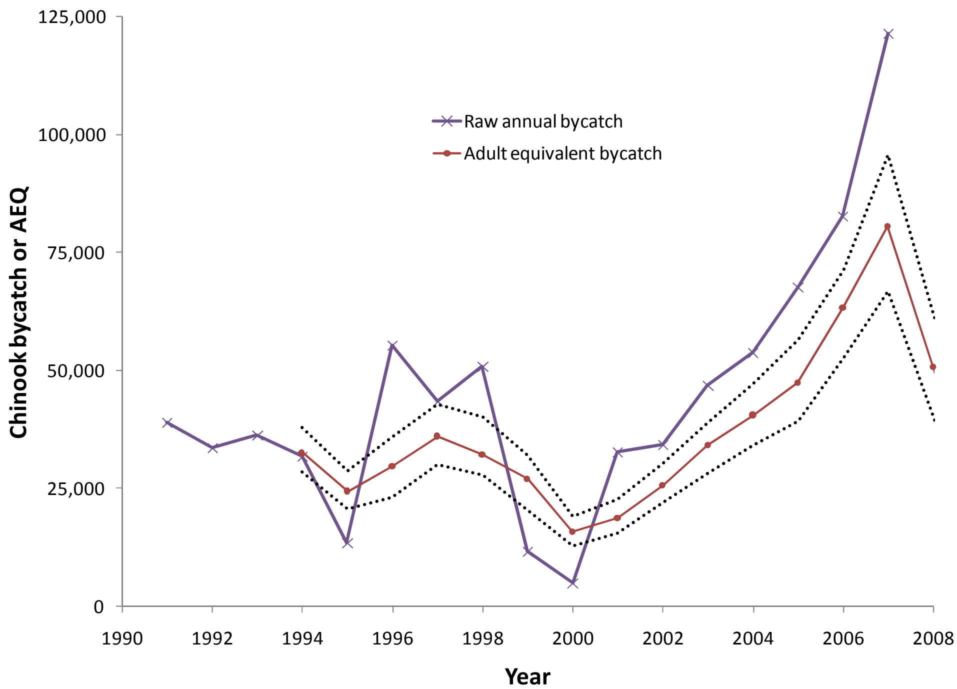


Fig. 6-1 Time series of Chinook actual and adult equivalent bycatch from the pollock fishery, 1991-2007 (2008 raw annual bycatch also indicated separately). The dotted lines represent the uncertainty of the AEQ estimate, due to the combined variability of ocean mortality, maturation rate, and age composition of bycatch estimates (NPFMC/NOAA 2009).

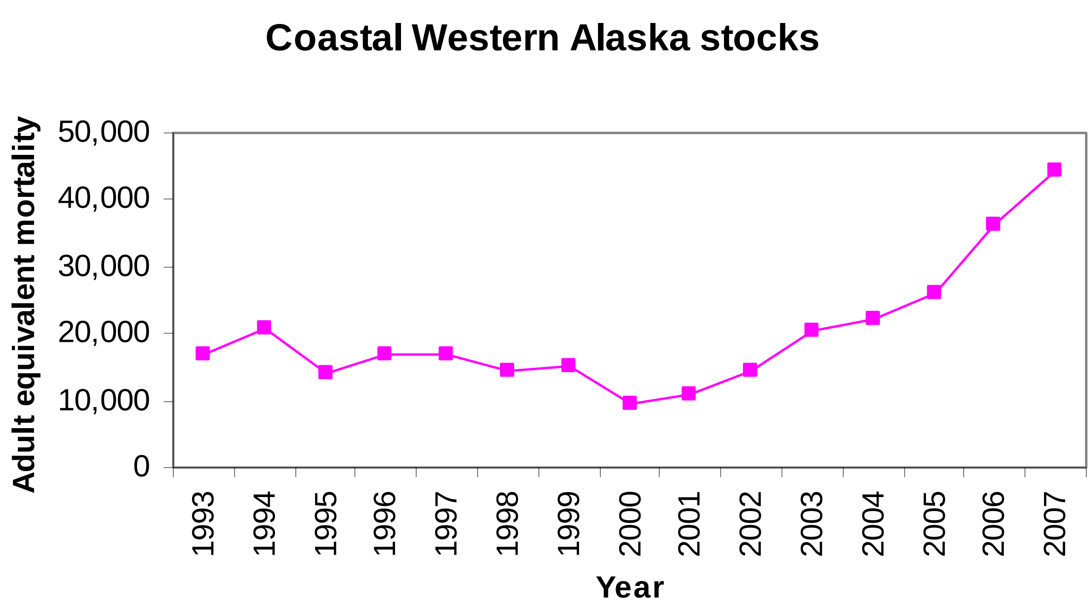


Figure 6-2 Annual estimated pollock fishery adult equivalent removals on stocks from the Coastal western Alaska returns, 1993-2007.

### 6.3.1 Summary of impacts of pollock fishery on Chinook salmon for Alternative 1

Following the criteria used to evaluate the impact of alternative management measures on Chinook salmon PSC the status quo alternative results in adverse impacts since there are incidental takes of Chinook PSC. Alternatives are evaluated against the status quo incidental catch to estimate potential means to minimize the adverse impacts of chum PSC and in doing so these alternatives may either minimize the adverse impacts on Chinook PSC or increase the adverse impacts on Chinook by increasing the incidental catch above that realized under status quo.

### 6.3.2 Impacts on Chinook salmon under Alternative 2

The annual impact of chum salmon options of alternative 2 indicate that Chinook salmon bycatch will decreased in many years under option 1a, especially for the lower cap levels (Table 6-9). However, under option 1b (which would close the fishery only within the June-July period) resulted in increased bycatch of Chinook salmon because of pollock that would be diverted later in the year (Table 6-10). All sectors are estimated to have a similar pattern between options (Table 6-11).

Table 6-9. Estimated annual reduction in Chinook salmon bycatch by year for chum management measures under Alternative 2 by cap, suboption, and sector allocation, 2003-2011.

| Cap | Suboption 1a | | | Suboption 1b | | |
|---|---|---|---|---|---|---|
| 50,000 | 2ii | 4ii | 6 | 2ii | 4ii | 6 |
| 2003 | 11,815 | 10,479 | 9,340 | -1,882 | -826 | -1,419 |
| 2004 | 27,543 | 27,069 | 26,588 | -2,469 | -2,669 | -3,813 |
| 2005 | 36,715 | 36,130 | 36,152 | -18,564 | -20,414 | -21,772 |
| 2006 | 22,691 | 22,492 | 22,175 | -11,556 | -11,301 | -11,276 |
| 2007 | 46,059 | 48,149 | 47,059 | -2,125 | -2,041 | -5,380 |
| 2008 | | | | | | |
| 2009 | | 835 | 1,083 | -84 | -296 | -818 |
| 2010 | | | | -4 | | |
| 2011 | 12,045 | 11,741 | 11,681 | -11,225 | -11,284 | -11,475 |
| Total | 156,868 | 156,895 | 154,078 | -47,910 | -48,830 | -55,953 |
| Cap | Suboption 1a | | | Suboption 1b | | |
| 200,000 | 2ii | 4ii | 6 | 2ii | 4ii | 6 |
| 2003 | 1,559 | 3,609 | 6,020 | | | |
| 2004 | 22,258 | 20,670 | 21,308 | -1,667 | -1,477 | -969 |
| 2005 | 35,247 | 33,820 | 31,842 | -12,499 | -12,015 | -13,550 |
| 2006 | 20,066 | 20,438 | 20,999 | -9,152 | -10,726 | -11,208 |
| 2007 | | | | | | |
| 2008 | | | | | | |
| 2009 | | | | | | |
| 2010 | | | | | | |
| 2011 | 3,777 | 2,346 | 9,647 | -4,821 | -5,288 | -6,850 |
| Total | 82,907 | 80,883 | 89,816 | -28,140 | -29,505 | -32,577 |
| Cap | Suboption 1a | | | Suboption 1b | | |
| 353,000 | 2ii | 4ii | 6 | 2ii | 4ii | 6 |
| 2003 | | | | | | |
| 2004 | 15,603 | 16,362 | 18,289 | -1,521 | -566 | |
| 2005 | 33,358 | 31,445 | 31,590 | -11,001 | -10,619 | -11,478 |
| 2006 | | 19,801 | 20,106 | -8,344 | -8,344 | -9,115 |
| 2007 | | | | | | |
| 2008 | | | | | | |
| 2009 | | | | | | |
| 2010 | | | | | | |
| 2011 | 2,901 | 1,850 | | -1,832 | -1,152 | -3,035 |
| Total | 51,862 | 69,459 | 69,985 | -22,698 | -20,680 | -23,627 |

Table 6-10. Estimated total reduction in Chinook salmon bycatch for chum management measures under Alternative 2 by cap, suboption, and sector allocation, 2003-2011.

| | | Allocation configuration | | |
|---|---|---|---|---|
| Cap | Option | 2ii | 4ii | 6 |
| 50,000 | 1a) | 156,868 | 156,895 | 154,078 |
| | 1b) | -47,910 | -48,830 | -55,953 |
| 200,000 | 1a) | 82,907 | 80,883 | 89,816 |
| | 1b) | -28,140 | -29,505 | -32,577 |
| 353,000 | 1a) | 51,862 | 69,459 | 69,985 |
| | 1b) | -22,698 | -20,680 | -23,627 |

Table 6-11. Estimated total reduction in Chinook salmon bycatch by sector for chum management measures under Alternative 2 by cap, suboption, and sector allocation, 2003-2011.

| Cap | Option | Allocation | CDQ | CP | M | S |
|---|---|---|---|---|---|---|
| **50,000** | 1a) | 2ii | 5,909 | 16,963 | 8,237 | 125,760 |
| | | 4ii | 4,847 | 14,459 | 7,858 | 129,732 |
| | | 6 | 3,534 | 11,578 | 7,349 | 131,616 |
| | 1b) | 2ii | -484 | -7,132 | -4,172 | -36,121 |
| | | 4ii | -36 | -4,315 | -3,516 | -40,964 |
| | | 6 | | -4,128 | -3,270 | -48,556 |
| **200,000** | 1a) | 2ii | 1,305 | 6,337 | 5,332 | 69,932 |
| | | 4ii | | 3,813 | 2,723 | 74,347 |
| | | 6 | | 697 | 2,318 | 86,801 |
| | 1b) | 2ii | | -2,668 | -2,515 | -22,957 |
| | | 4ii | | -1,516 | -2,188 | -25,800 |
| | | 6 | | -969 | -1,823 | -29,785 |
| **353,000** | 1a) | 2ii | | 4,565 | 2,466 | 44,831 |
| | | 4ii | | | 1,850 | 67,609 |
| | | 6 | | | | 69,985 |
| | 1b) | 2ii | | -1,560 | -2,175 | -18,963 |
| | | 4ii | | -566 | -1,152 | -18,963 |
| | | 6 | | | -670 | -22,957 |

### 6.3.3 Impacts on Chinook salmon under Alternative 3

Similar to the hard cap option, Alternative 3 with options that divert pollock into later in the season result in worse bycatch of Chinook salmon (Table 6-12 and Table 6-13). The variability is somewhat greater which likely reflects changes in the spatio-temporal patterns of Chinook salmon bycatch between years.

Table 6-12. Estimated annual reduction in Chinook salmon bycatch by year for chum management measures under Alternative 3 by cap, suboption, and sector allocation equal to 2ii (option 1), 2003-2011.

| | | Option | | | |
|---|---|---|---|---|---|
| Cap | Year | 1a) | 1b) | 2a) | 2b) |
| 25,000 | 2003 | -13,801 | -952 | 1,277 | -887 |
| | 2004 | -13,057 | -1,844 | 2,283 | -1,645 |
| | 2005 | 27,475 | -16,598 | 14,463 | -12,349 |
| | 2006 | 19,997 | -6,010 | 10,197 | -4,216 |
| | 2007 | 28,113 | -1,687 | 19,869 | -838 |
| | 2008 | | | | |
| | 2009 | 897 | -106 | 341 | -92 |
| | 2010 | | -4 | | -4 |
| | 2011 | 10,681 | -6,221 | 6,146 | -3,155 |
| | | 60,305 | -33,423 | 54,577 | -23,184 |
| 75,000 | 2003 | -5,340 | -52 | 3,155 | -52 |
| | 2004 | -7,114 | -561 | 3,186 | -353 |
| | 2005 | 27,064 | -12,281 | 14,519 | -8,662 |
| | 2006 | 18,920 | -6,002 | 9,296 | -4,215 |
| | 2007 | 1,680 | -15 | 1,502 | -4 |
| | 2008 | | | | |
| | 2009 | | -13 | | -13 |
| | 2010 | | | | |
| | 2011 | 10,606 | -4,799 | 5,616 | -2,162 |
| | | 45,815 | -23,723 | 37,274 | -15,461 |
| 200,000 | 2003 | 302 | | 428 | |
| | 2004 | 1,985 | -302 | 763 | -201 |
| | 2005 | 26,829 | -9,444 | 14,422 | -6,412 |
| | 2006 | 17,969 | -4,363 | 8,615 | -2,718 |
| | 2007 | | | | |
| | 2008 | | | | |
| | 2009 | | | | |
| | 2010 | | | | |
| | 2011 | 2,570 | -2,156 | 1,400 | -846 |
| | | 49,655 | -16,266 | 25,628 | -10,176 |

Table 6-13. Estimated total reduction in Chinook salmon bycatch by year for chum management measures under Alternative 3 by cap, suboption, and sector allocation equal to 2ii (option 1), 2003-2011.

| | | | | Allocation |
|---|---|---|---|---|
| Cap | Option | 2ii | 4ii | 6 |
| 25,000 | 1a) | 60,305 | 60,804 | 65,576 |
| | 1b) | -33,423 | -37,002 | -42,564 |
| | 2a) | 54,577 | 55,904 | 60,222 |
| | 2b) | -23,184 | -26,249 | -30,412 |
| 75,000 | 1a) | 45,815 | 45,869 | 50,740 |
| | 1b) | -23,723 | -24,704 | -28,475 |
| | 2a) | 37,274 | 35,010 | 38,625 |
| | 2b) | -15,461 | -15,971 | -19,830 |
| 200,000 | 1a) | 49,655 | 48,403 | 42,389 |
| | 1b) | -16,266 | -17,684 | -19,336 |
| | 2a) | 25,628 | 25,650 | 29,144 |
| | 2b) | -10,176 | -11,323 | -12,249 |

### 6.3.4 Summary of the impacts of the alternatives on Chinook salmon

Under all three of the alternatives under consideration, there are adverse impacts on Chinook PSC due to the incidental take of Chinook PSC under all alternatives. Some of the alternatives, notably Alternative 2 option 1B and Alternative 3 option 1B would increase fishing pressure to later in the B-season and likely increase the catch of Chinook and thus increase the adverse impact on Chinook PSC. Other alternatives such as Alternative 2, option 1a would close the fishery earlier in the B season and thus likely minimize the adverse impact on Chinook PSC.

Under Alternative 2 there are incidental takes of Chinook salmon PSC and thus there is an adverse impact under this alternative. For Option 1b and suboptions as described above, this management alternative will likely increase the bycatch of Chinook salmon due to increased fishing pressure later in the B season when Chinook rates tend to be higher. These alternatives and options would increase the adverse impact on Chinook. For options 1a and suboptions, as indicated previously, fishing would likely close earlier in the B season which would reduce the bycatch of Chinook and thus minimize the adverse impact.

Under Alternative 3 there are incidental takes of Chinook salmon PSC and thus there is an adverse impact under this alternative. For Option 1b and suboptions as described above, this management alternative will likely increase the bycatch of Chinook salmon due to increased fishing pressure diverted to later in the B season when Chinook rates tend to be higher. These alternatives and options would increase the adverse impact on Chinook. For options 1a and suboptions, as indicated previously, fishing would be less likely to be diverted early in the B season but any increased effort later in the B season would nonetheless be likely to increase Chinook PSC and thus increase the adverse impact of this alternative on Chinook PSC The estimated impacts under Alternatives 2 and 3 are not believed to be significantly adverse in either case because they would not diminish protections afforded to Chinook salmon under the provisions of Amendment 91 in the current management of the groundfish fisheries.

# 7 Other Marine Resources

The Bering Sea pollock fishery, and potential changes to the prosecution of the pollock fishery to reduce salmon bycatch under the alternatives, impacts other fish species, marine mammals, seabirds, and essential fish habitat. This chapter analyses the impacts to these other marine resources.

## 7.1 Other fish species

Vessels participating in the directed pollock fishery catch other groundfish species incidentally while also incidentally caught in the fishery in lesser amounts.

Table 7-1 Bycatch estimates (t) of non-target species caught in the BSAI directed pollock fishery, 1997-2002 based on observer data, 2003-2010 based on observer data as processed through the catch accounting system (NMFS Regional Office, Juneau, Alaska).

| Group | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|
| Jellyfish | 6,632 | 6,129 | 6,176 | 9,361 | 3,095 | 1,530 |
| Squid | 1,487 | 1,210 | 474 | 379 | 1,776 | 1,708 |
| Skates | 348 | 406 | 376 | 598 | 628 | 870 |
| Misc Fish | 207 | 134 | 156 | 236 | 156 | 134 |
| Sculpins | 109 | 188 | 67 | 185 | 199 | 199 |
| Sleeper shark | 105 | 74 | 77 | 104 | 206 | 149 |
| Smelts | 19.5 | 30.2 | 38.7 | 48.7 | 72.5 | 15.3 |
| Grenadiers | 19.7 | 34.9 | 79.4 | 33.2 | 11.6 | 6.5 |
| Salmon shark | 6.6 | 15.2 | 24.7 | 19.5 | 22.5 | 27.5 |
| Starfish | 6.5 | 57.7 | 6.8 | 6.2 | 12.8 | 17.4 |
| Shark | 15.6 | 45.4 | 10.3 | 0.1 | 2.3 | 2.3 |
| Benthic inverts. | 2.5 | 26.3 | 7.4 | 1.7 | 0.6 | 2.1 |
| Sponges | 0.8 | 21 | 2.4 | 0.2 | 2.1 | 0.3 |
| Octopus | 1 | 4.7 | 0.4 | 0.8 | 4.8 | 8.1 |
| Crabs | 1 | 8.2 | 0.8 | 0.5 | 1.8 | 1.5 |
| Anemone | 2.6 | 1.8 | 0.3 | 5.8 | 0.1 | 0.6 |
| Tunicate | 0.1 | 1.5 | 1.5 | 0.4 | 3.7 | 3.8 |
| Unident. inverts | 0.2 | 2.9 | 0.1 | 4.4 | 0.1 | 0.2 |
| Echinoderms | 0.8 | 2.6 | 0.1 | 0 | 0.2 | 0.1 |
| Sea pen/whip | 0.1 | 0.2 | 0.5 | 0.9 | 1.5 | 2.1 |
| Other | 0.8 | 2.9 | 1.1 | 0.8 | 1.2 | 3.7 |

Table 7-1 Bycatch estimates (t) of non-target species caught in the BSAI directed pollock fishery, 1997-2002 based on observer data, 2003-2010 based on observer data as processed through the catch accounting system (NMFS Regional Office, Juneau, Alaska). (Continued)

| Group | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|
| Jellyfish | 5,592 | 6,495 | 5,084 | 2,657 | 2,156 | 3,722 | 3,731 | 2,174 |
| Skates | 462 | 829 | 693 | 1,258 | 1,182 | 2,301 | 1,635 | 1,076 |
| Squid | 952 | 717 | 699 | 893 | 962 | 374 | 119 | 77 |
| Sharks | 191 | 186 | 163 | 506 | 214 | 114 | 92 | 24 |
| Sculpins | 92 | 141 | 140 | 171 | 161 | 254 | 153 | 157 |
| Eulachon | 2 | 19 | 9 | 87 | 101 | 2 | 2 | 1 |
| Eelpouts | 1 | 1 | 1 | 21 | 119 | 7 | 2 | 0 |
| Sea stars | 89 | 7 | 10 | 11 | 5 | 7 | 5 | 5 |
| Grenadier | 20 | 10 | 9 | 9 | 11 | 4 | 1 | 1 |
| Other osmerids | 7 | 2 | 3 | 5 | 37 | 2 | 0 | 0 |
| Octopus | 9 | 3 | 1 | 2 | 4 | 3 | 4 | 1 |
| Lanternfish | 0 | 0 | 0 | 10 | 6 | 1 | 0 | 0 |
| Sea pens, whips | 1 | 1 | 2 | 2 | 4 | 1 | 2 | 2 |
| Birds | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 |
| Capelin | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 |
| Other fish | 98 | 88 | 147 | 140 | 198 | 102 | 59 | 134 |
| Other invertebrates | 2 | 2 | 11 | 5 | 6 | 7 | 2 | 2 |

Table 7-2 Bycatch estimates (t) of other target species caught in the BSAI directed pollock fishery, 1997-2010 based on then NMFS Alaska Regional Office reports from observers (*2010 data are preliminary*).

| | Pacific Cod | Flathead Sole | Rock Sole | Yellowfin Sole | Arrowtooth Flounder | Pacific Ocean Perch | Atka Mackerel | Sablefish | Greenland Turbot | Alaska Plaice | All other | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 8,262 | 2,350 | 1,522 | 606 | 985 | 428 | 83 | 2 | 123 | 1 | 879 | 15,241 |
| 1998 | 6,559 | 2,118 | 779 | 1,762 | 1,762 | 682 | 91 | 2 | 178 | 14 | 805 | 14,751 |
| 1999 | 3,220 | 1,885 | 1,058 | 350 | 273 | 121 | 161 | 7 | 30 | 3 | 249 | 7,357 |
| 2000 | 3,432 | 2,510 | 2,688 | 1,466 | 979 | 22 | 2 | 12 | 52 | 147 | 306 | 11,615 |
| 2001 | 3,878 | 2,199 | 1,673 | 594 | 529 | 574 | 41 | 21 | 68 | 14 | 505 | 10,098 |
| 2002 | 5,925 | 1,843 | 1,885 | 768 | 606 | 544 | 221 | 34 | 70 | 50 | 267 | 12,214 |
| 2003 | 5,968 | 1,740 | 1,419 | 210 | 618 | 935 | 762 | 48 | 40 | 7 | 67 | 11,814 |
| 2004 | 6,437 | 2,105 | 2,554 | 841 | 557 | 393 | 1,051 | 17 | 18 | 8 | 120 | 14,100 |
| 2005 | 7,413 | 2,352 | 1,125 | 63 | 651 | 652 | 677 | 11 | 31 | 45 | 125 | 13,145 |
| 2006 | 7,285 | 2,861 | 1,361 | 256 | 1,088 | 737 | 789 | 9 | 65 | 11 | 152 | 14,612 |
| 2007 | 5,627 | 4,228 | 510 | 86 | 2,794 | 624 | 315 | 12 | 107 | 3 | 188 | 14,494 |
| 2008 | 6,761 | 4,209 | 1,964 | 405 | 1,364 | 336 | 15 | 2 | 82 | 30 | 39 | 15,205 |
| 2009 | 7,876 | 4,652 | 7,534 | 269 | 2,143 | 114 | 25 | 2 | 44 | 176 | 25 | 22,861 |
| 2010 | 6,902 | 4,333 | 2,220 | 1,017 | 1,414 | 230 | 55 | 2 | 23 | 109 | 22 | 16,326 |
| Average | 6,110 | 2,813 | 2,021 | 621 | 1,126 | 457 | 306 | 13 | 67 | 44 | 268 | 13,845 |

### 7.1.1 Effects on other Fish Species

#### 7.1.1.1 Significance Criteria for Other Fish Species

The following criteria from the 2006-2007 groundfish harvest specifications environmental assessment/final regulatory flexibility analysis (EA/FRFA) is used to evaluate the impact of the alternatives on non-target fish species (Table 7-3).

Table 7-3. Criteria used to determine significance of effects on other fish species.

| | |
|---|---|
| No impact | No incidental take of the nontarget and prohibited species in question. |
| Adverse impact | There are incidental takes of the nontarget and prohibited species in question. |
| Beneficial impact | Natural at-sea mortality of the nontarget and prohibited species in question would be reduced – perhaps by the harvest of a predator or by the harvest of a species that competes for prey. |
| Significantly adverse impact | Fisheries are subject to operational constraints under PSC management measures. Groundfish fisheries without the PSC management measures would be a significantly adverse effect on prohibited species. Operation of the groundfish fisheries in a manner that substantially increases the take of nontarget species would be a significantly adverse effect on nontarget species. |
| Significantly beneficial impact | No benchmarks are available for significantly beneficial impact of the groundfish fishery on the nontarget and prohibited species, and significantly beneficial impacts are not defined for these species. |
| Unknown impact | Not applicable |

The effects of the EBS pollock fishery on fish species that are caught incidentally has most recently been analyzed in the Alaska Groundfish Fisheries Harvest Specifications EIS (NMFS 2007) as well as analyzed in the Chinook Salmon Bycatch Measures EIS (NPFMC/NMFS 2009). The harvest specifications analysis concludes that under the status quo, the neither the level of mortality nor the spatial and temporal impacts of fishing are likely to jeopardize the sustainability of the target and nontarget fish populations while the Chinook EIS concluded that none of the proposed alternative measures, neither hard caps nor area closures (similar to ones examined here) would jeopardize the sustainability of target and nontarget fish populations either.

Alternative 2 would establish a hard cap that limits bycatch of chum salmon in the EBS pollock fishery either in June and July or for the remainder of the B-season when triggered. A lower hard cap may result in the pollock fishery closing before the TAC is reached, which may reduce impacts of this fishery on incidental catch species. A higher hard cap may allow for pollock fishing at current levels, and impacts would likely be similar to the status quo fishery. Some incidental catch of non-target species occurs in the pollock fishery. Fishing pressure is unlikely to increased (and more likely to decrease) under alternative 1, and options and suboptions would thus decrease this incidental catch and minimize the adverse impact on non-target species. This alternative is not likely to result in significant adverse impacts given the small amount of incidental catch under status quo and the likelihood that alternative management measures would minimize this catch.

The Alternative 2 hard caps, to the extent that they prevent the pollock fleet from harvesting the pollock TAC and therefore reduce pollock fishing effort, would reduce the pollock fisheries impacts on forage fish from Alternative 1. Depending on the extent vessels move to avoid salmon bycatch or as pollock catch rates decrease, pollock trawling effort may increase even if the fishery is eventually closed due to a hard cap. This would increase the adverse impact under this alternative but this is not likely to be significantly adverse given the low levels of incidental catch in this fishery and catch of non-targets is unlikely to substantially increase.

Alternative 3 proposes a large-scale fixed or triggered closure as a back-stop mechanism to encourage participation in the RHS program for bycatch reduction. Given that there is 100% participation by the fleet in the current RHS program it is reasonable to assume that under this alternative the incentive to remain in the program would be strong enough to continue to maintain 100% participation. Thus the impacts of this alternative on incidental catch of other fish species would be similar to status quo.
Alternative 3, components 2-6 propose additional triggered closures on the RHS participants which wouldclose identified areas for June and July or the remainder of the B-season when a specific cap level is reached by fishery or sector. The area closure would reduce the pollock fisheries impacts to ecosystem component species in the closed area, but it would increase the fishing effort and therefore the impacts in the adjoining areas. Since the total amount of pollock harvested and the total effort would not change under Alternative 3, it is reasonable to conclude that the overall impacts on ecosystem component species and incidental catch of other fish species would be similar to Alternative 1. As with Alternative 2, fishing effort may increase as vessels move to avoid salmon bycatch or as pollock catch rates decrease. This would increase the adverse impact under this alternative but this is not likely to be significantly adverse given the low levels of incidental catch in this fishery and catch of non-targets is unlikely to substantially increase.

## 7.2 Marine Mammals

### 7.2.1 Status of Marine Mammals

The Bering Sea supports one of the richest assemblages of marine mammals in the world. Twenty-five species are present from the orders Pinnipedia (seals, sea lion, and walrus), Carnivora (sea otter and polar bear), and Cetacea (whales, dolphins, and porpoises). Marine mammals occur in diverse habitats, including deep oceanic waters, the continental slope, the continental shelf, sea ice, shores and rocks, and nearshore waters (Lowry et al. 1982). The PSEIS (NMFS 2004) describes the range, habitat, diet, abundance, and population status for marine mammals.

The most recent marine mammal stock assessment reports (SARs) for strategic BSAI marine mammals stocks (Steller sea lions, northern fur seals, harbor porpoise, North Pacific right whales, humpback whales, sperm whales, fin whales and bowhead whales) were completed in 2011 based on a review of data available through 2010 (Allen and Angliss 2011). Polar bears, Pacific walrus, and northern sea otters are under U.S. Fish and Wildlife Service juriscition. Polar bears and Pacific walrus status were updated in 2010, northern sea otters were updated in 2008 (Allen and Algliss 2011). The SARs provide population estimates, population trends, and estimates of the potential biological removal (PBR) levels for each stock. The SARs also identify potential causes of mortality and whether the stock is considered a strategic stock under the MMPA. The SARs are available on the Protected Resources Division web site at http://www.nmfs.noaa.gov/pr/sars/region.htm.

The Alaska Groundfish Harvest Specifications EIS provides information on the effects of the groundfish fisheries on marine mammals (NMFS 2007a). Direct and indirect interactions between marine mammals and groundfish fishing vessels may occur due to overlap in the size and species of groundfish harvested in the fisheries that are also important marine mammal prey, and due to temporal and spatial overlap in marine mammal occurrence and commercial fishing activities. This discussion focuses on those marine mammals that may interact or be affected by the pollock pelagic trawl fishery in the Bering Sea, as listed in the List of Fisheries (LOF) for 2011 (75 FR 68468, November 8, 2010) or in the 2010 Alaska Marine Mammal Stock Assessments (Allen and Angliss 2011). These species are listed in Table 7-4 and Table 7-5.

Table 7-4 Status of Pinniped stocks potentially affected by the Bering Sea pollock fishery

| ***Pinnipedia species and stock*** | ***Status under the ESA*** | ***Status under the MMPA*** | ***Population Trends*** | ***Distribution in action area*** |
|---|---|---|---|---|
| Steller sea lion - Western and Eastern Distinct Population Segment (DPS) | Endangered (W)<br>Threatened (E) | Depleted, strategic | For the western DPS, regional increases in counts in trend sites of some areas have been offset by decreased counts in other areas so that the overall population of the western DPS appears stable (Fritz et al. 2008). The eastern DPS is steadily increasing and is being considered for delisting (NMFS 2010). | Western DPS inhabits Alaska waters from Prince William Sound westward to the end of the Aleutian Island chain and into Russian waters. Eastern DPS inhabit waters east of Prince Williams Sound to California. Occur throughout AK waters, terrestrial haulouts and rookeries on Pribilof Is., Aleutian Is., St. Lawrence Is. And off mainland. Use marine areas for foraging. Critical habitat designated around major rookeries and haulouts and foraging areas. |
| Northern fur seal – Eastern Pacific | None | Depleted, strategic | Recent pup counts show a continuing decline in productivity in the Pribilof Islands. During 1998-2006, pup production declined 6.1% annually on St. Paul Island and 3.4% annually on St. George Island. Despite near exponential growth on Bogoslof Island, the overall abundance estimate continues to decline in the Bering Sea. | Fur seals occur throughout Alaska waters, but their main rookeries are located in the Bering Sea on Bogoslof Island and the Pribilof Islands. Approximately 55% of the worldwide abundance of fur seals is found on the Pribilof Islands (NMFS 2007b). Forages in the pelagic area of the Bering Sea during summer breeding season, but most leave the Bering Sea in the fall to spend winter and spring in the N. Pacific. |
| Harbor seal –<br>Gulf of Alaska<br>Bering Sea | None | None | Moderate to large population declines have occurred in the Bering Sea and Gulf of Alaska stocks. | GOA stock found primarily in the coastal waters and may cross over into the Bering Sea coastal waters between islands.<br>Bering Sea stock found primarily around the inner continental shelf between Nunivak Island and Bristol Bay and near the Pribilof Islands. |
| Ringed seal – Alaska | Status under review | None | Reliable data on population trends are unavailable. | Found in the northern Bering Sea from Bristol Bay to north of St. George Island and occupy ice (Figure 7-3). |
| Bearded seal – Alaska | Status under review | None | Reliable data on population trends are unavailable. | Found in the northern Bering Sea from Bristol Bay to north of St. George Island and inhabit areas of water less than 200 m that are seasonally ice covered (Figure 7-3). |
| Ribbon seal – Alaska | None | None | Reliable data on population trends are unavailable. | Found throughout the offshore Bering Sea waters (Figure 7-3). |
| Spotted seal - Alaska | Status under review | None | Reliable data on population trends are unavailable. | Found throughout the Bering Sea waters (Figure 7-3). |
| Pacific Walrus | Status under review | Strategic | Population trends are unknown. Population size estimated from a 2006 ice survey is 15,164 animals, but this is considered a low estimate. Further analysis is being conducted on the 2006 survey to refine the population estimate. | Occur primarily is shelf waters of the Bering Sea. Primarily males stay in the Bering Sea in the summer. Major haulout sites are in Round Island in Bristol Bay and on Cape Seniavin on the north side of the Alaska Peninsula. |
| Source: Allen and Angliss 2011 and List of Fisheries for 2011 (75 FR 68468).<br>Northern fur seal pup data available from http://www.fakr.noaa.gov/newsreleases/2007/fursealpups020207.htm. | | | | |

Table 7-5 Status of Cetacea stocks potentially affected by the Bering Sea pollock fishery

| ***Cetacea species and stock*** | ***Status under the ESA*** | ***Status under the MMPA*** | ***Population Trends*** | ***Distribution in action area*** |
|---|---|---|---|---|
| Killer whale – AT1 Transient; Eastern North Pacific GOA, AI, and BS transient; West Coast transient; and Eastern North Pacific Alaska Resident | None | AT1 Transient Depleted, strategic | AT1 group is estimated at 7 animals. Unknown abundance for the eastern North Pacific Alaska resident; West Coast transient; and Eastern North Pacific Gulf of Alaska, Aleutian Islands, and Bering Sea transient stocks. Minimum abundance estimates for the Eastern North Pacific Alaska Resident and West coast transient stocks are likely underestimated because new whales recently found in the Alaskan waters. | Transient-type killer whales from the Aleutian Islands and Bering Sea are considered to be part of a single population that includes Gulf of Alaska transients. Killer whales are seen in the northern Bering Sea and Beaufort Sea, but little is known about these whales. |
| Dall’s porpoise – Alaska | None | None | Reliable data on population trends are unavailable. | Found offshore waters from coastal western Alaska to Bering Sea. |
| Humpback whale- Western North Pacific Central North Pacific | Endangered | Depleted, strategic | Reliable data on population trends are unavailable for the western North Pacific stock. Central North Pacific stock thought to be increasing. The status of the stocks in relation to optimal sustainable population (OSP) is unknown. | W. Pacific and C. North Pacific stocks occur in Alaskan waters and may mingle in the North Pacific feeding area shown in Figure 7-2. Humpback whales in the Bering Sea identity to western or Central North Pacific stocks, or to a separate, unnamed is stock difficult. |
| North Pacific right whale Eastern North Pacific | Endangered | Depleted, strategic | Abundance not known, stock is considered to represent only a small fraction of its pre-commercial whaling abundance. | See Figure 7-4 for distribution and designated critical habitat. |
| Fin whale – Northeast Pacific | Endangered | Depleted, strategic | Abundance may be increasing but surveys only provide information for portions of the stock in the central-eastern and southeastern Bering and coastal waters of the Aleutian Islands and the Alaska Peninsula, and much of the North Pacific range has not been surveyed. | Found in the Bering Sea and coastal waters of the Aleutian Islands and Alaska Peninsula. Most sightings in the central-eastern Bering Sea occur in a high productivity zone on the shelf break (Figure 7-1). |
| Minke whale - Alaska | None | None | Considered common but abundance not known and uncertainty exists regarding the stock structure. | Common in the Bering and Chukchi Seas and in the inshore waters of the GOA. |
| Sperm Whale – North Pacific | Endangered | Depleted, strategic | Abundance and population trends in Alaska waters are unknown. | Inhabit waters 600 m or more depth, south of 62°N lat. Males inhabit Bering Sea in summer. |
| Gray Whale – Easter North Pacific | None | None | Minimum population estimate is 17,752 animals. Increasing populations in the 1990’s but below carrying capacity. | Most spend summers in the shallow waters of the northern Bering Sea and Arctic Ocean. Winters spent along the Pacific coast near Baja California. |

. Source: Allen and Angliss 2011 and List of Fisheries for 2011 (72 FR 68468). North Pacific right whale included based on NMFS 2006 and Salveson 2008 www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spermwhale.htm

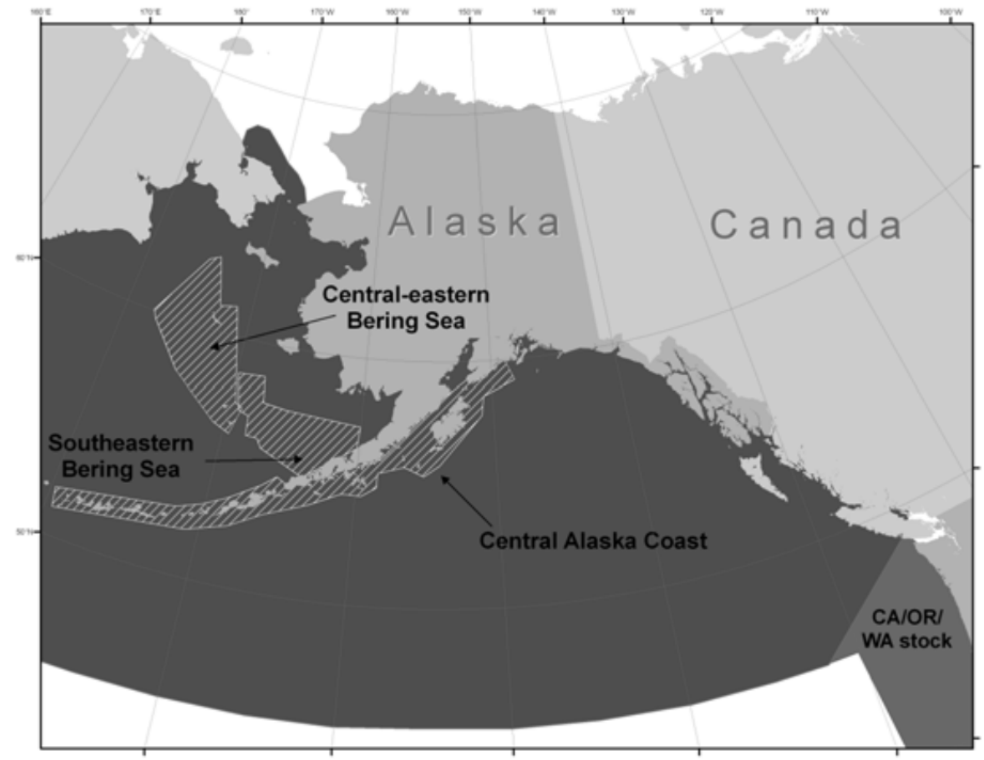


Figure 7-1. Fin whale distribution and survey areas in lined locations (Allen and Angliss 2011))

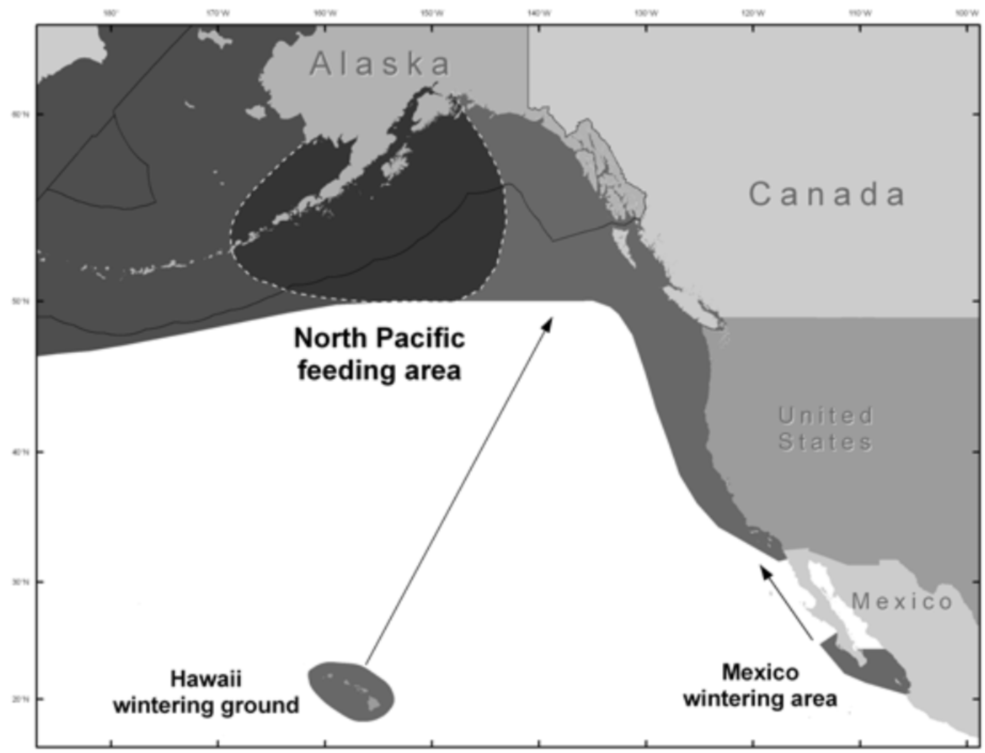


Figure 7-2. Feeding area of humpback whales (Allen and Angliss 2011). Shaded area shows overlap of Central and western North Pacific humpback whale stocks. Arrows show migration from winter grounds.

### 7.2.2 ESA Consultations for Marine Mammals

For Bering Sea marine mammals, ESA Section 7 consultations have been completed for all ESA-listed marine mammals (NMFS 2000, NMFS 2001, NMFS 2010). The Alaska Groundfish Harvest Specifications EIS provides a detailed description of the status of ESA Section 7 consultations through December 2006 (Section 8.2 of NMFS 2007a). This section provides information on Section 7 consultations that have taken place since that document was published.

#### 7.2.2.1 Steller Sea Lions

The Steller sea lion has been listed as threatened under the ESA since 1990. In 1997, two stocks or distinct population segments (DPS) were recognized, based on genetic and demographic dissimilarities. Because of a pattern of continued decline, the western DPS was listed as endangered on May 5, 1997 (62 FR 30772), while the eastern DPS remains listed as threatened. NMFS is currently considering delisting the eastern DPS (75 FR 77602, December 13, 2010). The western DPS inhabits an area of Alaska approximately from Prince William Sound (west of 144° W longitude) westward to the end of the Aleutian Island chain and into Russian waters.

In 2006, NMFS reinitiated a FMP-level Section 7 consultation on the effects of the groundfish fisheries on Steller sea lions, humpback whales, and sperm whales to consider new information on these species and their interactions with the fisheries (NMFS 2006a). A draft Biological Opinion (BiOp) was released in July 2010 (NMFS 2010a). The draft opinion found that the effects of the groundfish fisheries were likely to jeopardize the continued existence of Steller sea lions and adversely modify designated critical habitat (JAM). The draft BiOp also found that the groundfish fisheries were not likely to jeopardize the continued existence of humpback or sperm whales. Because the draft BiOp found that the groundfish fisheries caused JAM for Steller sea lions, a reasonable and prudent alternative (RPA) was included. The final BiOp was released in November 2010, and NMFS implemented the Steller sea lion protection measures in the RPA on January 1, 2011 (NMFS 2010b) by interim final rule (75 FR 77535, December 13, 2010, corrected 75 FR 81921, December 29, 2010). The RPA did not change the Steller sea lion protection measures in the EBS. Incidental take statements for Steller sea lions, humpback whales, fin whales, and sperm whales were completed on February 10, 2011 (Balsiger 2011).

A detailed discussion of Steller sea lion population trends in the WDPS is included in the most recent Biological Opinion (NMFS 2010b) and is summarized here. Based on non-pup counts of Steller sea lions on trend sites throughout the range of the WDPS the overall population trend for the WDPS of Steller sea lions is stable and may be increasing, but the trend is not statistically significant. The number of non-pups counted at trend sites increased by12% between 2000 and 2008. However, counts increased by only 1% between 2004 and 2008 (DeMaster 2009). Population trends differ across the range of the WDPS. Non-pup counts have declined in the Aleutian Islands, with the decline being most severe in the west and becoming less severe towards the east (7% decline in Area 543, 1% to 4% decline in Areas 542 and 541; NMFS 2010b). Pup and non-pup counts in the remainder of the WDPS range are either stable or increasing from 0% to 5% from 2000 to 2008 (NMFS 2010b).

#### 7.2.2.2 Ice Seals

In December 2007, NMFS was petitioned by the Center for Biological Diversity (CBD) to list ribbon seals as endangered or threatened under the ESA (CBD 2007). The petition was based on the dependence of this species on sea ice and the loss of sea ice due to global climate change. The petition presented information on (1) global warming which is resulting in the rapid melt of the seals' sea-ice habitat; (2) high harvest levels allowed by the Russian Federation; (3) current oil and gas development; (4) rising contaminant levels in the Arctic; and (5) bycatch mortality and competition for prey resources from commercial fisheries. NMFS determined that the petition presented substantial information that a listing may be warranted and started a status review of the species (73 FR 16617, March 28, 2008). Detailed information on the biology, distribution and potential threats on ribbon seals is contained in CBD 2007.

NMFS determined that the listing was not warranted due to modeling of future sea ice extent and population estimates (73 FR 79822, December 30, 2008). On March 31, 2009, the CBD and Greenpeace filed a 60 day notice of intent to sue NMFS for failing to propose listing ribbon seals under the ESA. The CBD and Greenpeace filed a complaint for declaratory and injunctive relief on September 3, 2009, asking for the 12-month finding to be remanded. In December, 2011, NMFS announced that it was initiating a new status review of ribbon seals to determine whether it should be listed under the U.S. ESA.

On May 28, 2008, the CBD petitioned NMFS to list ringed, bearded, and spotted seals under the ESA due to threats to the species from (1) global warming, (2) high harvest levels allowed by the Russian Federation, (3) oil and gas exploration and development, (4) rising contaminant levels in the Arctic, and (5) bycatch mortality and competition for prey resources from commercial fisheries (CBD 2008a). NMFS initiated the status review for ringed, bearded, and spotted seals (73 FR 51615, September 4, 2008). Pursuant to a court settlement, NMFS completed the status review and issued a 12-month finding on October 15, 2009 for the spotted seal (74 FR 53683, October 20, 2009). NMFS determined that the status of the stocks of spotted seals occurring in Alaska indicated that no listing was needed. On December 10, 2010, NMFS completed its status reviews of ringed and bearded seals. The agency proposed listing four subspecies of ringed seals found in the Arctic Basin (including the Bering Sea) and the North Atlantic as threatened, and two distinct population segments (DPS) of bearded seals in the Bering Sea and Okhotsk Sea as threatened under the Endangered Species Act. In December, 2011, NMFS extended the date for the final determination to list two DPSs of bearded seals as threatened, and four subspecies of ringed seals as threatened. Final decisions are due in June 2012. Listing of ringed or bearded seals would require ESA consultation on federal actions that may adversely affect them or any designated critical habitat.

The National Marine Mammal Laboratory surveyed ice seals during April through June 2007 from the USGC vessel Healy in the Bering Sea. Figure 7-3 shows the abundance and distribution of bearded, ribbon, and spotted seals over the survey area. Satellite tagged ribbon and spotted seals from late spring through July showed that the animals mostly stayed in the Bering Sea south and west of St. Matthews Island with a few animals traveling north through the Bering Strait (Boveng, et. al. 2008).

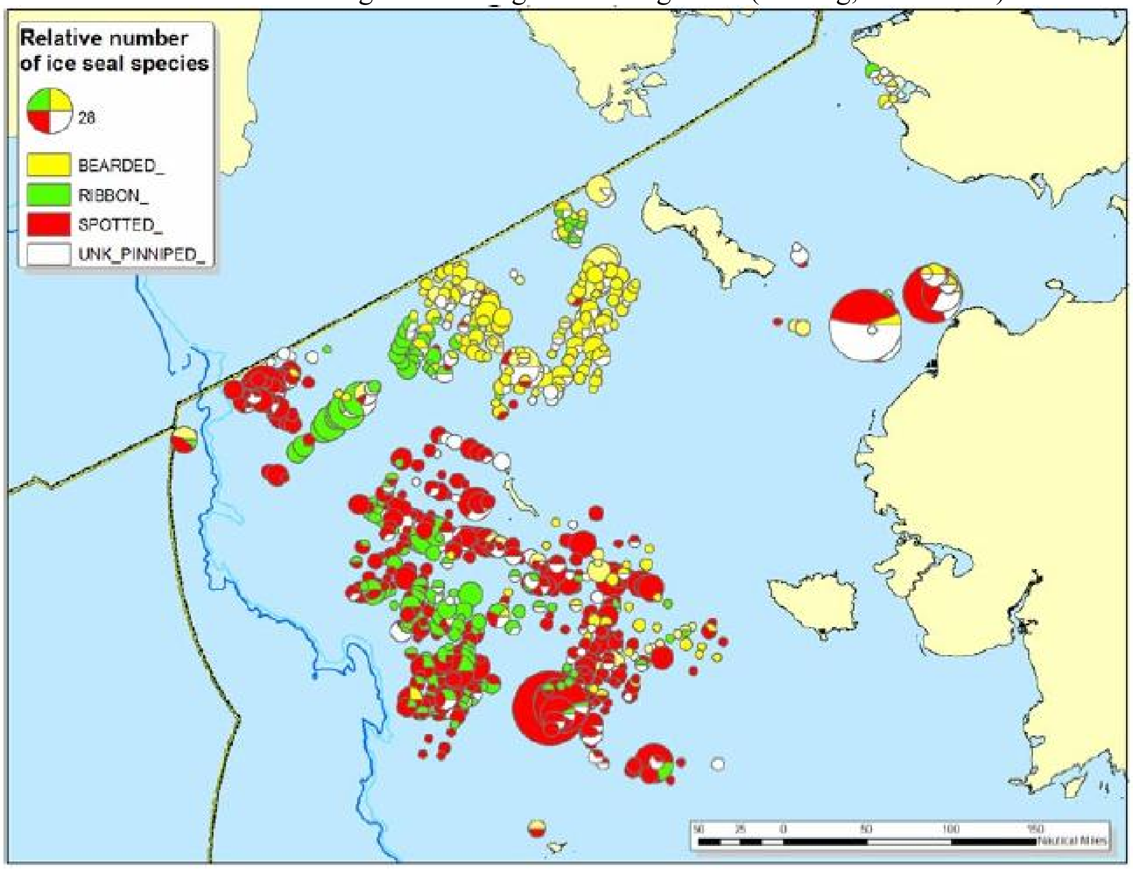


Figure 7-3. Ice seal survey during Healy cruises in summer in Bering Sea 2007 (Cameron and Boveng 2007)

### 7.2.2.3 North Pacific Right Whale

North Pacific right whales (*Eubalaena japonica*) were distinguished from North Atlantic right whales (*Eubalaena glacialis*) in 2008 (73 FR 1224). North Pacific right whales are arguably the most endangered stock of large whales in the world (Allen and Anglis 2011), with a minimum population estimate of 17 individuals. Critical habitat for North Pacific right whales consists of an area in the southeast Bering Sea and a small area southeast of Kodiak Island (Fig. 7-4), although most North Pacific right whale sightings have occurred within critical habitat in the Bering Sea.

After the North Pacific species was designated, the NMFS Alaska Region Sustainable Fisheries Division requested Section 7 consultation under the U.S. ESA on the effects of the Alaska groundfish fisheries (Salveson 2008). However, NMFS Protected Resources Division (Brix 2008) concluded that because an analysis in 2006 (Brix 2006) determined that the groundfish fisheries were unlikely to cause jeopardy to the population or adversely modify critical habitat, and the 2008 action was a change in taxanomic status, no further consultation was required.

Gillnets were implicated in the death of a North Pacific right whale off the Kamchatka Peninsula (Russia) in October of 1989 (Kornev 1994). No other incidental takes of right whales are known to have occurred in the North Pacific. North Atlantic right whales are known to become entangled in fishing gear, including lobster pot and sink gillnet gear, and entanglement is considered a major source of mortality for right whales in the Atlantic (Waring et al. 2004). Any mortality to North Pacific right whales from fishing activities or other human-caused mortality would be considered significant.

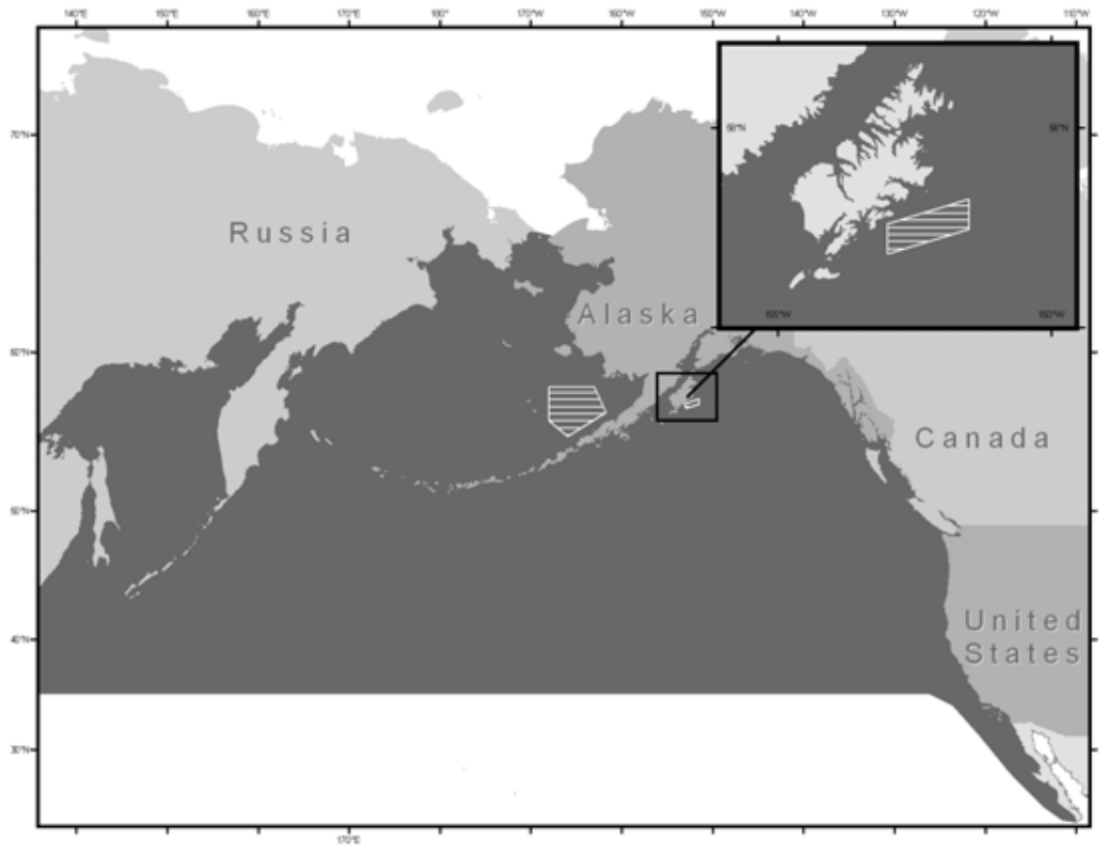


Figure 7-4. North Pacific right whale distribution and critical habitat shown in lined boxes. (Angliss and Outlaw 2008)

### 7.2.2.4 Pacific Walrus

Pacific walrus (*Odobenus rosmarus divergens*) are managed by the U.S. Fish and Wildlife Service (FWS). They occur throughout the shallow, continental shelf waters of the Bering and Chukchi Seas, occasionally moving into the East Siberian Sea and the Beaufort Sea. During the summer months, most of the population migrates into the Chukchi Sea, but several thousand animals, primarily adult males, aggregate at coastal haulouts in the Bering Straits region, Gulf of Anadyr, and Bristol Bay. The size of the Pacific walrus population has never been known with any certainty, and recent population estimates have provided unsatisfactory results because of differences in survey methods that produced large variances and unknown biases. The most recent population estimation (Speckman et al. 2011) is 129,000 with 95% confidence limits of 55,000 to 507,000.

On February 7, 2008, the Center for Biological Diversity petitioned the USFWS to list Pacific walrus under the ESA because of the impact of global warming in the sea ice habitat (CBD 2008). On December

3, 2008, the CBD filed suit against the USFWS for failing to act on the petition (http://www.biologicaldiversity.org/news/ press releases/2008/pacific-walrus-12-03-2008.html). On September 8, 2009, the USFWS announced that the CBD petition presented substantial scientific or commercial information indicating that adding Pacific walrus to the federal list of threatened and endangered species may be warranted. On February 10, 2011, the USFWS released its 12-month finding. The USFWS found that listing the Pacific walrus as threatened or endangered is warranted but precluded at this time by higher priority actions under the ESA. Therefore, the agency has added Pacific walrus to the candidate species list. As priorities allow, the USFWS will develop a proposed rule to list the Pacific walrus.

In the Bering Sea, the most heavily used coastal haulouts are Round Island (Walrus Islands State Game Sanctuary), Cape Peirce and Cape Newenham (Togiak National Wildlife Refuge), and Cape Seniavin on the Alaska Peninsula. Less consistently used haulouts occur at Cape Constantine, Amak Island, Big Twon Island, Crooked Island, High Island, and Hagemeister Island. Walrus have also occasionally been observed at isolated beaches near Port Moller, Port Heiden, and Egegik Bay. Recently, thousands of of walrus have hauled out on beaches near Point Lay in the Chukchi Sea as sea ice recedes off of the continental shelf and over deep, Arctic basin waters. At these dense haulouts, young walrus may be at increased risk of death by trampling if the adults stampeed into the water (Garlich-Miller et al. 2011).

Pacific walrus occasionally interact with trawl and longline gaer of groundfish fisheries. No data are availabon incidental catch of walrus in fisheries operating in Russian waters, although trawl and longline fisheries are known to operate there. Incidental mortality during the 5-year period 2002-2006 was recorded only for the BSAI non-pelagic trawl fishery. No incidental injury was recorded during this time period.

### 7.2.3 Existing Management Measures to Mitigate Fishing Impacts on Marine Mammals

In the BS, extensive closures are in place for Steller sea lions including no transit zones and closures of critical habitat around rookeries and haulouts, and some offshore foraging areas. These closures affect commercial harvests of pollock, Pacific cod, and Atka mackerel, which are important components of the Steller sea lion diet. Pollock is an important prey species for Steller sea lions (NMFS 2010b). The Bering Sea subarea has several pollock fishery closures in place for Steller sea lion protection including no transit zones, closures around rookeries and haulouts, the Bogoslof foraging area closure, and the Steller Sea Lion Conservation Area (Figure 7-5). On January 1, 2011, the Interim Final Rule resulting from the 2010 BSAI and GOA FMP-level Biological Opinion went into effect. This Interim Final Rule provides additional protection to Steller sea lions by restricting fishing for Atka mackerel and Pacific cod in vast areas of the western and central Aleutian Islands (Fig. 7-5). Before this, the most recent action that provided protection to some marine mammals in the Bering Sea was the approval of the Fishery Management Plan for Fish Resources of the Arctic Management Area. This plan was approved on August 17, 2009 and implemented in December 2009. This plan prohibits commercial fishing in the Arctic Management Area until information is available to evaluate and mitigate the impacts of commercial fisheries in the Arctic.

The proposed action would not change the closures associated with the five Bering Sea Steller sea lion sites located at Sea lion Rock, Bogoslof Island/Fire Island, Adugak Island, Pribilof Islands, and Walrus Islands and with the Bogoslof Foraging Area. The harvest of pollock in the Bering Sea subarea is temporally and spatially dispersed through area closures (§§ 679.20, 679.22 and 679.23). Based on the most recent completed biological opinion, these harvest restrictions on the pollock fishery decrease the likelihood of disturbance, incidental take, and competition for prey to ensure the pollock fishery does not jeopardize the continued existence or adversely modify the designated critical habitat of Steller sea lions

(NMFS 2000, NMFS 2001, and NMFS 2010b). A detailed analysis of the effects of these protection measures is provided in the Steller Sea Lion Protection Measures Final Supplemental EIS (NMFS 2001).

Figure 7-5 also shows the other areas closed to pollock fishing. The Nearshore Bristol Bay Trawl Closure prohibits pollock vessels from fishing in Bristol Bay. The Pribilof Island Area Habitat Conservation Zone prevents pollock trawling at all times in the area around the Pribilof Islands. The walrus protection areas around Round Island and The Twins, are closed from April 1 through September 30 to pollock vessels.

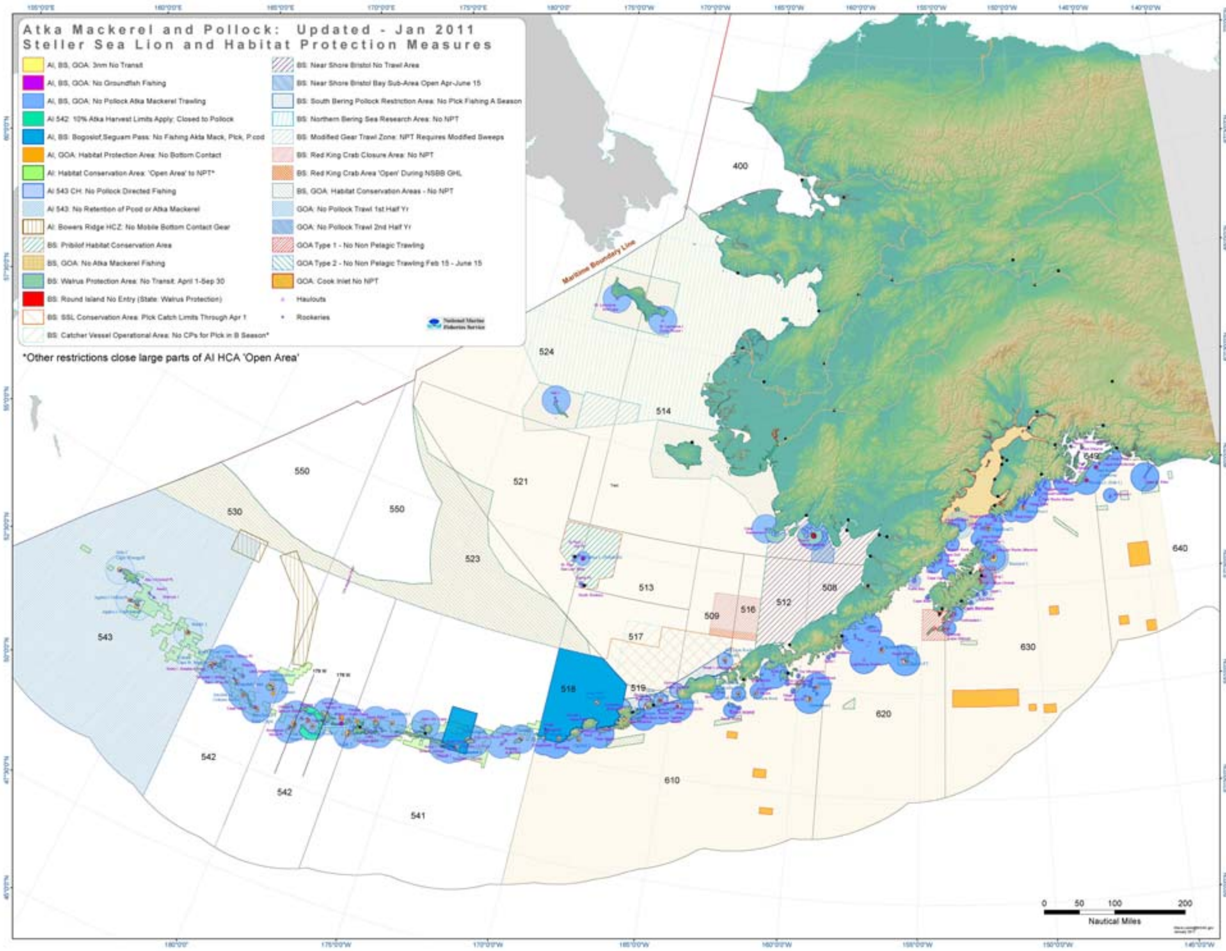


Figure 7-5. Pollock Fishery Restrictions Including Steller Sea Lion Protection Areas. (Details of these closures are available through the NMFS Alaska Region website at http://www.fakr.noaa.gov/sustainablefisheries/sslpm/).

## 7.2.4 Effects on Marine Mammals

### 7.2.4.1 Significance Criteria for Marine Mammals

Criteria to assess the impacts of the action on marine mammals are listed below. These criteria are adopted from the 2006-2007groundfish harvest specifications environmental assessment/final regulatory flexibility analysis (EA/FRFA). As the alternatives being considered constitute a change from status quo, impacts are assessed as a change from status quo. Although impacts from commercial fisheries cannot be considered beneficial (incidental take, reduced prey availability, and increased disturbance are all adverse impacts), it is possible that an alternative considered in this analysis could reduce the harmful effects of commercial fisheries on marine mammals and seabirds, if it can be demonstrated that they reduce incidental take, competition for prey, or disturbance.

Table 7-6. Criteria for determining significance of impacts to marine mammals.

| | **Incidental take and entanglement** | **Prey availability** | **Disturbance** |
|---|---|---|---|
| **Adverse impact** | Mammals are taken incidentally to fishing operations or become entangled in marine debris. | Fisheries reduce the availability of marine mammal prey. | Fishing operations disturb marine mammals. |
| **Beneficial impact** | There is no beneficial impact. | There is no beneficial impact. | There is no beneficial impact. |
| **Insignificant impact** | No substantial change in incidental take by fishing operations, or in entanglement in marine debris | No substantial change in competition for key marine mammal prey species by the fishery. | No substantial change in disturbance of mammals. |
| **Significantly adverse impact** | Incidental take is more than PBR or is considered major in relation to estimated population when PBR is undefined. | Competition for key prey species likely to constrain foraging success of marine mammal species causing population decline. | Disturbance of mammal is such that population is likely to decrease. |
| **Significantly beneficial impact** | Not applicable | Not applicable | Not applicable |
| **Unknown impact** | Insufficient information available on take rates. | Insufficient information as to what constitutes a key area, prey species, or important time of year. | Insufficient information as to what constitutes disturbance. |

### 7.2.5 Incidental Take Effects

The Alaska Groundfish Harvest Specifications EIS contains a detailed description of the effects of the groundfish fisheries on marine mammals (Chapter 8 of NMFS 2007a) and is incorporated by reference. The BSIA pollock fishery is listed as a Category II fishery in the 2011List of Fisheries, meaning incidental take of marine mammals ranges from 1% to 50% of Potential Biological Removal (PBR). Potential take in the pollock fishery is below the PBR for all marine mammals for which PBR has been determined. Table 7-7 provides more detail on the levels of take based on the most recent SARs (Angliss and Outlaw 2008, 2007, and 2006). Overall, very few marine mammals are reported taken in the Bering Sea pollock fishery.

Table 7-7. Estimated mean annual mortality of marine mammals from observed BSAI pollock fishery and potential biological removal. Mean annual mortality is expressed in number of animals and includes both incidental takes and entanglements. The averages are from the most recent 5 years of data since the last SAR update, which may vary by stock. Groundfish fisheries mortality calculated based on Allen and Angliss (2011).

| Marine Mammal Species and Stock | Years used to calculate mean annual mortality from BSIA pollock fishery | Mean annual mortality, from BSAI pollock fishery | Potential Biological Removal (PBR) |
|---|---|---|---|
| *Steller sea lions (western) | 2002-2006 | 3.83 | 254 |
| Northern fur seal | 2002-2006 | 0.21 | 13,809 |
| Harbor seal (BS) | 2002-2006 | 0.29 | 603 |
| Harbor seal (AI) | 2000-2004 | 0 | 1334 |
| Spotted seal | N/A | N/A | Undetermined |
| Ringed seal | N/A | N/A | Undetermined |
| Ribbon seal | N/A | N/A | Undetermined |
| Killer whale Eastern North Pacific AK resident | N/Z | N/Z | 20.8 |
| Killer whale, GOA, BSAI transient | 2002-2006 | 0.41 | 5.5 |
| Dall’s porpoise | 2002-2006 | 1.09 | Undetermined |
| *Humpback whale, Western North Pacific | N/A | N/A | 2.6 |
| *Humpback whale, Central North Pacific | N/A | N/A | 61.2 |
| Minke whale, Alaska | N/A | N/A | Undetermined |
| *Fin whale, Northeast Pacific | 2002-2006 | 0.23 | 11.4 |
| Pacific walrus | N/A | N/A | 2,580 |

* ESA-listed stock

Table 7-8 shows the months and locations when incidental takes of marine mammals occurred in 2003, 2004, 2005, and 2006. It is not possible to determine any seasonality to the incidental takes of killer whales, fur seals, or fin whales since only one occurrence for each is reported during this time period. It appears that Dall’s porpoise may be more likely taken in July and bearded seals may be more likely taken in September and October. Steller sea lions appear to be taken in the A and B pollock fishing seasons, mostly in January through March and in September. Based on the very limited data in Table 7-8, bearded seals were primarily taken in the northern portion of the eastern Bering Sea. Killer whale, Dall’s porpoise, and fin whale appear to be taken in the area along the shelf break. Steller sea lions appear to be taken primarily in the southern portion of the eastern Bering Sea and northwest of the Pribilof Islands.

Table 7-8. Marine Mammals taken in the pollock fishery in 2003, 2004, 2005, and 2006. Locations correspond to the areas depicted in Figure 7-5 (Sources: National Marine Mammal Laboratory 4-28-08 and the North Pacific Groundfish Observer Program 10-31-08)

| SPECIES | DATE | LOCATION |
|---|---|---|
| Killer whale | 20-Mar-03 | Area 521 |
| Dall's porpoise | 20-Jul-04 | Area 521 |
| Steller sea lion | 15-Jul-04 | Area 513 |
| Steller sea lion | 3-Feb-05 | Area 509 |
| Steller sea lion | 3-Mar-05 | Area 521 |
| Steller sea lion | 5-Mar-05 | Area 521 |
| Steller sea lion | 5-Sep-05 | Area 521 |
| Northern fur seal | 29-Jun-05 | Area 521 |
| Steller sea lion | 27-Jan-06 | Area 509 |
| Steller sea lion | 30-Jan-06 | Area 509 |
| Steller sea lion | 5-Feb-06 | Area 509 |
| Steller sea lion | 6-Mar-06 | Area 509 |
| Steller sea lion | 15-Sep-06 | Area 521 |
| Steller sea lion | 18-Sep-06 | Area 509 |
| Bearded seal | 6-Sep-06 | Area 524 |
| Bearded seal | 18-Oct-06 | Area 524 |
| Fin whale | 16-Aug-06 | Area 521 |
| Dall's porpoise | 26-Jul-06 | Area 517 |

#### 7.2.5.1 Incidental Take Effects under Alternative 1: Status Quo

The effects of the status quo fisheries on the incidental takes of marine mammals are detailed in the 2007 harvest specifications EIS (NMFS 2007a) and the Chinook Salmon Bycatch Management Measures EIS (NPFMC/NMFS 2009). The mean annual take of marine mammals in the pollock fishery is well below PBRs for those species for which PBR has been calculated (Table 7-5). Many of the species identified in Table 7-5 do not have a take associated with the BS pollock fishery from 2002 – 2006, the years used to estimate take (Allen and Angliss 2011), and for some species the PBR has not been estimated. However, considering that takes of marine mammals are rare, it is unlikely that incidental takes of these species will have impact on their respective stocks. It is also likely that under the Status Quo alternative, there will not be a substantial changein incidental take, or in entanglement in marine debris. Therefore, impacts from Alternative 1 are considered insignificant.

#### 7.2.5.2 Incidental Take Effects under Alternative 2: Hard Cap

Imposing hard caps on the pollock fishery and the impact this could have on fishing pressures was also examined in the Chinook Bycatch Management Measures EIS (NPFMC/NMFS 2009). The range of hard caps under Alternative 2 may result in different potential for incidental takes of marine mammals. Lower hard caps may stop the pollock fishery in the Bering Sea earlier, which could reduce the potential for incidental takes in fishing areas where marine mammals interact with pollock fishing vessels. However, impacts are likely to be incremental and insignificant.

The options for sector allocations and transfers, and cooperative provisions affect the management and distribution of the cap across the sectors. These options are not likely to have any effect on pollock fishing in a manner that would change the potential for incidental takes of marine mammals since the overall quantity of pollock fishing and potential for interaction with marine mammals is not changed by the allocations, transfers, and cooperative provisions.

#### 7.2.5.3 Incidental Take Effects under Alternative 3: Triggered Closures

Alternative 3, component 1, proposes a large-scale fixed or triggered closure as a back-stop mechanism to encourage participation in the RHS program for bycatch reduction. Given that there is 100% participation by the fleet in the current RHS program it is reasonable to assume that under this alternative the incentive to remain in the program would be strong enough to continue to maintain 100% participation. Thus the impacts of this alternative on incidental catch of marine mammals would be similar to status quo. Components 2 through 6 propose additional triggered area closure for RHS participants. A closure of an area where marine mammals are likely to interact with pollock fishing vessels would likely reduce the potential for incidental takes. The potential reduction would depend on the location and marine mammal species. A number of marine mammal species have been taken in northern waters of the Bering Sea (Table 7-7). Fishing under any of the alternatives and options would require vessels to comply with Steller sea lion protection measures and the Pribilof Island Area Habitat Conservation Zone, reducing the potential for interaction with Steller sea lions and northern fur seals in these areas. A large portion of the closures are located in the southern part of the Bering Sea where Steller sea lions are more likely to be encountered. These closures for salmon also may reduce the potential for incidental takes of Steller sea lions in the closure locations. However, impacts are likely to be incremental and insignificant.

### 7.2.6 Prey Availability Effects

Table 7-8 shows the Bering Sea marine mammals that may be impacted by the pollock fishery and their prey species. Pollock and salmon prey are in **bold**.

Table 7-9 Bering Sea Marine Mammal that are known to feed on pollock or salmon.

| Species | Prey |
|---|---|
| Fin whale | Zooplankton, squid, fish (herring, cod, capelin, and **pollock**), and cephalopods |
| Humpback whale | Zooplankton, schooling fish (**pollock**, herring, capelin, saffron cod, sand lance, Arctic cod, and **salmon** species) |
| Minke whale | Pelagic schooling fish (herring and **pollock**) |
| Beluga whale | Wide variety invertebrates and fish including **salmon and pollock** |
| Killer whale | (transient) Marine mammals and (resident) fish (including herring, halibut, **salmon,** and cod) |
| Dall's porpoise | hake, squid, lanternfish, anchovy, sardines, and small schooling fish. |
| Bearded seal | Primarily crab, shrimp, and mollusks; some fish (Arctic cod, saffron cod, sculpin, and **pollock**) |
| Spotted seal | Primarily pelagic and nearshore fish (**pollock and salmon**), occasionally cephalopods and crustaceans |
| Ribbon seal | Arctic and saffron cods, **pollock**, capelin, eelpouts, sculpin and flatfish, crustaceans and cephalopods |
| Northern fur seal | **Pollock**, squid, and bathylagid fish (northern smoothtongue), herring, **salmon,** and capelin. (Females at Bogoslof eat primarily squid and bathylagid fish and less pollock than in the Pribilofs, and salmon irregularly.) |
| Harbor seal | crustaceans, squid, fish, and mollusks |
| Steller sea lion | **pollock**, Atka mackerel, Pacific herring, Capelin, Pacific sand lance, Pacific cod, and **salmon** |

Sources: NOAA 1988; NMFS 2004; NMFS 2007b; Nemoto 1959; Tomilin 1957; Lowry et al. 1980; Kawamura 1980; http://www.afsc.noaa.gov/nmml/education/cetaceans/sperm.php; Rolf Ream, NMML personal communication, September 26, 2008; and http://www.adfg.state.ak.us/pubs/notebook/marine/orca.php

Nine of the species listed in Table 7-9 are documented to eat pollock, and six of the marine mammals listed eat salmon. Salmon is primarily a summer prey species for Steller sea lions (NMFS 2001), resident killer whales (NMFS 2004), spotted seals (CBD 2008a), beluga whales (NMFS 2008), and northern fur seals (NMFS 2007b). Steller sea lions, ribbon seals, and northern fur seals depend on pollock as a principal prey species (NMFS 2007a, 2007b and http://www.adfg.state.ak.us/pubs/notebook/marine/rib-seal.php). Spotted seals eat pollock mainly in the winter and spring, and salmon in the summer (CBD 2008).

Several marine mammals do not depend primarily on pollock or salmon but may be impacted indirectly by effects that the pelagic trawl gear may have on benthic habitats where marine mammals are dependent on benthic prey. The EFH EIS provides a description of the effects of pollock fishing on bottom habitat in Appendix B (NMFS 2005a). Although pollock trawl gear is considered pelagic, pollock trawl gear is known to contact the bottom and may impact benthic habitat. The fisheries effects analysis in the EFH EIS determined that the long term effects indices for pollock fishing on sand/mud and slope biostructure in the Bering Sea were much larger than the effects from other fisheries conducted in the Bering Sea, especially on the slope (Table 8.2-10 in NMFS 2005a)

Table 7-10 shows the marine mammals that feed on benthic prey and the known depths of diving and Bering Sea locations. Most pollock fishing is conducted in waters between 50 m and 200 m (Figure 4-2).

Table 7-10. Name, location and dive characteristics of benthic feeding marine mammals that may be affected by the pollock fishery.

| **Species** | **Location and dive characteristics** |
|---|---|
| Bearded seal | Occur in waters < 200 m, at least 20 nm from shore during spring and summer (Figure 7-4) |
| Ringed seal | Usually shallow but can dive up to 500 m. Throughout pack ice. |
| Ribbon seal | Mostly dive < 150 m on shelf, deeper off shore. Shelf and slope areas |
| Spotted seal | Up to 300 m. Coastal habitats in summer and fall and ice edge in winter |
| Harbor seal | Up to 183 m. Generally coastal |
| Pacific walrus | Usually in waters < 100 m. Shelf area, concentrated SW of St. Lawrence Island and in Nunivak Island/Bristol Bay area |
| Gray whale | < 60 m waters, coastal and shelf area. |
| Beluga whale | 6-30 m, shelf area and nearshore estuaries and river mouths |

Sources: http://www.adfg.state.ak.us/pubs/notebook/marine/harseal.php, http://www.afsc.noaa.gov/nmml/species/species_ribbon.php, http://www.adfg.state.ak.us/pubs/notebook/marine/rib-seal.php, Burns et al. 1981, Angliss and Outlaw 2008, Angliss and Outlaw 2007, http://www.adfg.state.ak.us/pubs/notebook/marine/gray.php, http://alaska.fws.gov/fisheries/mmm/walrus/nhistory.htm, and http://www.adfg.state.ak.us/pubs/notebook/marine/beluga.php

Sperm whales, beluga whales, and harbor seals are unlikely to be affected by the Bering Sea pollock fishery because they occur in areas outside of pollock trawling concentration. The pollock fishery in the SE Bering Sea occurs between 100 m and 50 m deep, and may overlap with a portion of the gray whale feeding area. However, pollock fishing is not likely to impact gray whales considering the extensive area of the Bering Sea under 60 m depth that is not fished for pollock and the areas of pollock fishing compared to the areas of gray whale migration and feeding.

Ice seals occur seasonally in areas where the pollock fishery operates during the ice-free season, and may, therefore, be affected by benthic disturbance by the pollock fishery. Bearded seals have been taken incidentally in area 524 by the pollock fishery (Table 7-7) and may use benthic habitat for feeding in locations where pollock fishing has occurred. Ribbon and spotted seals are probably less likely to be affected by any benthic prey disturbance compared to the other ice seals due to pollock being their primary prey.

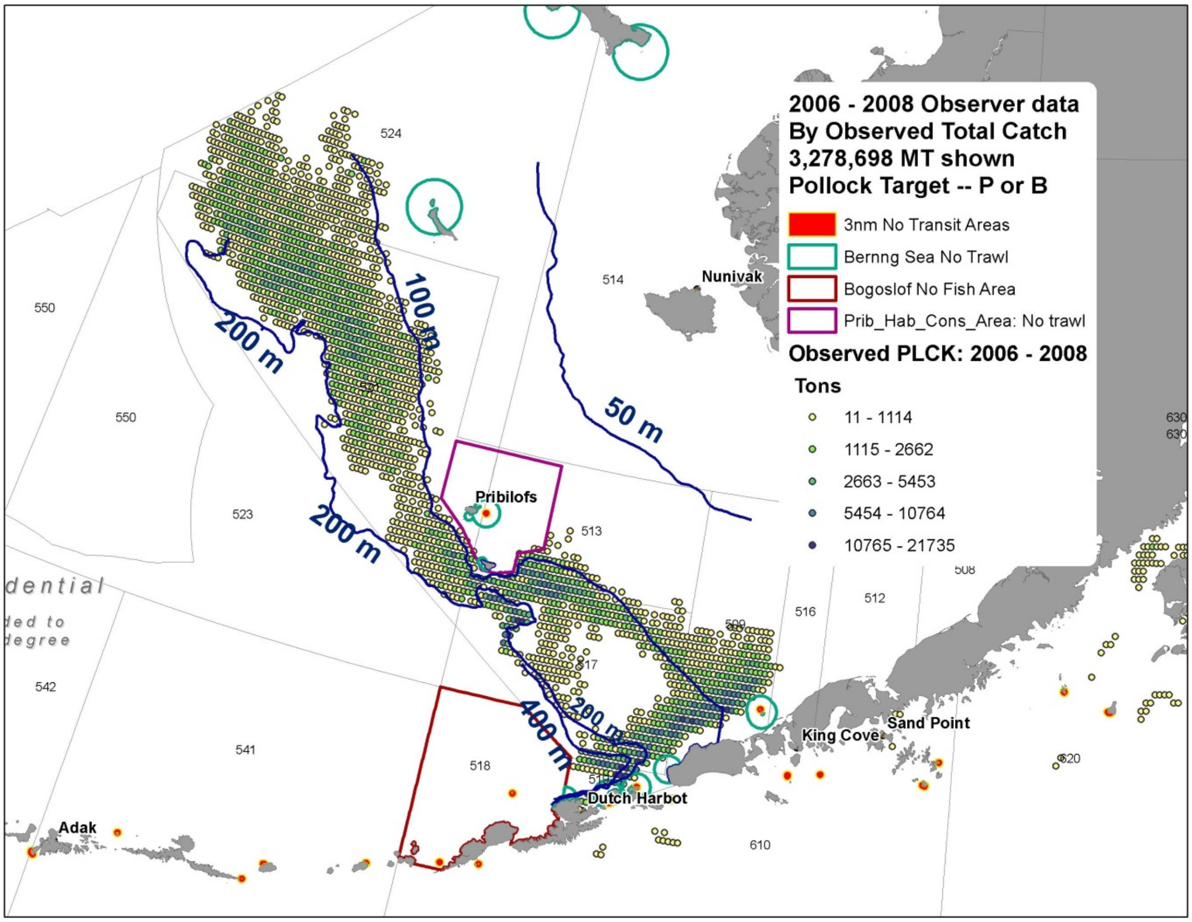


Figure 7-6. 2006-2008 Observed pollock harvest and bathymetry of the Bering Sea (Steve Lewis, NMFS Analytical Team, October 5, 2008)

The Alaska Groundfish Harvest Specifications EIS determined that competition for key prey species under the status quo fishery is not likely to constrain foraging success of marine mammal species or cause population declines (NMFS 2007a). The exceptions to this are northern fur seals and Steller sea lions which potentially compete for principal prey with the groundfish fisheries (NMFS 2001, 2007b).

### 7.2.6.1 Prey Availability Effects under Alternative 1: Status Quo

#### *7.2.6.1.1 Northern Fur Seals*

The Northern Fur Seal Conservation Plan recommends gathering information on the effects of fisheries on fur seal prey, including measuring and modeling effects of fishing on prey (commercial and noncommercial species) composition, distribution, abundance, and schooling behavior, and evaluating existing fisheries closures and protected areas (NMFS 2007b). The Alaska Groundfish Harvest Specifications EIS analyzed the effects of groundfish fisheries on fur seal prey (Section 8.3.2 of NMFS 2007a). The EIS for the annual subsistence harvest of fur seals determined that groundfish fisheries in combination with the subsistence harvest may have a conditional cumulative effect on prey availability if fisheries were to become further concentrated spatially or temporally in fur seal habitat, especially during June through August (NMFS 2005b).

Migration of fur seals is described in detail in the Conservation Plan for the Eastern Pacific stock of Northern Fur Seal (NMFS 2007b). Northern fur seals begin to return to the breeding islands from their pelagic winter foraging in the spring of each year. Adult males arrive in early May and establish territories on the breeding rookeries. The youngest males may not return to the breeding areas until mid-August or later. Some yearlings arrive as late as September or October, but most remain at sea. Older pregnant females arrive mid-June and the peak of pupping occurs in early July. Pups leave the islands in early November after the older animals have left. Fur seals migrate during early winter through the Eastern Aleutian Islands into the North Pacific Ocean then into the waters off the coasts of British Columbia, Washington, Oregon, and California. Fur seal pups (Baker 2007) departed the Pribilof Islands from 9 Novemer to 3 December, and moved broadly through the Bering Sea before entering the North Pacific through Unimak Pass, Akutan Pass, an unnamed passage between Yunaska Island and the Islands of the Four Mountains, Amukta Pass, and Seguam Pass.

Northern fur seals foraging locations vary by island and by rookery (Robson et al. 2004). Fur seals from St. Paul Island tend to forage to the north and west, while fur seals from St. George Island tend to forage to the south and east. Fur seals from Bogoslof Island rookery primarily forage near Bogoslof Island, in the Bogoslof Island Foraging Area, in deep water.

Pollock is particularly important for northern fur seals around the Pribilof Islands and other inshroea areas from July through September (NMFS 2007b, Gudmondson et al. 2006, Zeppelin and Ream 2006). Pollock occurred in 64- 84% of fur seal scat samples from St. Paul Island, and 43-70% of samples from St. George Island (Zeppelin and Ream 2006). In the summer of 1999 and 2000, 37% of the spew samples and 60% of scats collected at the same time from St. George Island contained pollock (Gudmundson et al. 2006). On St. Paul Island, pollock occurred in 70% of both spew and scat samples (Gudmondson et al. 2006). Adult pollock were most frequently found in the stomachs of fur seals collected over the outer domain of the continental shelf (Fig. 7-7), while juvenile pollock were found in the stomachs of seals collected both over the midshelf and outer doman (NMFS 2005b).

Salmon occurred in 10-19% of the scat samples collected from St. George Island, and 3-12% of scats collected from St. Paul Island (Zeppelin and Ream 2006). Because of this discrepancy, it is possible that actions that affects salmon harvest in the BS pollock fishery may impact fur seals from St. George Island more than those from St. Paul Island.

Under the status quo alternative, no substantial changes are expected in the potential competition for resources of northern fur seals. Therefore, any impacts from Alternative 1 are considered insignificant.

#### *7.2.6.1.2 Steller sea lions*

Analysis of diet data for Steller sea lions in the Bering Sea includes scats collected at haulouts and rookeries along the eastern portion of the Aleutian Island chain and Bogoslof/Fire Island. Pollock appear to be a major component of the Steller sea lion diet for animals using Bogoslof/Fire Island and the Akutan sites, present in 54% of the samples collected in the summer and 59% winter samples (Sinclair and Zeppelin 2002). Steller sea lions at Akutan sites appear to depend on pollock more in the winter than the summer (Figure 3 in Trites et al. 2007). Pollock occurred in more than 36% of the stomach samples taken from Steller sea lions on the Pribilof Islands in the 1980s (NMFS 2008). Pollock occurred in 100% of the samples from Steller sea lions taken at sea in the winter of 1981 in an area between the Pribilof and St. Matthew Islands (Caulkins 1998).

Sea lions eat salmon primarily in May where salmon congregate for migration (Lowell Fritz, National Marine Mammals Laboratory, pers. comm. February 14, 2008). Diet analysis from the Akutan area indicated that Steller sea lions may be more dependent on salmon in the summer than in the winter (Figure 3 in Trites et al. 2007).

Under the status quo alternative, no substantial changes are expected in the potential competition for resources of Steller sea lions. Therefore, any impacts from Alternative 1 are considered insignificant.

##### *7.2.6.1.3 Other direct impacts on marine mammal prey*

Killer whales eat salmon that are migrating to spawning streams in nearshore waters (NMFS 2004). The impact of the pollock fishery on prey for resident killer whales would be only in the interception of salmon that would have been eaten by killer whales.

Spotted seals forage on pelagic fish and nearshore species, including pollock and salmon. Sampling of spotted seals in the Bering Sea coastal area in September through October showed salmon in the diet (Lowry et al. 2000). Juvenile pollock are important prey species for ribbon seals. Pollock occurred in approximately 80% of the scat samples collected from ribbon seals in 2006 and 2007 (Ziel et al. 2008). Juvenile pollock are also important prey species for spotted seals. Pollock occurred in approximately 40% of the scat samples collected from spotted seals in 2006 and 2007 (Ziel et al. 2008).

Of the ice seals, ribbon seals appear to be more dependent on pollock and may be directly impacted by pollock harvests in locations where ribbon seals may forage during summer months. Bearded seals feed primarily on benthic invertebrates (Lowry et al. 1980a) and schooling fish and invertebrates in the vicinity of St. Matthew Island (Antonelis et al. 1994). Ringed seals eat primarily Arctic and saffron cod and epibenthic and pelagic crustaceans (Lowry et al. 1980b).

Beluga whales are not likely to compete with the pollock fishery for pollock because their occurrence does not overlap with pollock fishery locations (Figure 7-7 and Table 7-9 Table 7-9).

Minke, fin, and humpback whales potentially compete with the pollock fishery for pollock because of the overlap of their occurrence with the location of the pollock fishery in the Bering Sea. Fin and humpback whales have a more diverse diet than minke whales and therefore may have less potential to be affected by any competition (Table 7-8). An area of overlap for feeding humpback whale stocks occurs in the southeastern Bering Sea where the pollock fishery occurs (Figure 4-2). The area of distribution and surveys for fin whales is in the same slope area as the pollock fishery (Figure 4-3).

Under the status quo alternative, no substantial changes are expected in the direct take or potential competition for resources of these species. Therefore, any impacts from Alternative 1 are considered insignificant.

#### 7.2.6.2 Prey Availability Effects under Alternative 2: Hard Caps

A hard cap on the amount of salmon taken in the pollock fishery could benefit Steller sea lions, resident killer whales, spotted seals, ribbon seals, and northern fur seals if the cap prevents harvest of salmon and pollock that these species prey upon. If the hard cap results in additional fishing effort in less productive pollock areas with less salmon bycatch, the shifting of the fleet may allow for additional pollock being available as prey in those areas where salmon is concentrated, if these areas are also used by Steller sea lions, spotted seals, ribbon seals, and northern fur seals for foraging. The higher hard cap would be less constraining on the fishery and would likely result in effects on prey availability similar to the status quo. Lower hard caps would be more constraining on the fishery, making more salmon available for prey for Steller sea lions, northern fur seals, spotted seals, and resident killer whales, and may allow for more pollock prey if the fishery is closed before reaching its pollock TAC.

The more restrictive caps may result in smaller pollock being taken by the pollock fishery, as described in Chapter 4. It is not clear how much smaller the pollock might be. Since 2003, the pollock fishery has tended to harvest pollock that are less than 60 cm and greater than 30 cm in the Bering Sea (NPFMC 2007). Steller sea lions and northern fur seals tend to prey on whatever size of pollock is most abundant at the time of foraging (Fritz et al. 1995). In years with one or more large recently spawned year classes, Steller sea lions and fur seals consume primarily juvenile pollock (Pitcher 1981, Calkins 1998, Zeppelin et al. 2004, and Sinclair et al. 1994). As large year classes of pollock age and grow, they will continue to be targeted by sea lions and fur seals particularly if the size of subsequent year classes is small. As a consequence, overlap between fisheries (that generally take large pollock) and pinnipeds in the size of pollock consumed will change depending on the age structure of pollock. Juvenile Steller sea lions are more likely to successfully forage on smaller rather than larger pollock. Taking smaller pollock may increase the potential for the fishery to compete with juvenile Steller sea lions for pollock, and may increase the estimated overlap between the fishery and juvenile Steller sea lions for pollock prey size. Whether competition would occur depends on the abundance of the size of prey targeted by the sea lions. Steller sea lions tend to prey more on juvenile pollock in the summer on haulouts than in the winter or in the summer on rookeries (Zeppelin et al. 2004). For the year of data analyzed, the overlap between the size of pollock taken in the fishery and those used as prey by Steller sea lions in the winter and summer is 56% and 61%, respectively (Zeppelin et al. 2004). Harvesting smaller pollock in the early B season may have more of a potential for competition for juvenile Steller sea lions using haulouts in the summer compared to animals at rookeries and in the winter.

All pollock recovered from scat samples from spotted and ribbon seals in 2006 and 2007 were well below 20 cm in length (range 5-22.7 cm) (Ziel et al. 2008). It is not clear if this size of pollock was eaten because it was the size that could easily be captured or it was the most abundant size. It is not likely the shifting of the pollock fishery to smaller fish would result in fish less than 20 cm in length being taken and therefore, competition with ribbon and spotted seals is not likely if they are targeting these smaller fish, regardless of abundance.

The options for sector allocations, sector transfers, and cooperative provisions affect the management and distribution of the cap across the sectors and are not likely to have any overall effect on pollock fishing that would change the potential competition for prey species between the pollock fishery and marine mammals. Options that allocate more chum salmon bycatch to the CV sector compared to the offshore sector would result in more harvest of pollock in the southern part of the Bering Sea where more Steller sea lions are located compared to the northern Bering Sea where northern fur seals and spotted seals may be foraging. This may result in more potential for competition for salmon and pollock prey for Steller sea lions than for northern fur seals or spotted seals. The Steller sea lion protection measures were designed to mitigate competition between the fisheries and Steller sea lions. This may reduce any potential for increased competition for prey if allocating higher portions of the salmon caps to the CV sector would result in more fishing in the southern Bering Sea.

Any impacts from establishment of hard caps are likely to be incremental. Therefore, any impacts from Alternative 2 are expected to be insignificant.

### 7.2.6.3 Prey Availability Effects under Alternative 3: Triggered Closures

Alternative 3, component 1, proposes a large-scale fixed or triggered closure as a back-stop mechanism to encourage participation in the RHS program for bycatch reduction. Given that there is 100% participation by the fleet in the current RHS program it is reasonable to assume that under this alternative the incentive to remain in the program would be strong enough to continue to maintain 100% participation. Thus the impacts of this alternative on incidental catch of marine mammals would be similar to status quo. Components 2 through 6 propose additional triggered area closure for RHS participants.

A pollock fishery closure of an area where Steller sea lions, humpback whales, spotted seals, or northern fur seals are likely to compete with pollock fishing vessels would likely reduce the potential for competition for prey resources (pollock and salmon). Occurrences of fin and minke whales are more widespread in the Bering Sea and therefore, they are less likely to be affected by the triggered closures. The potential reduction in competition would depend on the foraging locations and prey species for Steller sea lions, humpback whales, spotted seals, and northern fur seals and on the timing of the foraging activity and fishing.

Based on stomach samples collected in the 1980s, Steller sea lions may not depend on salmon as prey in the areas of the Pribilof Islands and northern Bering Sea (NMFS 2008). No salmon was detected in stomach samples from these areas. Steller sea lions appear to use salmon resources in the southern portion of the Bering Sea based on scat sampling near Akutan and Bogoslof Island (Figure 3 in Trites et al. 2007). Salmon area closures in the northern portion of the Bering Sea are not likely to have any effect on salmon prey resources for Steller sea lions and spotted seals, because there is no evidence of the sea lions or spotted seals eating salmon in the northern portion of the Bering Sea.

For fur seals, spotted seals, and Steller sea lions, closing the salmon areas in the northern portion of the Bering Sea may only provide a localized benefit for reducing competition for pollock in the closure area. The overall availability of pollock as prey is not likely to change given the existing closure areas and the pollock fleet’s likely ability to still harvest its TAC.

Any impacts from the establishment of triggered closures are expected to be incremental. Therefore, any impacts from Alternative 3 are expected to be insiginificant.

### 7.2.7 Disturbance Effects

#### 7.2.7.1 Disturbance Effects under Alternative 1: Status Quo

The Alaska Groundfish Harvest Specifications EIS analyzed the potential disturbance of marine mammals by the groundfish fisheries (Section 8.3.3 of NMFS 2007a). The EIS concluded that the status quo fishery does not cause disturbance to marine mammals that may cause population level effects, and fishery closures exist to limit the potential interaction between the fishing vessels and marine mammals.

#### 7.2.7.2 Disturbance Effects under Alternative 2: Hard Cap

The effects on the disturbance of marine mammals by the proposed hard caps would be similar to the effects of these hard caps on the potential for incidental takes. If hard caps reduce pollock fishing, then the potential for disturbance of marine mammals is reduced. If hard caps increase the duration of the fishing season as vessels move to areas of lower pollock concentration to avoid areas of high salmon bycatch, the potential for disturbance of marine mammals increases if those mammals are present in the areas to which the fleet moves. The higher hard caps are less likely to constrain the BS pollock fishery, and impacts of the higher caps are likely to be similar to status quo. Considering that the Alaska Groundfish Harvest Specifications EIS concluded that the groundfish fisheries do not cause disturbance to marine mammals that may cause population effects, it is likely that any impacts from Alternative 2 would be insiginificant.

#### 7.2.7.3 Disturbance Effects under Alternative 3: Triggered Closures

Alternative 3, component 1, proposes a large-scale fixed or triggered closure as a back-stop mechanism to encourage participation in the RHS program for bycatch reduction. Given that there is 100%

participation by the fleet in the current RHS program it is reasonable to assume that under this alternative the incentive to remain in the program would be strong enough to continue to maintain 100% participation. Thus the impacts of this alternative on incidental catch of marine mammals would be similar to status quo.

Components 2 through 6 propose additional triggered area closure for RHS participants. As has been discussed above, disturbance effects are most likely for Steller sea lions, northern fur seals, spotted seals, and humpback whales. Other mammal species considered in this analysis are unlikely to be disturbed by the BS pollock fishery, and any impacts from Alternative 3 on them is considered insignificant. Humpback whales are highly mobile, and likely to transit through any proposed closure areas. Therefore, any impact to them would be incremental, and is considered insignificant.

For Steller sea lions, northern fur seals, spotted seals, and humpback whales, the potential for impact from Alternative 3 is limited to the extent that closures occur in the area where those species are present, and at the time that those species are present. Closures would occur south of the Pribilof Islands, and north of the Alaska Peninsula. Closures of these waters to pollock fishing could reduce the potential for disturbance to Steller sea lions, northern fur seals, and spotted seals in the area, at the time of the closure. However impacts from these closures would be incremental, and are considered insignificant.

Any vessels that participate in a RHS program would be exempted from the closure areas. If vessels remain in the RHS program, then the impacts of Alternative 3 would be similar to the status quo, and are considered insignificant.

## 7.3 Seabirds

### 7.3.1 Seabird Resources in the Bering Sea

Thirty-eight species of seabirds breed in Alaska. Breeding populations are estimated to contain 36 million individual birds in Alaska, and total population size (including subadults and nonbreeders) is estimated to be approximately 30% higher. Five additional species that breed elsewhere but occur in Alaskan waters during the summer months contribute another 30 million birds.

As noted in the PSEIS, seabird life history includes low reproductive rates, low adult mortality rates, long life span, and delayed sexual maturity. These traits make seabird populations extremely sensitive to changes in adult survival and less sensitive to fluctuations in reproductive effort. The problem with attributing population changes to specific impacts is that, because seabirds are long-lived animals, it may take years or decades before relatively small changes in survival rates result in observable impacts on the breeding population.

More information on seabirds in Alaska's EEZ may be found in several NMFS, Council, and USFWS documents:

- The URL for the USFWS Migratory Bird Management program is at: http://alaska.fws.gov/mbsp/mbm/index.htm
- Section 3.7 of the PSEIS (NMFS 2004a) provides background on seabirds in the action area and their interactions with the fisheries. This may be accessed at http://www.fakr.noaa.gov/sustainablefisheries/seis/final062004/Chaps/chpt_3/chpt_3_7.pdf
- The annual Ecosystems Considerations chapter of the SAFE reports has a chapter on seabirds. Back issues of the Ecosystem SAFE reports may be accessed at http://www.afsc.noaa.gov/REFM/REEM/Assess/Default.htm.
- The Seabird Fishery Interaction Research webpage of the Alaska Fisheries Science Center http://www.afsc.noaa.gov/refm/reem/Seabirds/Default.htm

- The NMFS Alaska Region's Seabird Incidental Take Reduction webpage: http://www.fakr.noaa.gov/protectedresources/seabirds.html
- The BSAI and GOA Groundfish FMPs each contain an "Appendix I" dealing with marine mammal and seabird populations that interact with the fisheries. The FMPs may be accessed from the Council's home page at http://www.fakr.noaa.gov/npfmc/default.htm
- Washington Sea Grant has several publications on seabird takes, and technologies and practices for reducing them: http://www.wsg.washington.edu/publications/online/index.html
- The seabird component of the environment affected by the groundfish FMPs is described in detail in Section 3.7 of the PSEIS (NMFS 2004a).
- Seabirds and fishery impacts are also described in Chapter 9 of the Alaska Groundfish Harvest Specifications EIS (NMFS 2007a).

Table 7-11. Seabird species in the BSAI (NMFS 2004).

| Type | Common name | Status | Type | Common name | Status |
|---|---|---|---|---|---|
| Albatrosses | Black-footed | | | | |
| | Short-tailed | Endangered | Guillemots | Black | |
| | Laysan | | | Pigeon | |
| Fulmars | Northern fulmar | | | | |
| Shearwaters | Short-tailed | | Eiders | Common | |
| | Sooty | | | King | |
| Storm petrels | Leach's | | | Spectacled | Threatened |
| | Fork-tailed | | | Steller's | Threatened |
| Cormorants | Pelagic | | Murrelets | Marbled | |
| | Red-faced | | | Kittlitz's | Candidate |
| | Double-crested | | | Ancient | |
| Gulls | Glaucous-winged | | Kittiwakes | Black-legged | |
| | Glaucous | | | Red-legged | |
| | Herring | | Auklets | Cassin's | |
| | Mew | | | Parakeet | |
| | Bonaparte's | | | Least | |
| | Sabine | | | Whiskered | |
| | Ivory | | | Crested | |
| Murres | Common | | | Rhinoceros | |
| | Thick-billed | | Terns | Arctic | |
| Jaegers | Long-tailed | | | Aleutian | |
| | Parasitic | | Puffins | Horned | |
| | Pomarine | | | Tufted | |

### 7.3.2 ESA-Listed Seabirds in the Bering Sea

Several species of conservation concern occur in the EBS. Short-tailed albatross is listed as endangered under the ESA, and Steller's eider and spectacled eider are listed as threatened. Kittlitz's Murrelet is a candidate species for listing under the ESA. The red-legged kittiwake is a species of conservation concern due to recent population declines.

#### 7.3.2.1 Short-tailed albatross

Short-tailed albatross (*Phoebastria albatrus*) is currently listed as endangered under the ESA. Short-tailed albatross populations were decimated by hunters and volcanic activity at nesting sites in the early 1900s, and the species was reported to be extinct in 1949. In recent years, the population has recovered at a 7%

to 8% annual rate. The world population of short-tailed albatross in 2009 was estimated at 3,000 birds. The majority of nesting occurs on Torishima Island in Japan, where an active volcano threatens the colony. No critical habitat has been designated for the short-tailed albatross in the United States, because the population growth rate does not appear to be limited by marine habitat loss (NMFS 2004b). Short-tailed albatross feeding grounds are continental shelf breaks and areas of upwelling and high productivity. Short-tailed albatross are surface feeders, foraging on squid and forage fish.

#### 7.3.2.2 Steller’s eider and spectacled eider

Both Steller’s eider (*Polysticta stelleri)* and spectacled eider (*Somateria fishcheri)* are listed as threatened under the ESA. While designated critical habitat for both of these species does overlap with fishing grounds, there has never been an observed take of either of these species off Alaska (USFWS 2003a and 2003b, NMFS 2008), and no take estimates are produced by AFSC. Therefore, impacts to Steller’s and spectacled eiders are not analyzed in this document.

#### 7.3.2.3 Kittlitz's murrelet

Kittlitz's murrelet (*Brachyramphus brevirostris*) is a small diving seabird that forages in shallow waters for capelin, Pacific sandlance, zooplankton, and other invertebrates. It feeds near glaciers, icebergs, and outflows of glacial streams, sometimes nesting up to 45 miles inland on rugged mountains near glaciers. Most recent population estimates indicate that it has the smallest population of any seabird considered a regular breeder in Alaska (9,000 to 25,000 birds). This species appears to have undergone significant population declines in several of its core population centers. USFWS believes that glacial retreat and oceanic regime shifts are the factors that are most likely causing population-level declines in this species. Kittlitz’s murrelet is currently a candidate species for listing under the ESA. No Kittlitz's murrelets were reported taken in the observed groundfish fisheries between 1993 and 2001 (NMFS 2004a).

#### 7.3.2.4 Red-legged kittiwake

The red-legged kittiwake (*Rissa brevirostris*) is a small gull that breeds at only a few locations in the world, all of which are in the Bering Sea (USFWS 2006). Eighty percent of its worldwide population nests at St. George Island, with the remainder nesting at St. Paul, the Otter Islands, Bogoslof and Buldir Islands. The total population is estimated at around 209,000 birds (USFWS 2006). They are listed as a USFWS bird of conservation concern because recent severe population declines remain unexplained (NMFS 2004b), but could be due to irregular food supplies in the Pribilof Islands. Red-legged kittiwakes are present in the eastern Bering Sea, but do not interact regularly with the Bering Sea fisheries.

### 7.3.3 Status of ESA Consultations on Groundfish and Halibut Fisheries

USFWS has primary responsibility for managing seabirds and has evaluated effects of the BSAI and GOA FMPs and the harvest specifications process on currently listed species in two Biological Opinions (USFWS 2003a and 2003b). Both Biological Opinions concluded that the groundfish fisheries off Alaska, including the EBS pollock fishery, are unlikely to jeopardize populations of listed species or adversely modify or destroy critical habitat for listed species. The current population status, life history, population biology, and foraging ecology of these species, as well as a history of ESA Section 7 consultations and NMFS actions carried out as a result of those consultations are described in detail in section 3.7 of the PSEIS (NMFS 2004a).

In 1997, NMFS initiated a Section 7 consultation with USFWS on the effects of the Pacific halibut fishery off Alaska on the short-tailed albatross. USFWS issued a Biological Opinion in 1998 that concluded that the Pacific halibut fishery off Alaska was not likely to jeopardize the continued existence of the short-tailed albatross. USFWS issued an Incidental Take Statement of two short-tailed albatross in a 2-year period (e.g., 1998/1999, 2000/2001, 2002/2003), reflecting what the agency anticipated the incidental take could be from the fishery action. Under the authority of ESA, USFWS identified non-discretionary reasonable and prudent measures that NMFS must implement to minimize the impacts of any incidental take.

Two updated USFWS biological opinions were published in 2003:

- Section 7 Consultation - Biological Opinion on the Effects of the Total Allowable Catch-Setting Process for the Gulf of Alaska and Bering Sea/Aleutian Islands Groundfish Fisheries to the Endangered Short-tailed Albatross (*Phoebastria albatrus*) and Threatened Steller's Eider (*Polysticta stelleri*) (USFWS 2003b).
- Section 7 Consultation - Programmatic Biological Opinion on the Effects of the Fishery Management Plans for the Gulf of Alaska and Bering Sea/Aleutian Islands Groundfish Fisheries on the Endangered Short-tailed Albatross (*Phoebastria albatrus*) and Threatened Steller's Eider (*Polysticta stelleri*) (USFWS 2003a).

Although USFWS has determined that the short-tailed albatross is adversely affected by hook-and-line Pacific halibut and groundfish fisheries off Alaska, both USFWS opinions concurred with NMFS and concluded that the Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands Management Area (BSAI) fishery actions are not likely to jeopardize the continued existence of the short-tailed albatross or Steller's eider or result in adverse modification of Steller's eider critical habitat. USFWS also concluded that these fisheries are not likely to adversely affect the threatened spectacled eider. The Biological Opinion on the TAC-setting process updated incidental take limits to—

- four short-tailed albatross taken every 2 years in the hook-and-line groundfish fishery off Alaska, and
- two short-tailed albatross taken in the groundfish trawl fishery off Alaska while the biological opinion is in effect (approximately 5 years).

These incidental take limits are in addition to the previous take limit set in 1998 for the Pacific halibut hook-and-line fishery off Alaska of two short-tailed albatross in a 2-year period. The 2003 Biological Opinion on the TAC-setting process also included mandatory terms and conditions that NMFS must follow in order to be in compliance with the ESA. These include implementation of seabird deterrent measures, outreach and training of fishing crews on proper deterrence techniques, training observers in seabird identification, and retention of all seabird carcasses until observers can identify and record takes, continued analysis and publication of estimated incidental take in the fisheries, collection of information regarding the efficacy of seabird protection measures, cooperation in reporting sightings of short-tailed albatross, and continued research and reporting on the incidental take of short-tailed albatross in trawl gear.

USFWS also released a short-tailed albatross recovery plan in September 2008 (USFWS 2008). This recovery plan describes site-specific actions necessary to achieve conservation and survival of the species, downlisting and delisting criteria, and estimates of time and cost required to implement the recovery plan. Because the primary threat to the species recovery is the possibility of an eruption of Torishima Island, the most important recovery actions include monitoring the population and managing habitat on Torishima Island, establishing two or more breeding colonies on non-volcanic islands, monitoring the Senkaku population, and conducting telemetry and other research and outreach. Translocation of chicks to new colonies has begun. USFWS estimates that short-tailed albatross may be delisted in the year 2030, if new colony establishment is successful.

### 7.3.4 Short-tailed albatross distribution and interactions with Alaska fisheries

#### 7.3.4.1 *Satellite Tracking of Short-tailed Albatross*

USFWS and Oregon State University placed 52 satellite tags on Laysan, black-footed, and short-tailed albatrosses in the central Aleutian Islands to study movement patterns of the birds in relation to commercial fishing activity and other environmental variables. From 2002 to 2006, 21 individual short-tailed albatrosses (representing about 1% of the entire population) were tagged, including adults, sub-adults, and hatch-year birds. During the non-breeding season, short-tailed albatross ranged along the Pacific Rim from southern Japan through Alaska and Russia to northern California, primarily along continental shelf margins (Suryan et al. 2006).

Sufficient data existed for 11 of the 14 birds to analyze movements within Alaska. Within Alaska, albatrosses spent varying amounts of time among NMFS reporting areas, with six of the areas (521, 524, 541, 542, 543, 610) being the most frequently used (Suryan et al. 2006). Non-breeding albatross concentrate foraging in oceanic areas characterized by gradients in topography and water column productivity. The primary hot spots for short-tailed albatrosses in the Northwest Pacific Ocean and Bering Sea occur where a variety of underlying physical processes enhance biological productivity or prey aggregations. The Aleutian Islands, in particular, were a primary foraging destination for short-tailed albatrosses.

#### 7.3.4.2 *Short-tailed Albatross Takes in Alaska Fisheries*

Table 6-2 lists the short-tailed albatrosses reported taken in Alaska fisheries since 1983. With the exception of one take in the Western GOA, all takes occurred along the shelf break in the Bering Sea. The Western GOA take was in the hook-and-line halibut fishery. No takes were reported from 1999 through 2009. No takes with trawl gear have been reported. While the incidental take statement take limits for short-tailed albatross have never been met or exceeded, three short-tailed albatrosses were taken in the BSAI hook-and-line Pacific cod fishery in 2010 (Table 6-2 and Figure 6-3). NMFS is working closely with industry and the observer program to understand the specific circumstances of these incidents.

Table 7-12. Reported takes of short-tailed albatross in Alaska fisheries.

| Date of take | Location | Fishery | Age when taken |
|---|---|---|---|
| July 1983 | BS | brown crab | juvenile (4 mos) |
| 1 Oct 87 | GOA | halibut | juvenile (6 mos) |
| 28 Aug 95 | EAI | hook-and-line | sub-adult (16 mos) |
| 8 Oct 95 | BS | hook-and-line | sub-adult |
| 27 Sept 96 | BS | hook-and-line | sub-adult (5 yrs) |
| 21 Sept 98 | BS | Pacific cod hook-and-line | adult (8 yrs) |
| 28 Sept 98 | BS | Pacific cod hook-and-line | sub-adult |
| 27 Aug 2010 | BS | Pacific cod hook-and-line | Sub-adult (7 yrs 10 mos) |
| 14 Sept 2010 | BS | Pacific cod hook-and-line | Sub-adult (3 yrs 10 mos) |
| 25 Oct 2010 | BS | Pacific cod hook-and-line | Sub-adult (less than 2 years) |

Source: AFSC.

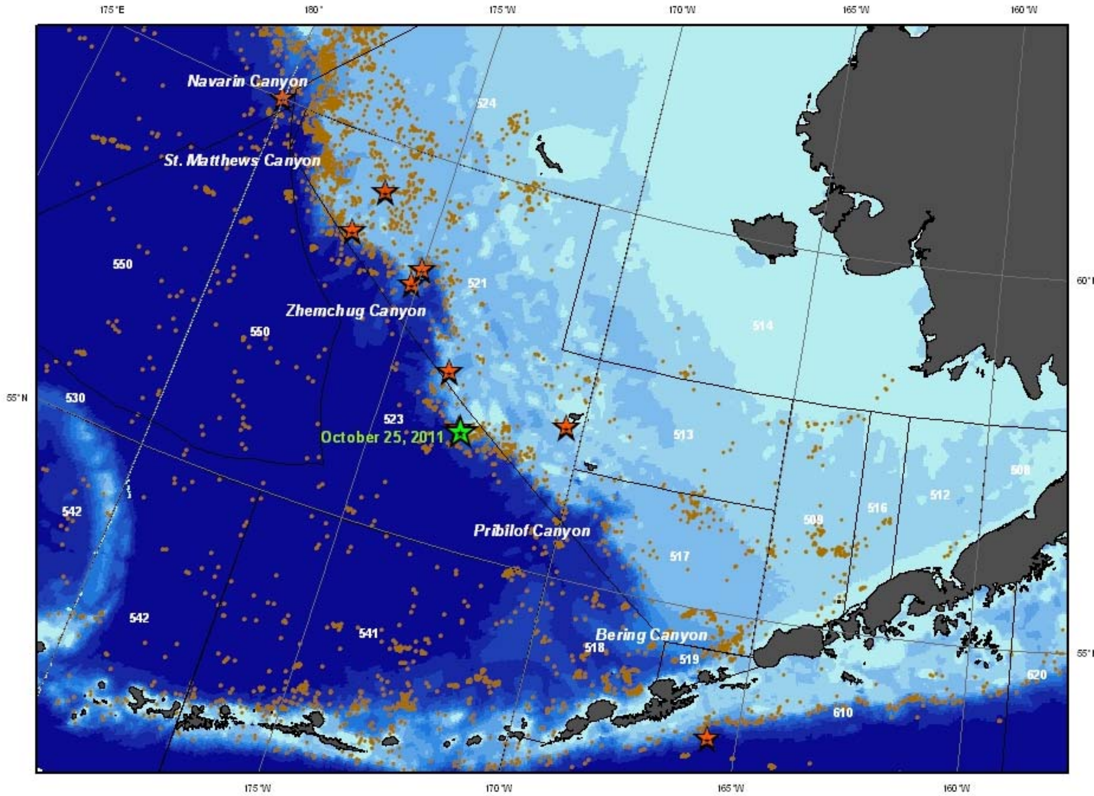


Figure 7-7. Locations (brown dots) of all Short-tailed albatross locations during September to November 2001-2010, and locations of all STAL takes in Alaska fisheries (red stars) from 1983 to 2010, and location of the most recent STAL take (green star). Credits: Yamashita Institute for Ornithology, Oregon State University, U.S. Fish and Wildlife Service, and Ministry of Environment, Japan. Reprinted from http://alaskafisheries.noaa.gov/index/infobulletins/bulletin.asp?BulletinID=7771.

### 7.3.5 Effects on Seabirds

#### 7.3.5.1 Significance Criteria for Seabirds

Criteria for analyzing the potential impacts of these alternatives are identified below. These criteria are adopted form the 2006-2007 groundfish harest specifications environmental assessment/final regulatory flexibility analysis (EA/FRFA). As with marine mammals, all potential impacts are assessed as a change from status quo.

Table 7-13. Criteria used to determine significance of impacts to seabirds.

| | Incidental take | Prey availability | Benthic habitat |
|---|---|---|---|
| Insignificant | No substantive change in bycatch of seabirds during the operation of fishing gear. | No substantive change in forage available to seabird populations. | No substantive change in gear impact on benthic habitat used by seabirds for foraging. |
| Adverse impact | Non-zero take of seabirds by fishing gear. | Reduction in forage fish populations, or the availability of forage fish, to seabird populations. | Gear contact with benthic habitat used by benthic feeding seabirds reduces amount or availability of prey. |
| Beneficial impact | No beneficial impact can be identified. | Availability of offal from fishing operations or plants may provide additional, readily accessible, sources of food. | No beneficial impact can be identified. |
| Significantly adverse impact | Trawl take levels increase substantially from the baseline level, or level of take is likely to have population level impact on species. | Food availability decreased substantially from baseline such that seabird population level survival or reproduction success is likely to decrease. | Impact to benthic habitat decreases seabird prey base substantially from baseline such that seabird population level, survival, or reproductive success is likely to decrease. (ESA-listed eider impacts may be evaluated at the population level). |
| Significantly beneficial impact | No threshold can be identified. | Food availability increased substantially from baseline such that seabird population level survival or reproduction success is likely to increase. | No threshold can be identified. |
| Unknown impacts | Insufficient information available on take rates or population levels. | Insufficient information available on abundance of key prey species or the scope of fishery impacts on prey. | Insufficient information available on the scope or mechanism of benthic habitat impacts on food web. |

### 7.3.6 Seabird Interactions with Alaska Groundfish Trawl Fisheries

The impacts of the Alaska groundfish fisheries on seabirds were analyzed in the Alaska Harvest Specifications EIS (NMFS 2007). That document evaluates the impacts of the alternative harvest strategies on seabird takes, prey availability, and seabird ability to exploit benthic habitat. The focus of this analysis is similar, as any changes to the pollock fishery in the Bering Sea could change the potential for direct take of seabirds. Potential changes in prey availability (seabird prey species caught in the pollock trawl fishery) and disruption of bottom habitat via the intermittent contact with non-pelagic trawl gear under different levels of harvest are discussed in NMFS (2007). These changes would be closely associated with changes in take levels because of the nature of the alternatives using caps and spatial restrictions. Therefore, all impacts are addressed by focusing on potential changes in seabird takes.

Seabirds can interact with trawl fishing vessels in several ways. Birds foraging at the water surface or in the water column are sometimes caught in the trawl net as it is brought back on board. Some species strike cables attached to the infrastructure of vessels or collide with the infrastructure itself. Large winged birds such as albatrosses are most susceptible to mortalities from trawl-cable strikes (CCAMLR 2006a). Third wire cables have been prohibited in some southern hemisphere fisheries since the early 1990s due to substantial albatross mortality from cable strikes. No short-tailed albatross or black-footed albatross have been observed taken with trawl gear in Alaska fisheries, but mortalities to Laysan albatrosses have been observed.

There are presently no standardized observer data on seabird mortality from trawl third wire collisions in Alaskan waters. To date, there have been no observer reports of short-tailed albatross striking trawl vessels or gear. The probability of short-tailed albatross collisions with third wires or other trawl vessel gear in Alaskan waters cannot be assessed; however, given the available observer information and the observed at-sea locations of short-tailed albatrosses relative to trawling effort, the possibility of such collisions cannot be completely discounted. USFWS issued an incidental take statement of two short-tailed albatross every 5 years for the trawl groundfish fisheries off Alaska (USFWS 2003).

#### 7.3.6.1 Incidental Take Effects under Alternative 1 Status Quo

The effects of the status quo fisheries on incidental takes of seabirds are detailed in the 2007 harvest specifications EIS (NMFS 2007). Figure 7-8 and Table 7-11show the number and  species of seabirds taken as bycatch in the Bering Sea trawl fisheries from 2007-2010 (AFSC 2011). This includes trawl fisheries for pollock, Pacific cod, Atka mackerel, rockfish, and flatfish. Northern fulmars dominated the seabird bycatch for these years, and were the most abundant bird caught as bycatch in all years except 2007 when Shearwaters were most often caught. All of these takes are small in comparison to seabird population estimates, and under the status quo alternative, it is reasonable to conclude that the impacts would be similar.

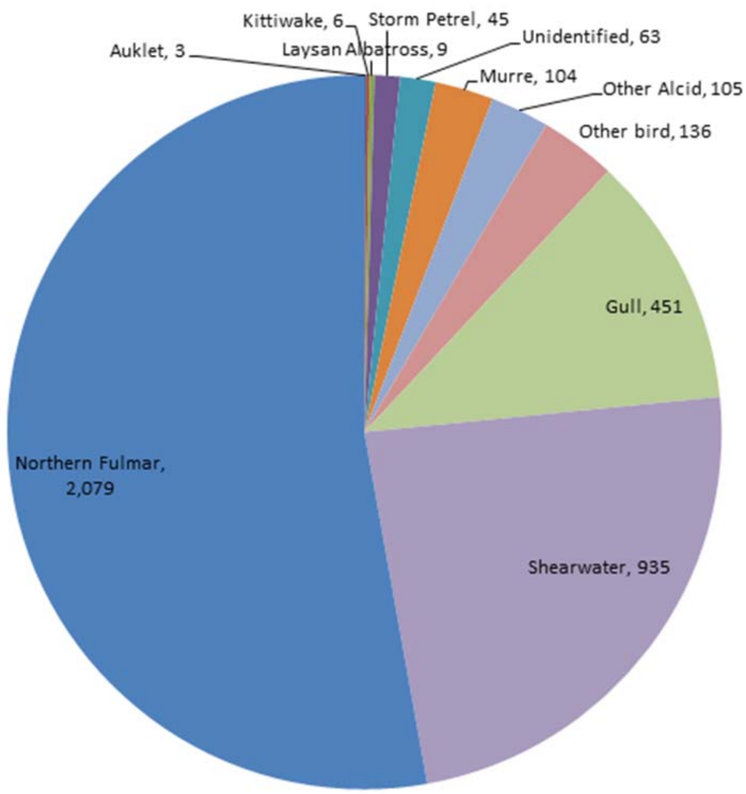


Figure 7-8. Bycatch composition of seabirds in the Bering Sea pelagic and non-pelagic trawl fisheries, 2007-2010 (from AFSC 2011)

Table 7-14. Estimates of seabird bycatch in the BSAI pelagic and non-pelagic trawl fisheries, 2007 – 2010

| Species | Estimate |
|---|---|
| Auklets | 3 |
| Kittiwakes | 6 |
| Laysan Albatross | 9 |
| Storm Petrels | 45 |
| Unidentified Species | 199 |
| Murres | 104 |
| Other Alcids | 105 |
| Gulls | 451 |
| Shearwater | 935 |
| Northern Fulmar | 2,079 |

SourceAFSC (2011). All other species are estimated at zero takes.

Dietrich and Melvin (2007) investigated the overlap in albatross presence with trawl fisheries effort in summer 2004, and 2005, when most of the albatross sightings were collected. They reported the locations and number of hours that the warp lines (main lines that connect the vessel to the trawl doors) and third wire (wire connected to sensors on the net) were in operation, and compared that with albatross sightings from NMFS surveys. Overlap was low, except at the BS shelf break in 2004 (Fig. 7-9), when it was moderate to high (Dietrich and Melvin 2007). It is important to note that overlap of albatross sightings and fishing effort does not imply interactions, only the potential for interaction.

Melvin et al. (2010) investigated rates of seabird strikes aboard two pollock catcher processors in the BS pollock fishery: one that rendered offal into fish meal and oil, and one that minced offal prior to discharge, and investigated efficacy of mitigation measures to reduce bird strikes. More birds attended the vessel that minced offal, but more strikes occurred on the other vessel due to greater aerial extent of its cables. Streamer lines effectively reduced seabird strikes on both vessels, as did reducing the aerial extent of warp and third wires. Warp booms designed to divert seabirds from warps failed to reduce strikes.

Figure 7-5 shows the current spatial restrictions on the pollock trawl fishery in the Bering Sea and Aleutian Islands. Steller sea lion haulouts near the Pribilof, St. Lawrence, St. Matthew, Walrus, and Round Islands are protected out to various distances by closing those waters to pollock fishing (and other fisheries). Additionally, restrictions on fishing activities in Bristol Bay, the Bogoslof area, and the CVOA further spatially restrict the pollock fishery. These closures decrease the potential for interaction with birds in these areas and would not change under the status quo alternative.

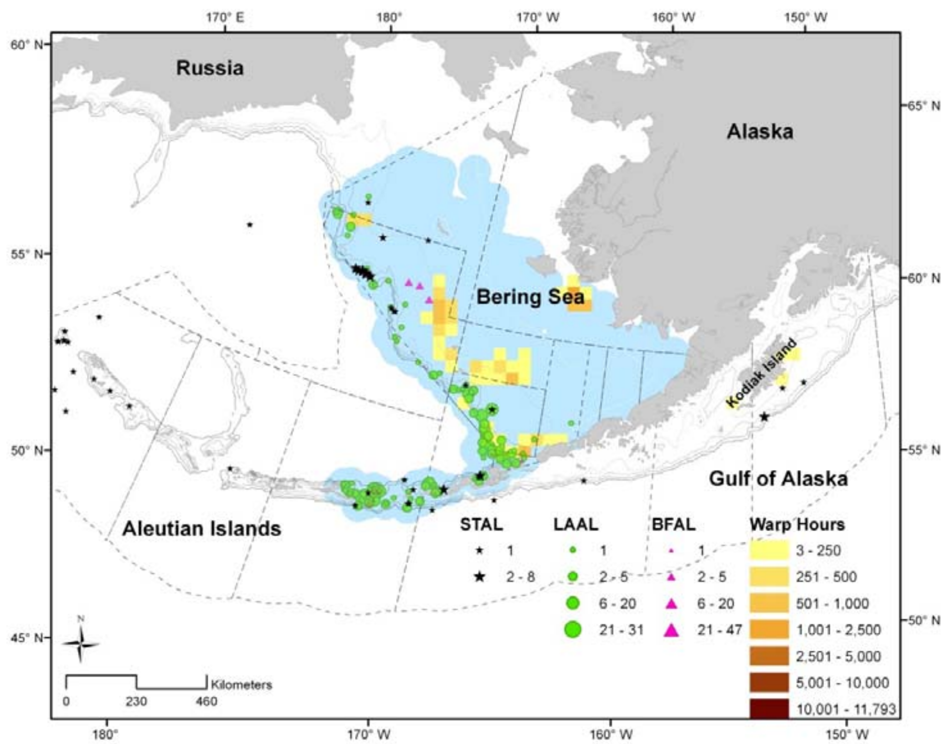


Figure 7-9. Overlap of fishing effort (warp hours) in the pollock trawl fishery with Short-tailed albatross (STAL), Laysan albatross (LAAL), and Black-footed albatross (BFAL) sightings, 2004. Figure used with permission (Dietrich and Melvin 2007).

### 7.3.6.2 Incidental Take Effects under Alternative 2 Hard Cap

The range of hard caps under Alternative 2 offer a range of potential for incidental takes of seabirds. If hard caps constrain the pollock fishery, then the potential for takes of seabirds is reduced. If hard caps do not constrain the fishery, then impacts from Alterantive 2 would be similar to the status quo alternative. Under either scenario, any chage from status quo is likely to be insubstantial and the impacts would be insignificant .

#### 7.3.6.3 Incidental Take Effects under Alternative 3 Triggered Closures

Alternative 3, component 1 proposes a large-scale fixed or triggered closure as a back-stop mechanism to encourage participation in the RHS program for bycatch reduction. Given that there is 100% participation by the fleet in the current RHS program it is reasonable to assume that under this alternative the incentive to remain in the program would be strong enough to continue to maintain 100% participation. Thus the impacts of this alternative on incidental catch of seabird species would be similar to status quo.

Alternative 3, components 2 through 6 propose additional triggered closures on RHS participants. The potential effects of the trigger closures depend on the presence of seabirds in the closure areas and the timing of the closures. If Alternative 3 results in the closure of areas where interactions between pollock trawl vessels and seabirds are more likely to occur, it would reduce the potential for incidental takes of seabirds. As with Alternative 2, the likely change in seabird interaction would be insubstantial, and the impacts are likely to be insignificant.

### 7.3.7 Conclusions

Many seabird species utilize the marine habitat of the Bering Sea. Several species of conservation concern and many other species could potentially interact with trawl cables. The AFSC estimates of takes are small relative to seabird population total estimates. However, those estimates do not include cable-related trawl mortalities which may be undetected. Recent modeling suggests that even if there were to be a large increase in trawl cable incidental takes of short-tailed albatross (the only seabird listed as endangered under the ESA), it would have negligible effects on the recovery of the species.

## 7.4 Essential Fish Habitat

This section addresses the mandatory requirements for an essential fish habitat (EFH) assessment enumerated in the final rule (67 FR 2343, January 17, 2002) implementing the EFH provisions of the Magnuson-Stevens Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267). Importantly, an EFH assessment is required for any federal action that may adversely affect EFH. The mandatory requirements for an EFH assessment are:

- a description of the action;
- an analysis of the potential adverse effects of the action on EFH and the managed species;
- the Federal agency’s conclusions regarding the effects of the action on EFH; and
- proposed mitigation, if applicable.

An EFH assessment may incorporate by reference other relevant environmental assessment documents, such as a Biological Assessment, a NEPA document, or another EFH assessment prepared for a similar action.

The Magnuson-Stevens Act defines EFH as “those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity.” For the purpose of interpreting the definition of EFH, the EFH regulations at 50 CFR 600.10 specify that “waters” include aquatic areas that are used by fish and their associated physical, chemical, and biological properties, and may include areas historically used by fish where appropriate; “substrate” includes sediments, hard bottom, structures underlying the waters, and associated biological communities; “necessary” means the habitat required to support a sustainable fishery and the managed species’ contribution to a healthy ecosystem; and “spawning, breeding, feeding, or growth to maturity” covers a species’ entire life cycle.

The criterion for analyzing effects on habitat is derived from the requirement at 50 CFR 600.815(a)(2)(ii) that NMFS must determine whether fishing adversely affects EFH in a manner that is “more than minimal and not temporary in nature." This standard determines whether actions are required to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable.

The final rule for EFH (67 FR 2343; January 17, 2002) does not define minimal and temporary, although the preamble to the rule states, "Temporary impacts are those that are limited in duration and that allow the particular environment to recover without measurable impact. Minimal impacts are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions" (67 FR 2354).

In 2005, NMFS and the Council completed the EIS for EFH Identification and Conservation in Alaska (EFH EIS; NMFS 2005). The EFH EIS provided a thorough analysis of alternatives and environmental consequences for amending the Council's FMPs to include EFH information pursuant to Section 303(a)(7) of the Magnuson-Stevens Act and 50 CFR 600.815(a). Specifically, the EFH EIS examined three actions: (1) describing and identifying EFH for Council managed fisheries, (2) adopting an approach to identify HAPC within EFH, and (3) minimizing to the extent practicable the adverse effects of Council-managed fishing on EFH. The EFH EIS evaluates the long term effects of fishing on benthic habitat features, as well as the likely consequences of those habitat changes for each managed stock based on the best available scientific information.

In this analysis, the effects of fishing on EFH are analyzed for alternative salmon bycatch reduction measures, using the best available scientific information. Analysis included the review of the EFH Descriptions (EFH EIS Appendix D.3), the effects of fishing analysis (EFH EIS Appendix B.2), and associated Habitat Assessment Reports (EFH EIS Appendix F) to conclude whether or not an adverse effect on EFH will occur. A complete evaluation of effects would require detailed information on the distribution and abundance of habitat types, the life history of living habitat, habitat recovery rates, and natural disturbance regimes. Although more habitat data become available from various research projects each fishing year, much is still unknown about EFH in the EEZ off Alaska.

### 7.4.1 Description of the Action

The actions considered in this EFH assessment are the alternatives described in detail in Chapter 2. The important components of these alternatives for the EFH assessment are the gear used, the fishing effort, and the location of the fishery. This information for the pollock fishery is presented in the EFH EIS, and is incorporated here by reference. Appendix B of the EFH EIS contains an evaluation of the potential adverse effects of fishing activities on EFH, including the effects of pelagic trawl gear. Summaries and assessments of habitat information for all federally managed species in the BSAI are provided in Appendix F of the EFH EIS. The EFH EIS describes an overall fishery impact for each fishery based on the relative impacts of the gear used (which is related to physical and ecological effects), the type of habitat fished (which is related to recovery time), and the proportion of that bottom type utilized by the fishery. Under the alternative salmon bycatch reduction measures, pollock fishing effort may change and the location of the fisheries may change to avoid salmon bycatch or because specified areas may be closed to pollock fishing. However, the fishing seasons and the gear used in the fisheries are not likely to change under the alternatives. Changes to the prosecution of the pollock fishery are described in Chapter 4.

### 7.4.2 Impacts on EFH

Fishing operations change the abundance or availability of certain habitat features (e.g., prey availability or the presence of living or non-living habitat structure) used by managed fish species to spawn, breed, feed, and grow to maturity. These changes can reduce or alter the abundance, distribution, or productivity of that species, which in turn can affect the species' ability to support a sustainable fishery and the managed species' contribution to a healthy ecosystem (50 CFR 600.10). The outcome of this chain of effects depends on characteristics of the fishing activities, the habitat, fish use of the habitat, and fish population dynamics. The duration and degree of fishing's effects on habitat features depend on the intensity of fishing, the distribution of fishing with different gears across habitats, and the sensitivity and recovery rates of habitat features.

The Bering Sea pollock fishery harvests pollock with pelagic trawl gear in pelagic habitat. Pelagic habitat is identified as EFH for marine juvenile and maturing salmon. Amendments 7 and 8 defined salmon EFH in the FMP for the Salmon Fisheries in the EEZ off the Coast of Alaska. The EFH EIS, in Section 3.2.1.5 and Appendix F, provides habitat descriptions for the five salmon species managed under the FMP. Briefly, marine salmon stocks school in pelagic waters and utilize ocean conditions to grow and mature before returning to nearshore and freshwater adult spawning areas. Salmon are known to associate with ocean ledges and features, such as ridges and seamounts. Salmon utilize these features because the features attract and concentrate prey.

Appendix B to the EFH EIS describes how pelagic trawl gear impacts pelagic habitat (NMFS 2005). The EFH EIS concluded that pelagic effects from fisheries are minimal because no information was found indicating significant effects of fishing on features of pelagic waters serving a habitat function for managed species. The Bering Sea pollock fishery only interacts with salmon habitat in the ocean, and the concerns about these interactions center on effects on bycatch of prey and prey availability. Salmon prey (copepods, squid, herring, and other forage fish) are subject to only a few targeted fisheries outside of the EEZ, such as the State of Alaska herring fisheries and international squid fishery. However, the pollock fishery does catch salmon prey species, including squid, capelin, eulachon, and herring. Currently, the catch of these prey species is very small relative to overall population size of these species, thus fishing activities are considered to have minimal and temporary effects on prey availability for salmon. Chapter 7 provides more information on the impacts of the Bering Sea pollock fishery on these prey species.

Appendix B to the EFH EIS also describes how pelagic trawl gear impacts benthic species and habitat (NMFS 2005). The EFH EIS notes that "pelagic trawls may be fished in contact with the seafloor, and there are times and places where there may be strong incentives to do so, for example, the EBS shelf during the summer" (NMFS 2005). Trawl performance standards for the directed pollock fishery at 50 CFR 679.7(a)(14) reduce the likelihood of pelagic trawl gear use on the bottom. However, concern exists about the contact of pelagic trawl gear on the bottom and the current standards used to limit bottom contact (from June 2006 minutes of the SSC and AP, available at: http://www.fakr.noaa.gov/npfmc/minutes/minutes.htm). Flatfish and crab bycatch in the pollock fishery also shows that pelagic gear contacts the bottom. The description of impacts by pelagic trawl gear on habitat in this document is based on the best available science, but may be considered controversial with some believing the impact may be more than described.

The results of the EFH EIS analysis of the effects of fishing on benthic habitat features determined the long-term effect index (LEI) to represent the proportion of feature abundances (relative to an unfished state) that would be lost if recent fishing patterns were continued indefinitely. The LEI was 10.9% for the biological structure of sand/mud and slope habitats of the eastern Bering Sea where fishing effort is concentrated, and recovery rates are moderately low. The analysis also calculated the proportion of each LEI attributable to each fishery. The pollock pelagic trawl fishery was the largest single component (4.6%) of the total effects on living structure in the eastern Bering Sea sand/mud habitat. The combined effects of the bottom trawl fisheries made up all of the remaining 6.3%. Nearly all (7.2%) of the LEI for living structure on the eastern Bering Sea slope was due to the pollock pelagic fishery. Based on this analysis, the EFH EIS determined that the fishing effects are not limited in duration and therefore not temporary. However, the EFH EIS considered LEIs of less than 11% as small.

The EFH EIS also evaluated the effects on managed species to determine whether stock condition indicates that the fisheries affect EFH in a way that is more than minimal. To conduct this evaluation, the analysts first reviewed the LEI from the fishing effects model to assess overlap with the distribution of each stock. The analysts then focused on habitat impacts relative to the three life-history processes of spawning/breeding, feeding, and growth to maturity. Finally, the analysts assessed whether available information on the stock status and trends indicated any potential influence of habitat disturbance due to fishing. Based on the available information, the EFH EIS analysis found no indication that continued fishing at the current rate and intensity would affect the capacity of EFH to support life history processes of any species. In other words, the effects of fishing of EFH would not be more than minimal.

Due to the nature of this action, the Bering Sea pollock fishery as modified by the proposed action is not predicted to have additional impacts beyond those identified in the EFH EIS. Based on the analysis presented in the EFH EIS and summarized above, NMFS concludes that Alternative 1 would impact EFH for managed species, but that the available information does not identify effects of fishing that are more than minimal. In other words, effects may occur but they would not exceed the minimal and temporary limits established by 50 CFR 600.815(a)(2).

The Alternatives 2 caps would, to the extent that they prevent the pollock fleet from harvesting the pollock TAC and therefore reduce pollock fishing effort, reduce the pollock fisheries impacts on EFH from status quo. The RIR provides a discussion of the ability of the pollock fleet to harvest the TAC under Alternative 2.

Alternative 3, component 1,  proposes a large-scale fixed or triggered closure as a back-stop mechanism to encourage participation in the RHS program for bycatch reduction. Given that there is 100% participation by the fleet in the current RHS program it is reasonable to assume that under this alternative the incentive to remain in the program would be strong enough to continue to maintain 100% participation. Thus the overall impacts on EFH would be similar to Alternative 1.

Alternative 3, components 2 through 6 propose additional triggered closures on RHS participants. Thesetrigger closures would close large areas either for June and July or for the remainder of the B-season when triggered. The area closures would reduce the pollock fisheries impacts to EFH in the closed area, but it would increase the fishing effort and therefore the impacts in the adjoining areas. However, many areas identified as having vulnerable or sensitive habitat features, such as canyons, hard corals, and skate nursery areas would be contained in the closure area. Since the total amount of pollock harvested and the total effort would not change under Alternative 3, it is reasonable to conclude that the overall impacts on EFH would be similar to Alternative 1. As with Alternative 2, fishing effort may increase as vessels move to avoid salmon bycatch or as pollock catch rates decrease.

### 7.4.3 Mitigation

Currently, pelagic trawl gear is subject to a number of area closures to protect habitat and marine species: the Steller Sea lion closure areas, the Nearshore Bristol Bay closure, the Pribilof Islands Habitat Conservation Zone. If new information emerges to indicate that the Bering Sea pollock trawl fishery is having more than a minimal impact on EFH, the Council may consider additional habitat conservation measures.

### 7.4.4 Conclusions

All alternatives would have impacts on EFH similar to those found in the EFH EIS. NMFS concludes that all of the alternatives would affect EFH for managed species. However, best available information does not identify any effects of fishing as significantly adverse. In other words, effects may occur from fishing, however these effects do not exceed the minimal and temporary limits established by 50 CFR 600.815(a)(2). Alternatives 2 to the extent that the cap level would close the pollock fishery before the TAC is harvested, could have less of an impact on EFH. Alternative 3 may have less of an impact because it would close, if triggered areas that include important habitat. If information indicates that the Bering Sea pollock trawl fishery is having an increased impact on EFH as a result of salmon bycatch reduction measures, then the Council could consider habitat conservation measures for pelagic trawl gear.

The continuing fishing activity in the years 2008 to 2015 is potentially the most important source of additional annual adverse impacts on marine benthic habitat in the action area. The size of these impacts would depend on the size of the fisheries, the protection measures in place, and the recovery rates of the benthic habitat. However, a number of factors will tend to reduce the impacts of fishing activity on benthic habitat in the future. These include the trend towards ecosystems management. Ecosystem-sensitive management will increase understanding of habitat and the impacts of fisheries on them, protection of EFH and HAPC, and institutionalization of ecosystems considerations into fisheries governance. With diligent oversight, the effects of actions of other federal, state, and international agencies and private parties are likely to be less important when compared to the direct interaction of commercial fishing gear with the benthic habitat.

## 7.5 Ecosystem

Ecosystems consist of communities of organisms interacting with their physical environment. Within marine ecosystems, competition, predation, and environmental disturbance cause natural variation in recruitment, survivorship, and growth of fish stocks. Human activities, including commercial fishing, can also influence the structure and function of marine ecosystems. Fishing may change predator-prey relationships and community structure, introduce foreign species, affect trophic diversity, alter genetic diversity, alter habitat, and damage benthic habitats.

The EBS pollock fishery potentially impacts the EBS ecosystem by relieving predation pressure on shared prey species (i.e., species which are prey for both pollock and other species), reducing prey availability for predators of pollock, altering habitat, imposing bycatch mortality, or by ghost fishing caused by lost fishing gear. Ecosystem considerations for the EBS groundfish fisheries are summarized annually in the Ecosystem Considerations chapter of the EBS Stock Assessment and Fishery Evaluation report (Zador and Gaichas 2010). These considerations are summarized according to the ecosystem effects on the groundfish fisheries as well as the potential fishery effects on the ecosystem.

### 7.5.1 Effects of the Alternatives

An evaluation of the effects of the EBS pollock fisheries on the ecosystem is discussed annually in the Ecosystem Considerations section of the pollock chapter of the SAFE report (Ianelli et al 2010), and was evaluated in the Harvest Specifications EIS (NMFS 2007). This analysis concluded that the current EBS pollock fisheries do not produce population-level impacts to marine species or change ecosystem-level attributes beyond the range of natural variation. Consequently, Alternative 1 is not expected to have a significant impact on the ecosystem.

Alternatives 2 and 3 will either maintain or reduce the overall level of pollock harvest from the status quo. The level of fishing effort by pollock vessels is not expected to change, except in years where the fishery is closed early due to the attainment of the chum salmon c under Alternative 2 cap. At an ecosystem level, the effects of reducing fishing to this extent are not expected to be significant. While the location and timing of fishing activities may show some localized changes due to the fleet’s efforts to find areas with low chum salmon bycatch rates outside of area closures, overall the fleet is not likely to have a significant impact on the ecosystem under any of the alternatives.

# 8 Cumulative Effects

This section analyzes the cumulative effects of the actions considered in this environmental assessment. A cumulative effects analysis includes the effects of past, present, and reasonably foreseeable future action (RFFA). The past and present actions are described in several documents and are incorporated by reference. These include the PSEIS (NMFS 2004), the EFH EIS (NMFS 2005), and the harvest specifications EIS (NMFS 2007a). This analysis provides a brief review of the RFFA that may affect environmental quality and result in cumulative effects. Future effects include harvest of federally managed fish species and current habitat protection from federal fishery management measures, harvests from state managed fisheries and their associated protection measures, efforts to protect endangered species by other federal agencies, and other non-fishing activities and natural events.

The most recent analysis of RFFAs for the groundfish fisheries is in the Harvest Specifications EIS (NMFS 2007a). No additional RFFAs have been identified for this proposed action. The RFFAs are described in the Harvest Specifications EIS Section 3.3 (NMFS 2007a), are applicable for this analysis, and are incorporated by reference. A summary table of these RFFAs is provided below (Table 8-1). The table summarizes the RFFAs identified applicable to this analysis that are likely to have an impact on a resource component within the action area and timeframe. Actions are understood to be human actions (e.g., a proposed rule to designate northern right whale critical habitat in the Pacific Ocean), as distinguished from natural events (e.g., an ecological regime shift). CEQ regulations require a consideration of actions, whether taken by a government or by private persons, which are reasonably foreseeable. This is interpreted as indicating actions that are more than merely possible or speculative. Actions have been considered reasonably foreseeable if some concrete step has been taken toward implementation, such as a Council recommendation or the publication of a proposed rule. Actions simply “under consideration” have not generally been included because they may change substantially or may not be adopted, and so cannot be reasonably described, predicted, or foreseen. Identification of actions likely to impact a resource component within this action’s area and time frame will allow the public and Council to make a reasoned choice among alternatives.

The reasonably foreseeable future actions that may affect resource components and that also may be affected by the alternatives in this analysis are listed below and in Table 8-1. These include future actions that may affect the Bering Sea pollock fishery, the salmon caught as bycatch in that fishery, and the impacts of salmon bycatch on the resources components analyzed in this analysis. The actions in the list have been grouped in the following four categories:

- Ecosystem-sensitive management
- Traditional management tools
- Actions by other Federal, State, and international agencies
- Private actions

The “action area” for salmon bycatch management includes the Federal waters of the Bering Sea. Impacts of the action may occur outside the action area in salmon freshwater habitats and along salmon migration routes.

Table 8-1 summarizes the reasonably foreseeable “actions” identified in this analysis that are likely to have an impact on a resource component within the action area and timeframe.

Table 8-1. Reasonably foreseeable future actions

| | |
|---|---|
| Ecosystem-sensitive management | • Ongoing Research to understand the interactions between ecosystem components<br>• Increasing protection of ESA-listed and other non-target species<br>• Increasing integration of ecosystems considerations into fisheries management |
| Traditional management tools | • Authorization of pollock fishery in future years<br>• Increasing enforcement responsibilities<br>• Technical and program changes that will improve enforcement and management<br>• Development of a Salmon Excluder Device |
| Other Federal, State, and international agencies | • State management of salmon fisheries<br>• Hatchery release of salmon<br>• Future exploration and development of offshore mineral resources<br>• Expansion and construction of boat harbors<br>• Other State actions |
| Private actions | • Commercial pollock and salmon fishing<br>• CDQ investments in western Alaska<br>• Subsistence harvest of chum salmon<br>• Sport harvest of chum salmon<br>• Increasing levels of economic activity in Alaska's waters and coastal zone |

### 8.1.1 Ecosystem-sensitive management[49]

### 8.1.2 Ongoing research to understand the interactions between ecosystem components

Researchers are learning more about the components of the ecosystem, the ways these interact, and the impacts of fishing activity on them. Research topics include cumulative impacts of climate change on the ecosystem, the energy flow within an ecosystem, and the impacts of fishing on the ecosystem components. Ongoing research will improve the interface between science and policy-making and facilitate the use of ecological information in making policy. Many institutions and organizations are conducting relevant research.

Recent fluctuations in the abundance, survival, and growth of salmon in the Bering Sea have added significant uncertainty and complexity to the management of Bering Sea salmon resources. Similar fluctuations in the physical and biological oceanographic conditions have also been observed; however, the limited information on Bering Sea salmon ecology was not sufficient to adequately identify mechanisms linking recent changes in ocean conditions to salmon resources. North Pacific Anadromous Fish Commission (NPAFC) scientists responded by developing BASIS (Bering-Aleutian Salmon International Survey), a comprehensive survey of the Bering Sea pelagic ecosystem. BASIS was designed to improve our understanding of salmon ecology in the Bering Sea and to clarify mechanisms linking

[49] The term "ecosystem-sensitive management" is used in this analysis in preference to the terms "ecosystem-based management" and "ecosystem approaches to management." The term was chosen to indicate a wide range of measures designed to improve our understanding of the interactions between groundfish fishing and the broader ecosystems, to reduce or mitigate the impacts of fishing on the ecosystems, and to modify fisheries governance to integrate ecosystems considerations into management. The term was used because it is not a term of art or commonly used term which might have very specific meanings. When the term "ecosystem-based management" is used, it is meant to reflect usage by other parties in public discussions.

recent changes in ocean conditions with salmon resources in the Bering Sea. The Alaska Fisheries Science Center's Ocean Carrying Capacity (OCC) Program is responsible for BASIS research in U.S. waters.

Researchers with the OCC Program have conducted shelf-wide surveys during fall 2002 through 2006 on the eastern Bering Sea shelf as part of the multiyear BASIS research program. The focus of BASIS research was on salmon; however, the broad spatial coverage of oceanographic and biological data collected during late summer and early fall provided insight into how the pelagic ecosystem on the eastern Bering Sea shelf responded to changes in spring productivity. Salmon and other forage fish (e.g., age-0 walleye pollock, Pacific cod, and Pacific herring) were captured with a surface net trawl, zooplankton were collected with oblique bongo tows, and oceanographic data were obtained from conductivity-temperature-depth (CTD) vertical profiles. More information on BASIS is provided in Chapter 5 and is available at the AFSC website at: http://www.afsc.noaa.gov/ABL/occ/ablocc_basis.htm.

In 2008, North Pacific Research Board (NPRB) and National Science Foundation (NSF) began a project for understanding ecosystem processes in the Bering Sea called the Bering Sea Integrated Ecosystem Research Program (BSIERP). Approximately 90 federal, state and university scientists will provide coverage of the entire Bering Sea ecosystem. Scientists conducted three years of field research on the eastern Bering Sea Shelf, from St. Lawrence Island to the Aleutians, and are currently conducting two more years for analysis and reporting. The study covers a range of issues, including atmospheric forcing, physical oceanography, and the economic and social impacts on humans and communities of a changing ecosystem. More information on this research project is available on the NPRB web site at: http://bsierp.nprb.org/index.htm.

Additionally, ecosystem protection is supported by an extensive program of research into ecosystem components and the integrated functioning of ecosystems, carried out at the AFSC. The AFSC’s Fishery Interaction Team (FIT), formed in 2000 to investigate the ecological impacts of commercial fishing, is focusing on the impacts of Pacific cod, pollock, and Atka mackerel fisheries on Steller sea lion populations (Conners and Logerwell 2005). The AFSC’s Fisheries and the Environment (FATE) program is investigating potential ecological indicators for use in stock assessment (Boldt 2005). The AFSC’s Auke Bay Lab and RACE Division map the benthic habitat on important fishing grounds, study the impact of fishing gear on different types of habitats, and model the relationship between benthic habitat features and fishing activity (Heifetz et al. 2003). Other AFSC ecosystem programs include the North Pacific Climate Regimes and Ecosystem Productivity Program, the Habitat and Ecological Processes program, and the Loss of Sea Ice program (J. Boldt, pers. comm., September 26, 2005). More information on these research programs is available at the AFSC website at: http://www.afsc.noaa.gov.

### 8.1.3 Increasing protection of ESA-listed and other non-target species

Pollock fishing may impact a wide range of other resources, such as seabirds, marine mammals, and non-target species, such as salmon and halibut. Recent Council and NMFS actions suggest that the Council and NMFS may consider measures for protection for ESA-listed and other non-target species.

Changes in the status of species listed under the ESA, the addition of new listed species, designation of critical habitat, and results of future Section 7 consultations may require modifications to pollock fishing practices to reduce the impacts of this fishery on listed species and critical habitat.

We are not aware of any changes to the ESA-listed salmon status or designated critical habitat that may affect the future pollock fishery. The impacts of the pollock fishery on ESA-listed salmon are currently limited to the Upper Willamette and Lower Columbia River stocks. The tracking of coded-wire tagged surrogate salmon for ESA-listed stocks may result in additional ESA-listed salmon stocks being identified as potentially impacted by the pollock fisheries. The possible take of any additional ESA-listed salmon stocks would trigger ESA consultation and may result in additional management measures for the pollock fishery depending on the result of the consultation.

Washington State's Sea Grant program is currently working with catcher-processors in the Bering Sea pollock fishery to study the sources of seabird strikes in their operations and to look for ways fishermen can reduce the rate of strikes (Melvin et al. 2004). Other studies are investigating the potential for use of video monitoring of seabird interactions with trawl and longline gear (McElderry et al. 2004; Ames et al. 2005). This research is especially important because action area has very high seabird densities and potential aggregations of ESA-listed short tailed albatross (NMFS 2007b).

Information on listed marine mammals and potential for impacts from this action are contained in Chapter 7.

#### 8.1.3.1 Increasing integration of ecosystems considerations into fisheries management

Ecosystem assessments evaluate the state of the environment, including monitoring climate–ocean indices and species that indicate ecosystem changes. Ecosystem-based fisheries management reflects the incorporation of ecosystem assessments into single species assessments when making management decisions, and explicitly accounts for ecosystem processes when formulating management actions. Ecosystem-based fisheries management may still encompass traditional management tools, such as TACs, but these tools will likely yield different quantitative results.

To integrate such factors into fisheries management, NMFS and the Council will need to develop policies that explicitly specify decision rules and actions to be taken in response to preliminary indications that a regime shift has occurred. These decision rules need to be included in long-range policies and plans. Management actions should consider the life history of the species of interest and can encompass varying response times, depending on the species' lifespan and rate of production. Stock assessment advice needs to explicitly indicate the likely consequences of alternate harvest strategies to stock viability under various recruitment assumptions.

Management strategy evaluations (MSEs) can help in this process. MSEs use simulation models of a fishery to test the success of different management strategies under different sets of fishery conditions, such as shifts in ecosystem regimes. The AFSC is actively involved in conducting MSEs for several groundfish fisheries, including for several flatfish species in the BS, and for pollock in the GOA.

Both the Pew Commission report and the Oceans Commission report point to the need for changes in the organization of fisheries and oceans management to institutionalize ecosystem considerations in policy making (Pew 2003; U.S. Commission on Ocean Policy 2004). The Oceans Commission, for example, points to the need to develop new management boundaries corresponding to large marine ecosystems, and to align decision-making with these boundaries (U.S. Commission on Ocean Policy 2004).

Since the publication of the Oceans Commission report, the President has established a cabinet-level Committee on Ocean Policy by executive order. The Committee is to explore ways to structure government to implement ecosystem-based ocean management (Evans and Wilson 2005). Congress reauthorized the Magnuson-Stevens Act in December 2006 to addresses ecosystem-based management.

NMFS and the Council are continuing to develop their ecosystem management measures for the fisheries in the EEZ off Alaska. NMFS is currently developing national Fishery Ecosystem Plan guidelines. It is unclear at this time whether these will be issued as guidelines, or as formal provisions for inclusion in the Magnuson-Stevens Act.

The Council has created a committee to research ecosystem developments and to assist in formulating positions with respect to ecosystem-based management. The Council completed a fishery ecosystem plan for the Aleutian Islands ecosystem (NPFMC 2007). An interagency Alaska Marine Ecosystem Forum (AMEF) is improving inter-agency communication on marine ecosystem issues. The Council has signed a Memorandum of Understanding with 10 Federal agencies and 4 State agencies, to create the AMEF. The AMEF seeks to improve communication between the agencies on issues of shared responsibilities related to the marine ecosystems off Alaska's coast. The initial focus of the AMEF will be on the Aleutian Islands marine ecosystem. The SSC holds annual ecosystem scientific meetings at the February Council meetings.

In addition to these efforts to explore how to develop its ecosystem management efforts, the Council and NMFS continue to initiate efforts to take account of ecosystem impacts of fishing activity. The Council has recommended habitat protection measures for the eastern Bering Sea (73 FR 12357, March 7, 2008). These measures include the Northern Bering Sea Research Area to address potential impacts of shifts in fishing activity to the north.

The Council's Ecosystem Committee discusses ecosystem initiatives and advise the Council on the following issues: (1) defining ecosystem-based management; (2) identifying the structure and Council role in potential regional ecosystem councils; (3) assessing the implications of NOAA strategic planning; (4) drafting guidelines for ecosystem-based approaches to management; (5) drafting Magnuson-Stevens Act requirements relative to ecosystem-based management; and (6) coordinating with NOAA and other initiatives regarding ecosystem-based management. More details are available in the Council's website at http://www.fakr.noaa.gov/npfmc/current_issues/ecosystem/Ecosystem.htm.

The Council established Federal fisheries management in the Arctic Management Area. The Council developed, and NMFS approved, an Arctic Fishery Management Plan that (1) closes the Arctic to commercial fishing until information improves so that fishing can be conducted sustainably and with due concern to other ecosystem components, (2) determines the fishery management authorities in the Arctic and provide the Council with a vehicle for addressing future management issues, and (3) implements an ecosystem based management policy that recognizes the unique issues in the Alaskan Arctic. No significant fisheries exist in the Arctic Management Area, either historically or currently. However, the warming of the Arctic and seasonal shrinkage of the sea ice may be associated with increased opportunities for fishing in this region. The action is necessary to prevent commercial fisheries from developing in the Arctic without the required management framework and scientific information on the fish stocks, their characteristics, and the implications of fishing for the stocks and related components of the ecosystem.

#### 8.1.3.2 Fishery management responses to the effects of climate change

While climate warming trends are being studied and increasingly understood at a global scale (IPCC 2007), the ability for fishery managers to forecast biological responses to changing climate continues to be difficult. The Bering Sea is subject to periodic climatic and ecological "regime shifts." These shifts change the values of key parameters of ecosystem relationships, and can lead to changes in the relative success of different species.

The Council and NMFS have taken actions that indicate a willingness to adapt fishery management to be proactive in the face of changing climate conditions. The Council currently receives an annual update on the status and trends of indicators of climate change in the Bering Sea through the presentation of the Ecosystem Assessment and Ecosystem Considerations Report (Boldt 2007). Much of the impetus for Council and NMFS actions in the northern Bering Sea, where bottom trawling is prohibited in the Northern Bering Sea Research Area, and in the Alaskan Arctic, where the Council and NMFS have prohibited all fishing until further scientific study of the impacts of fishing can be conducted, derives from the understanding that changing climate conditions may impact the spatial distribution of fish, and consequently, of fisheries. In order to be proactive, the Council has chosen to close any potential loopholes to unregulated fishing in areas that have not previously been fished.

Consequently, it is likely that as other impacts of climate change become apparent, fishery management will also adapt in response. Because of the large uncertainties as to what these impacts might be, however, and our current inability to predict such change, it is not possible to estimate what form these adaptations may take.

### 8.1.4 Traditional management tools

#### 8.1.4.1 Authorization of pollock fishery in future years

The annual harvest specifications process for the pollock (and the associated pollock fishery) creates an important class of reasonably foreseeable actions that will take place in every one of the years considered in the cumulative impacts horizon (out to, and including, 2015). Annual TAC specifications limit each year's harvest within sustainable bounds. The overall OY limits on harvests in the BSAI constrain overall harvest of all species. Each year, OFLs, ABCs, and TACs are specified for two years at a time, as described in the Alaska Groundfish Harvest Specifications EIS (NMFS 2007b).

The harvest specifications are adopted in accordance with the mandates of the Magnuson-Stevens Act, following guidelines prepared by NMFS, and in accordance with the process for determining overfishing criteria that is outlined in Section 3.2 of each of the groundfish FMPs. Specifications are developed using the most recent fishery survey data (often collected the summer before the fishery opens) and reviewed by the Council and its SSC, AP, and Plan Teams. The process provides many opportunities for public comment. The management process, of which the specifications are a part, is analyzed in an EIS (NMFS 2007b). Each year's specifications and the status of the environment are reviewed to determine the appropriate level of NEPA analysis.

Annual pollock harvests, conducted in accordance with the annual specifications, will impact pollock stocks. Annual harvest activity may change total mortality for the pollock stock, may affect stock characteristics through time by selective harvesting, may affect reproductive activity, may increase the annual harvestable surplus through compensatory mechanisms, may affect the prey for the target species, and may alter EFH.

The annual pollock harvests also impact the environmental components described in this analysis: salmon, non-target fish species, seabirds, marine mammals, and a more general set of ecological relationships. In general, the environmental components are renewable resources, subject to environmental fluctuations. Ongoing harvests of pollock may be consistent with the sustainability of other resource components if the fisheries are associated with mortality rates that are less than or equal to the rates at which the resources can grow or reproduce themselves.

The on-going pollock fishery employs hundreds of fishermen and fish processors, and contributes to the maintenance of human communities, principally in Alaska, Washington, and Oregon.

In 2010 the BSAI groundfish FMP was amended to 'break out' other species into individual categories for management purposes thus separate specification are now established for squid, sharks, octopus and skates (NPFMC 2010).. The number of TAC categories with low values for ABC/OFL is increasing which tends to increase the likelihood that NMFS will close directed fisheries to prevent overfishing. Managers closely watch species with fairly close amounts between the OFL and ABCs during the fishing year and the fleet will adjust behavior to prevent incurring management actions. While managing the species with separate ABCs and OFLs reduces the potential for overfishing the individual species, the effect of creating more species categories can increase the potential for incurring management measures to prevent overfishing.

### 8.1.5 Increasing enforcement responsibilities

The U.S. Coast Guard (USCG) conducts fisheries enforcement activities in the EEZ off Alaska in cooperation with NOAA Office for Law Enforcement (OLE). New programs to protect resource components from pollock fishery impacts will create additional responsibilities for enforcement agencies. Despite this likely increase in enforcement responsibilities, it is not clear that resources for enforcement will increase proportionately.

The USCG is expected to bear a heavy responsibility for homeland security and is not expected to receive proportionate increases in its budget to accommodate increased fisheries enforcement. Increased responsibilities for homeland security and for detection of increasing drug-smuggling activities in waters off Alaska have limited the resources available for the USCG to conduct enforcement activities at the same level as in the recent past. Any deterrent created by Coast Guard presence in enforcing fisheries regulations and restrictions would likely be reduced, as would the opportunities for detection of fisheries violations at-sea.

Likewise, the NOAA OLE has not recently received increased resources consistent with its increasing enforcement obligations (J. Passer, pers. comm., March 2008). However, new enforcement assistance has become available in recent years through direct Congressional line item appropriations for Joint Enforcement Agreements (JEAs) with all coastal states. The State of Alaska has received approximately $10 million of this funding since 2001, and has used JEA money to purchase capital assets such as patrol vessels and patrol vehicles. The State has also hired new personnel to increase levels of at-sea and dockside enforcement and used JEA money to pay for support and operational expenses pertaining to this increased effort (J. Passer, pers. comm., March 2008).

Uncertainties about Congressional authorization of increased enforcement funding preclude any prediction of trends in the availability of resources to meet increased enforcement responsibilities. Thus, while an increase in responsibilities is reasonably foreseeable, a proportionate increase in funding is not.

### 8.1.6 Technical and program changes that will improve enforcement and management

Managers are increasingly using technology for fisheries management and enforcement. Managers are likely to increase use of vessel monitoring systems (VMS) in coming years. Vessels fishing for pollock in the Bering Sea are required to operate VMS units (50 CFR 679.7(a)(18)). Managers and enforcement personnel are making extensive use of the information from existing VMS units, and are likely to make more use of it in the future, as they continue to learn how to use it more effectively.

Monitoring the catch of pollock and salmon bycatch in the pollock fisheries relies heavily on data collected by NMFS-certified observers. Increased observer coverage requirements as a result of Amendment 91 are contained in Chapter 2. Observers currently are provided through a system known as "pay-as-you-go" under which vessels operators required to carry a NMFS certified observer contract directly for observer services with observer providers (businesses who hire and provide observers).

The Council took action in October 2010 to restructure the North Pacific Groundfish Observer Program to provide a new system for procuring and deploying observers in those fisheries that require at least 100% observer coverage. The Council recommended restructuring the program such that NMFS would contract directly with observer companies to deploy observers according to a scientifically valid sampling and deployment plan, and industry would pay a fee equal to 1.25% of the ex-vessel value of the landings included under the program. (The Magnuson Stevens Act authorizes collection of an ex-vessel fee of up to 2%.) As all sectors benefit from the resulting data, the Council chose to apply the same fee percentage to all restructured sectors, in order to develop a fee program that is fair and equitable across all sectors in the restructured program.

The new program is intended to address problems identified under the status quo. Under the status quo, NMFS cannot determine when and where to deploy observers in the sectors with less than 100% coverage requirements, coverage levels are fixed in regulation, and data gaps exist for sectors without any coverage. The restructured program is intended to provide NMFS with the flexibility to deploy observers in response to fishery management needs and to reduce the bias inherent in the existing program by employing a random vessel selection process, to the benefit of the resulting data. While this action denotes a significant change in the observer program for many vessels and fisheries, it does not affect monitoring in the BS pollock fishery, as the Council action explicitly placed industry sectors that are determined to need at least 100% coverage in the ‘full coverage’ category. This category of vessels will continue to meet observer coverage requirements by contracting directly with observer companies under the status quo service delivery model. Vessels and processors in the full coverage category include: all catcher processors and motherships; catcher vessels while fishing under a management system that uses prohibited species caps in conjunction with a catch share program (e.g., catcher vessels while participating in AFA pollock and GOA rockfish catch share program); and shoreside and floating processors when taking deliveries of AFA and CDQ pollock. Thus, the primary improvements in monitoring within the BS pollock fishery are due to the increased observer coverage requirements implemented under Amendment 91 (refer to Chapter 2).

Support of the observer program and investigations involving observers and observer data quality are the highest priority of the NOAA OLE. Since 1998, the NOAA OLE has provided dedicated staff to investigate observer reported violations and to maintain the partnership between NOAA OLE and the NPGOP. NOAA OLE currently dedicates two Special Agents to liaison with and to provide law enforcement support for the observer program. The dedicated agents provide inseason enforcement, observer deployment and debriefing support, subject matter expertise, and observer training to the NPGOP staff and the observers. NOAA OLE provides support to observers and industry through public outreach, partnership building, education, program development, and the enforcement of laws and regulations intended to protect observers and to provide them safe and productive work environments. NOAA OLE strives to promote voluntary compliance and law enforcement through communication with the observers themselves, NMFS observer program staff, fishery stakeholders, and other law enforcement agencies.

In 2008, when compared to 2006 and 2007, NOAA OLE saw an increase of at least 62% in the total number of North Pacific groundfish observer statements alleging violations. This increase coincides with the increased concerns regarding prohibited species numbers and with the implementation of the Amendment 80 fisheries. Stronger prohibited species restrictions will continue to increase the need for the high quality observer data, while simultaneously providing greater incentive for industry to hide fish or to manipulate or bias observer data.

During 2008, NOAA OLE provided compliance monitoring training to more than 450 new and prior observers in more than 40 training sessions. NOAA OLE provides observer training on prohibited species mishandling, sample station requirements, limited access fishery requirements, reasonable assistance, accommodations, access to catch and records, recordkeeping and reporting, conflict resolution, interference, sample biasing, and hostile work environments. Under Amendment 91, NOAA OLE anticipates the need for additional law enforcement support and NOAA OLE provided training on the above subject categories and on issues related specifically to salmon number verification.

NMFS is investigating the use of shipboard video monitoring to ensure compliance with full retention requirements in other regions. In the Alaska Region, NMFS has implemented video monitoring to monitor catch sorting actions of crew members inside fish holding bins and investigating the use of video to monitor regulatory discards. An EFP for continued development of the capability to do video monitoring of rockfish catch in the GOA is currently under consideration by NMFS and Council (73 FR 14226, March 14, 2008). NMFS is hopeful that these investigations could lead to regulations that allow use of video monitoring to supplement observer coverage in some fisheries. Electronic monitoring technology is evolving rapidly, and it is probable that video and other technologies will be introduced to supplement current observer coverage and enhance data collection in some fisheries. Video monitoring as not been sufficiently tested to ensure compliance with a no discard requirement at this time, but NMFS would support and encourage research to explore the feasibility of video for this use.

In addition to the technical aspects of video monitoring, several other issues related to video must be resolved. These include the amount of staff time and resources that would be required to review video footage, curation and storage questions, and the costs to NMFS and the fishing industry. Until these issues are resolved, NMFS will continue to implement existing proven monitoring and catch estimation protocols. Electronic monitoring is discussed in more detail in section 10.5.7.4.

#### 8.1.6.1 Development of the salmon excluder device

Gear modifications are one way to reduce salmon bycatch in the pollock fisheries. NMFS has issued exempted fishing permits for the purpose of testing a salmon excluder device in the pollock trawl fishery of the Bering Sea from 2004 to 2006 and for fall 2008 through spring 2011. The successful development of a salmon excluder device for pollock trawl gear may result in reductions of salmon bycatch, potentially reducing costs associated with the harvest of pollock and reducing the potential impact on the salmon stocks. The excluder has been successful in reducing Chinook salmon bycatch and modifications are being tested to improve its effectiveness for reducing chum salmon bycatch.

### 8.1.7 Actions by Other Federal, State, and International Agencies

#### 8.1.7.1 State salmon fishery management

ADF&G is responsible for managing commercial, subsistence, sport, and personal use salmon fisheries. The first priority for management is to meet spawning escapement goals to sustain salmon resources for future generations. Highest priority use is for subsistence under both State and Federal law. Surplus fish beyond escapement needs and subsistence use are made available for other uses. Stock assessment overviews by region for Chum stocks and a description of state management by area are contained in Chapter 5. The Alaska Board of Fisheries (BOF) adopts regulations through a public process to conserve fisheries resources and to allocate fisheries resources to the various users. Yukon River salmon fisheries management includes obligations under an international treaty with Canada. Subsistence fisheries management includes coordination with U.S. Federal government agencies where federal rules apply under ANILCA. Subsistence salmon fisheries are important culturally and greatly contribute to local economies. Commercial fisheries are also an important contributor to many local communities as well as supporting the subsistence lifestyle.

##### *8.1.7.1.1 Area M chum harvests*

The Area M fishery in the Alaska Peninsula is managed by the State of Alaska. Area M is further divided into two management areas, the North Alaska management area and the South Alaska management area. Stock status of this region and direct impacts of the action on the Area M stocks are contained in Chapter 5 of this analysis. Combined harvests in the fishery in 2010 totaled more than 1.7 million fish.

**Overview of Area M chum harvests**: Salmon fishieries in the South Alaska Peninsula Management Area (Area M) are prosecuted in 2 seasons, a June commercial fishery and a post-June fishery occurring after July 1. Legal fishing gear types in South Peninsula waters include purse seine, drift gillnet and set gillnet (Potter et al, 2011). All five species of salmon are commercially harvested in this management area. Information on stock assessment in Area M is contained in Chpater 5.

A separate management plan exists for the June fishery, the *South Unimak and Shumagin Islands June Fisheries Management Plan* (5 AAC 09.365). The BOF modified this plan in 2004 to establish set fishing schedules during the June fishery (Poetter et al, 2011). In 2010 the BOF discussed proposed modifications to the plan but made no changes. However, during that meeting a significant amount of time was spent on the topic of the chum salmon harvest in June. A number of amendments were put before the BOF that included closing down the June fishery, reinstating the historical chum salmon cap, and establishing a ratio-based management system (Poetter et al., 2011). Due to these concerns in 2010 and 2011 the purse seine fleet voluntarily stodd down during the initial fishing period (3 days).

Harvests in the June fishery through 2010 comprise a significant proportion of the annual chum harvest. Table 8-2 below shows the harvest of chum since 2003 (to be consistent with the time frame in this analysis, additional years of harvest data are available at Poetter et al., 2011). in this fishery in conjunction with the total harvest of chum annually (i.e. including the post July 1 fishery). The proportion of harvest from the June fishery of the annual total over this time frame has ranged from as low as 25% in 2006 to 61% in 2004. The numbers of chum harvested in the June fishery over this time frame has ranged from 271,700 in 2010 to a high of 696,775 in 2009. It seems reasonably foreseeable that this fishery will continue in the future.

Table 8-2. South Alaska Peninsula (Area M) chum harvests (in number of fish) from 2003-2011 in the June fishery compared with the annual total chum harvest for Area M and the proportion of the harvest from the June fishery. Harvest data taken from Poetter et al., 2011.

| Year | June harvest | Annual total harvest | Proportion of annual total from June harvest |
|---|---|---|---|
| 2003 | 282,438 | 637,305 | 0.44 |
| 2004 | 482,309 | 790,108 | 0.61 |
| 2005 | 427,830 | 739,460 | 0.58 |
| 2006 | 299,827 | 1,175,843 | 0.25 |
| 2007 | 297,539 | 679,787 | 0.44 |
| 2008 | 410,932 | 814,123 | 0.50 |
| 2009 | 696,775 | 1,684,583 | 0.41 |
| 2010 | 271,700 | 792,369 | 0.34 |

**Stock of origin of Area M chum harvests:** Per Council request for additional information regarding the stock of origin of chum salmon caught in the combined Area M chum salmon fisheries, the following information was excerpted from a report presented by ADF&G to the BOF in February 2010 entitled "Summary of Studies Addressing Stock Composition in the South Unimak and Shumagin Islands Fishery" (ADF&G, 2010). The origin of chum salmon stocks harvested in the South Unimak and Shumagin Islands June fishery has been a source of concern among fishermen throughout Western Alaska for several decades. Many studies have been conducted to ascertain origins of harvested stocks and their relative proportions in fisheries during the past 88 years with the most recent study currently undergoing analysis (Western Alaska Salmon Stock Identification Project; WASSIP). The two most current completed analyses of stock composition in the June fishery are known as the "1987 Tagging Study" (Eggers et al. 1988; Eggers et al. 1991; ADF&G BOF Report 1992) and "Genetic analysis of chum salmon harvested in the South Unimak and Shumagin Islands June Fisheries, 1993-1996" (Seeb et al. 1997). Another genetic study called "Genetic analysis of chum salmon harvested in the South Peninsula

Post June Fishery, 1996-1997" (Crane and Seeb 2000) was conducted along the South Peninsula during July and August of 1996 and 1997.

Regarding the first study, there were many caveats noted in the BOF report with respect to tagging methodology and analysis but in general, the most recent analysis of data from the 1987 tagging study (ADF&G BOF Report 1992) attempted to model the possible range of stock compositions in the fishery. All modeled cases showed an overwhelming representation (83%-90%) of Western Alaska summer chum complex (Kotzebue, Norton Sound, Yukon, Kuskokwim, Bristol Bay) and Asian stocks, with stocks from North Peninsula, South Peninsula, and Central Alaska present in much smaller proportions. Early tag releases tended to be from Norton Sound, Yukon and Kuskokwim stocks while later releases were mainly from Bristol Bay, North or South Alaska Peninsula, and Central Alaska stocks. This study provided insight into the broad composition of stocks in the June fishery, which was valuable in determining appropriate baseline representation for subsequent genetic analyses.

Regarding the second study, chum salmon were sampled for genetic (allozyme) analysis during the June fisheries in 1993 through 1996 at South Unimak and 1994 through 1996 in the Shumagin Islands. The purpose was to estimate stock proportions in samples (Seeb et al. 1997). Results of this study were broadly similar to those of the 1987 tagging study, in that NW Alaska summer and Asian chum stocks represented the majority of stock groups present. Northwest Alaska summer chum was the largest component of the South Unimak and Shumagin Islands June fishery in every year sampled and was a larger component of the South Unimak fishery than the Shumagin Islands fishery in two of the three years.

Finally with respect to studies of stock composition from this fishery, during July and early August of 1996 and 1997, chum salmon were sampled for genetic stock identification on the South Alaska Peninsula (Crane and Seeb 2000). Fish were sampled from the department test fishery as well as from commercial harvests. The commercial fishery was divided into two geographical areas (the Shumagin Islands area consisting of the Shumagin Island Section of the Southeastern District and the Mainland Area consisting of the Southeastern District Mainland and the Unimak, Southwestern, and South Central districts) and into three time periods. Stock group proportions were estimated using allozymes and chum salmon were assigned to the same ten reporting groups as identified in the June genetics study. Over the time period analyzed in this study, little change in stock composition was observed. The majority of stocks came from the Alaska Peninsula/Kodiak group. In contrast to the pattern of stock contributions in the June fishery, proportions of NW Alaska summer and Fall Yukon in the post-June fishery were very low.

The Western Alaska Salmon Stock Identification Project (WASSIP) was initiated in 2006 and has comprehensively sampled commercial and subsistence fisheries for chum and sockeye salmon throughout Western Alaska, from Chignik to Kotzebue over a four year period. Mixed stock analyses to estimate relative stock contributions to catches will be accomplished using the single nucleotide polymorphism (SNP) baseline for chum salmon. The chum salmon baseline has been greatly expanded in recent years, and consists of greater than 32,000 individuals from 310 populations throughout the Pacific Rim. Analyses will be conducted using 96 SNP markers, many of which were developed to differentiate among chum salmon populations spawning within western Alaska and Alaska Peninsula drainages. With addition of more baseline populations, development of additional genetic markers and incorporation of methods designed to more precisely estimate small stock proportions in samples, WASSIP will be the most comprehensive stock identification project to date, including more than 75,000 chum salmon individuals from harvest samples. When WASSIP results are released in 2012, stock proportions for chum salmon catches will be reported to six broad scale groups in Western Alaska. These include four reporting groups from the Alaska Peninsula (Chignik, South Peninsula, Northwestern District, Northern District), a

Kotzebue area reporting group, and a single combined reporting group for the broad coastal region encompassing Bristol Bay, Kuskokwim River, Yukon River, and Norton Sound.

While specific aspects of overall State of Alaska salmon fishery management continue to be modified, it is reasonably foreseeable that the current State management of the salmon fisheries will continue into the future.

#### 8.1.7.2 Hatchery releases of salmon

Hatcheries produce salmon fry and release these small salmon into the ocean to grow and mature before returning as adults to the hatchery or local rivers and streams for harvest or breading. Hatchery production increases the numbers of salmon in the ocean beyond what is produced by the natural system. A number of hatcheries produce salmon in Korea, Japan, Russia, the US, and Canada. The North Pacific Anadromous Fish Commission summarizes information on hatchery releases, by country and by area, where available. Chapter 5, Chum salmon, and Chapter 6, Chinook salmon, provide more information on current and past hatchery releases. It is reasonably foreseeable the hatchery production will continue at a similar level into the future.

#### 8.1.7.3 Future exploration and development of offshore mineral resources

The Minerals Management Service (MMS) expects that reasonably foreseeable future activities include numerous discoveries that oil companies may begin to develop in the next 15-20 years in federal waters off Alaska. Potential environmental risks from the development of offshore drilling include the impacts of increased vessel offshore oil spills, drilling discharges, offshore construction activities, and seismic surveys. In an EIS prepared for sales in the OCS Leasing Program, the MMS has assessed the cumulative impacts of such activities on fisheries and finds only small incremental increases in impacts for oil and gas development, which are unlikely to significantly impact fisheries and essential fish habitat (MMS 2003).

### 8.1.8 Private actions

#### 8.1.8.1 Commercial pollock and salmon fishing

Fishermen will continue to fish for pollock, as authorized by NMFS, and salmon, as authorized by the State. Fishing constitutes the most important class of reasonably foreseeable future private actions and will take place indefinitely into the future. Chapter 4 and the RIR, provide more information on the Bering Sea pollock fishery.

Commercial salmon fisheries exist throughout Alaska, in marine waters, bays, and rivers. Chapter 5 Chum Salmon, Chapter 6 Chinook Salmon, and the RIR provide more information on the commercial salmon fisheries.

#### 8.1.8.2 CDQ Investments in western Alaska

The CDQ Program was designed to improve the social and economic conditions in western Alaska communities by facilitating their economic participation in the BSAI fisheries. The large-scale commercial fisheries of the BSAI developed in the eastern BS without significant participation from rural western Alaska communities. These fisheries are capital-intensive and require large investments in vessels, infrastructure, processing capacity, and specialized gear. The CDQ Program was developed to redistribute some of the BSAI fisheries' economic benefits to adjacent communities by allocating a portion of commercially important BSAI species to such communities as fixed shares, or quota, of groundfish, halibut, and crab. The percentage of each annual BSAI catch limit allocated to the CDQ

Program varies by both species and management area. These allocations, in turn, provide an opportunity for residents of these communities to both participate in and benefit from the BSAI fisheries.

Sixty-five communities participate in the CDQ Program. These communities are organized under six non-profit corporations (CDQ groups) to manage and administer the CDQ allocations, investments, and economic development projects. Annual CDQ allocations provide a revenue stream for CDQ groups through various channels, including the direct catch and sale of some species, leasing quota to various harvesting partners, and income from a variety of investments. In 2009, the six CDQ groups generated nearly $180 million in revenue with operating expenses of $161 million, resulting in an increase in net assets of nearly $18 million. Operating expenses include all program costs, investments, and general and administrative expenses.[50]

One of the most tangible direct benefits of the CDQ Program has been employment opportunities for western Alaska village residents. Jobs generated by the CDQ Program included work aboard a wide range of fishing vessels, internships with the business partners or government agencies, employment at processing plants, and administrative positions. Many of the jobs generated by the CDQ Program are associated with shoreside fisheries development projects in CDQ communities. This includes a wide range of projects, including those directly related to commercial fishing. Examples of such projects include building or improving seafood processing facilities, purchasing ice machines, purchasing and building fishing vessel, gear improvements, and construction of docks or other fish handling infrastructure.

CDQ groups also have invested in peripheral projects that directly or indirectly support commercial fishing for halibut, salmon, and other nearshore species. This includes seafood branding and marketing, quality control training, safety and survival training, construction and staffing of maintenance and repair facilities that are used by both fishermen and other community residents, and assistance with bulk fuel procurement and distribution. Several CDQ groups are actively involved in salmon assessment or enhancement projects, either independently or in collaboration with ADF&G. Salmon fishing is a key component of western Alaska fishing activities, both commercially and for subsistence. The CDQ Program provides a means to support and sustain both such activities.

#### 8.1.8.3 Subsistence harvest of salmon

Communities in western and Interior Alaska depend on salmon from the Bering Sea for subsistence and the associated cultural and spiritual needs. Chum and Chinook salmon consumption can be an important part of regional diets, and salmon products are distributed as gifts or through barter and small cash exchanges to persons who do not directly participate in the subsistence fishery. Subsistence harvests will continue indefinitely into the future. The RIR provides more information on subsistence harvests.

#### 8.1.8.4 Sport fishing for salmon

Regional residents may harvest chum and Chinook salmon for sport, using a State sport fishing license, and then use these salmon for essentially subsistence purposes. Regional sport fisheries, including salmon fisheries may also attract anglers from other places. Anglers who come to the action area from elsewhere to sport fish generate economic opportunities for local residents. Sport fishing for salmon will continue indefinitely into the future.

### 8.1.9 Summary of cumulative impacts

Reasonably foreseeable future actions that may affect target and prohibited species are shown in Table 8-1. Ecosystem management, rationalization, and traditional management tools are likely to improve the

[50] 2009 CDQ Sector report, WACDA, p. 16. http://www.wacda.org/media/pdf/SMR_2009.pdf

protection and management of target and prohibited species, including pollock and chum salmon and are not likely to result in significant effects when combined with the direct and indirect effects of Alternatives 2 and 3. Ongoing research efforts are likely to improve our understanding of the interactions between the harvest of pollock and salmon. NMFS is conducting or participating in several research projects to improve understanding of the ecosystems, fisheries interactions, and gear modifications to reduce salmon bycatch.

The State of Alaska manages the commercial salmon fisheries off Alaska. The State's first priority for management is to meet spawning escapement goals to sustain salmon resources for future generations. Subsistence use is the highest priority use under both State and Federal law. Surplus fish beyond escapement needs and subsistence use are made available for other uses, such as commercial and sport harvests. The State carefully monitors the status of salmon stocks returning to Alaska streams and controls fishing pressure on these stocks.

Other government actions and private actions may increase pressure on the sustainability of target and prohibited fish stocks either through extraction or changes in the habitat or may decrease the market through aquaculture competition, but it is not clear that these would result in significant cumulative effects. Any increase in extraction of target species would likely be offset by federal management. These are further discussed in Sections 4.1.3 and 7.3 of the Harvest Specifications EIS (NMFS 2007).

Reasonably foreseeable future actions for non-specified and forage species include ecosystem-sensitive management, traditional management tools, and private actions. Impacts of ecosystem-sensitive management and traditional management tools are likely to be beneficial as more attention is brought to the taking of non-specified species in the fisheries and accounting for such takes.

Reasonably foreseeable future actions for marine mammals and seabirds include ecosystem-sensitive management; rationalization; traditional management tools; actions by other federal, state, and international agencies; and private actions, as described in Sections 8.4 and 9.3 of the Harvest Specifications EIS (NMFS 2007a). Ecosystem-sensitive management, rationalization, and traditional management tools are likely to increase protection to marine mammals and seabirds by considering these species more in management decisions, and by improving the management of the pollock fishery through the restructured observer program, catch accounting, seabird avoidance measures, and vessel monitoring systems (VMS). Research into marine mammal and seabird interactions with the pollock fisheries are likely to lead to an improved understanding leading to trawling methods that reduce adverse impacts of the fisheries. Changes in the status of species listed under the ESA, the addition of new listed species or critical habitat, and results of future Section 7 consultations may require modifications to groundfish fishing practices to reduce the impacts of these fisheries on listed species and critical habitat. Any change in protection measures for marine mammals likely would have insignificant effects because any changes would be unlikely to result in the PBR being exceeded and would not be likely to result in jeopardy of continued existence or adverse modification or destruction of designated critical habitat. Additionally, since future TACs will be set with existing or enhanced protection measures, it is reasonable to assume that the effects of the fishery on the harvest of prey species and disturbance will likely decrease in future years.

Any action by other entities that may impact marine mammals and seabirds will likely be offset by additional protective measures for the federal fisheries to ensure ESA-listed mammals and seabirds are not likely to experience jeopardy or adverse modification of critical habitat. Direct mortality by subsistence harvest is likely to continue, but these harvests are tracked and considered in the assessment of marine mammals and seabirds. The cumulative effect of these impacts in combination with measures proposed under Alternatives 2 and 3 is not likely to be significantly adverse.

Reasonably foreseeable future actions for habitat and the ecosystem include ecosystem-sensitive management; rationalization; traditional management tools; actions by other federal, state, and international agencies; and private actions, as detailed in Sections 10.3 and 11.3 of the Harvest Specifications EIS (NMFS 2007). Ecosystem-sensitive management, rationalization, and traditional management tools are likely to increase protection to ecosystems and habitat by considering ecosystems and habitat more in management decisions and by improving the management of the fisheries through the observer program, catch accounting, seabird and marine mammal protection, gear restrictions, and VMS. Continued fishing under the harvest specifications is likely the most important cumulative effect on EFH but the EFH EIS (NMFS 2005) has determined that this effect is minimal. The Council is also considering improving the management of non-specified species incidental takes in the fisheries to provide more protection to this component of the ecosystem. Any shift of fishing activities from federal waters into state waters would likely result in a reduction in potential impacts to EFH because state regulations prohibit the use of trawl gear in much of state waters. Nearshore impacts of coastal development and the management of the Alaska Water Quality Standards may have an impact on EFH, depending on the nature of the action and the level of protection the standards may afford. Development in the coastal zone is likely to continue, but Alaska overall is lightly developed compared to coastal areas elsewhere and therefore overall impact to EFH are not likely to be great. The EBS pollock fishery has been independently certified to the Marine Stewardship Council environmental standard for sustainable fishing. Overall, the cumulative effects on habitat and ecosystems are under Alternatives 2 and 3 are not likely to be significantly adverse.

Considering the direct and indirect impacts of the proposed action when added to the impacts of past and present actions previously analyzed in other documents that are incorporated by reference and the impacts of the reasonably foreseeable future actions listed above, the cumulative impacts of the proposed action are determined to be not significant.

# 9 Policy considerations of alternatives relative to chum and Chinook salmon and pollock

Selection of a preferred alternative involves explicit consideration of trade-offs between the potential salmon saved (both chum and Chinook) and the forgone pollock catch, and of ways to maximize the amount of salmon saved and minimize the amount of forgone pollock.

As analyzed Chapters 4, 5 and 6, the impacts of the alternatives on total bycatch numbers of chum salmon and Chinook salmon and forgone pollock would vary by year. This is due to the annual variability in the rate of chum and Chinook salmon caught per ton of pollock and annual changes in chum salmon abundance and distribution in the Bering Sea. The RIR examines the relative cost of forgone pollock fishing under Alternative 2 and the revenue at risk under Alternative 3 as well as the potential benefits to subsistence, commercial, and recreational salmon fisheries.

In terms of cap and sector allocation options under Alternative 2, option 1a, the lowest forgone pollock catches result in expected reductions of chum salmon bycatch by about 10% to 45%, depending on the sector allocation options and stock considered (Figure 9-1). For hard cap scenarios that have the highest impact on forgone pollock catch levels, the sector allocation are estimated to have negligible additional improvements on chum salmon saved (Figure 9-1). For Alternative 2, option 1b, the Asian stocks have the least amount of chum salmon AEQ saved and generally the savings were relatively insensitive to cap levels and sector splits for the Alaskan stocks and savings were limited to about 40% in the best case.

Under Alternative 3, options that require a greater proportion of pollock to be diverted elsewhere have diminishing benefits in terms of increased salmon savings but in general require less pollock diversion than Alternative 2 (Figure 9-2). There are some cap options that provide savings of about 20% for chum salmon AEQ while only impacting the pollock fishery by diverting about 8% of the B-season pollock.

In 2011 (the first year Amendment 91 was in effect) the cumulative seasonal pattern was different than average with shorebased vessels having a peak Chinook bycatch event at the end of the season whereas the chum bycatch occurred earlier than typical (Figure 9-3). For offshore catcher-processors the pattern for chum was somewhat similar to catcher boats but there was a lower increase in Chinook salmon bycatch at the end (Figure 9-4).

The implications of imposing Alternatives 2 or 3 and the associated options indicate that reducing bycatch levels and impacts to Alaskan chum salmon runs can be achieved, but improvements would be relative to the current estimated impacts which are already low (typically less than 1%). It is clear that options which reduce chum salmon bycatch the most do so at the expense of forgone pollock and increased Chinook salmon bycatch (or reduced capabilities to avoid Chinook salmon PSC; Table 9-1). Options that perform better by lowering the forgone pollock while still reducing western Alaska chum salmon AEQ mortality, may do poorer at savings of chum salmon originating from Asian regions (Figure 9-5). The extent that these measures, if enacted without a system like the current RHS program (analyzed under Alternative 1), would reduce chum PSC are less well understood. It is clear that bycatch totals generally increase as run sizes increase. It is also clear that the effectiveness of triggered closure areas will vary from year to year due to the inherent variability and complexity of pollock and chum salmon seasonal and spatial distribution.

The amount of pollock diverted (meaning the pollock would have to be taken outside of closure areas) was intermediate at about 110 thousand t to just over 160 thousand t. Another examination involved seeing if there were differences in the maximum values that could be attained in a given historical year (2003-2011). The results were similar in relative benefits over alternatives and options (Table 9-2).

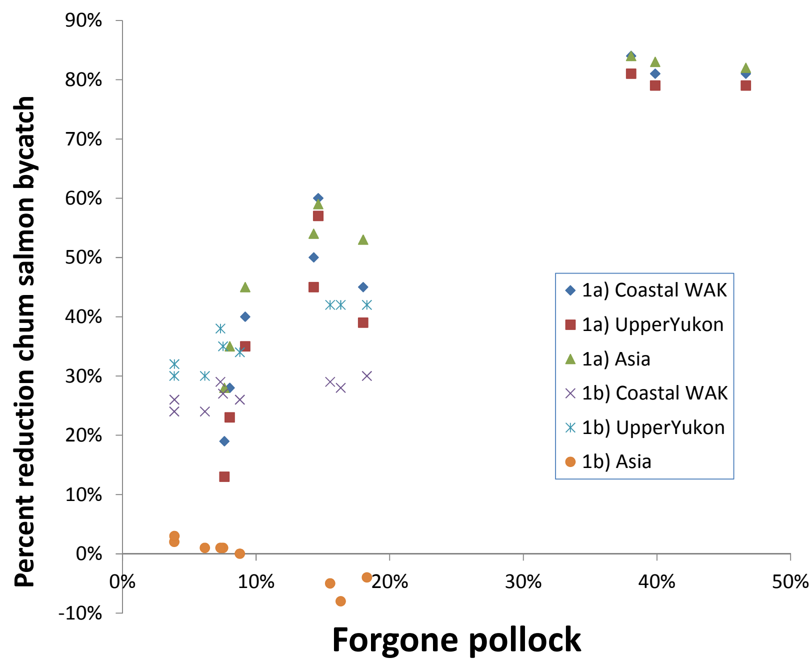


Figure 9-1. Relative reduction of chum salmon AEQ mortality (vertical axis) compared to relative amounts of pollock forgone (or diverted for 1b) by suboption for **Alternative 2**. Each point represents a different combination of sector allocation and cap level summed over 2003-2011.

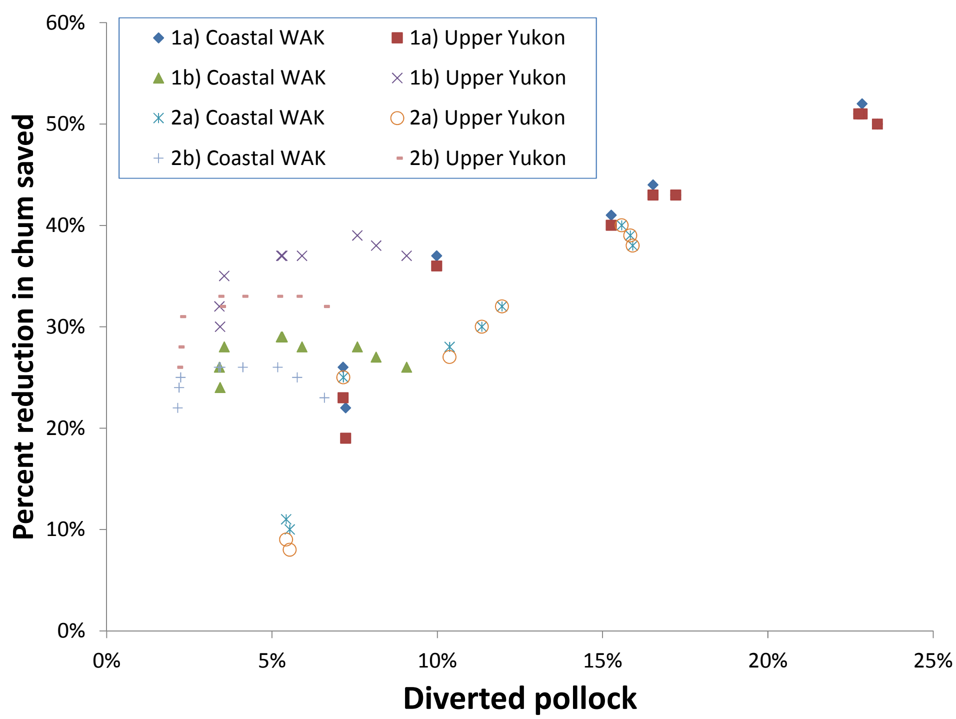


Figure 9-2. Relative reduction of chum salmon AEQ mortality (vertical axis) compared to relative amounts of pollock diverted by suboption for **Alternative 3**. Each point represents a different combination of sector allocation and cap level summed over 2003-2011.

Table 9-1. Summary over alternatives using sector split of 2ii, $\lambda=0$ for different cap levels alternatives and their options. Chum AEQ are estimates of the adult equivalent annual **average** (2004-2011) improvements by alternative and option. Western Alaska is Upper Yukon combined with Coastal west Alaska, Asia include chum from Russia and Japan, the total adds these two groups and the remaining stocks. Chinook salmon are saved are absolute reductions (or increases if negative) in bycatch and pollock are in tons with italicized values signifying diverted catch due to closed areas and bold signifies foregone catch as **averaged** over 2003-2011.

| | | | **Chum salmon** | | | | |
|---|---|---|---|---|---|---|---|
| | | | Western Alaska | Asian | Total chum | Pollock | Chinook |
| | 1a) | 50,000 | 30,142 | 99,352 | 167,897 | **332,264** | 17,430 |
| Alt 2 | | 200,000 | 16,072 | 64,724 | 103,328 | **128,305** | 9,212 |
| | | 353,000 | 6,288 | 34,109 | 50,304 | **54,350** | 5,762 |
| | 1b) | 50,000 | 12,862 | -4,966 | 16,523 | 130,318 | -5,323 |
| | | 200,000 | 10,735 | -336 | 17,500 | 62,579 | -3,127 |
| | | 353,000 | 9,761 | 653 | 16,821 | 43,883 | -2,522 |
| Alt 3 | 1a) | 25,000 | 19,347 | 60,518 | 104,096 | *162,719* | 6,701 |
| | | 75,000 | 15,091 | 52,048 | 86,885 | *108,705* | 5,091 |
| | | 200,000 | 7,717 | 37,696 | 57,769 | *51,486* | 5,517 |
| | 1b) | 25,000 | 12,038 | 530 | 21,529 | 53,998 | -3,714 |
| | | 75,000 | 11,922 | 4,838 | 25,866 | 37,860 | -2,636 |
| | | 200,000 | 9,817 | 4,643 | 21,646 | 24,449 | -1,807 |
| | 2a) | 25,000 | 14,592 | 48,198 | 81,832 | *112,802* | 6,064 |
| | | 75,000 | 10,338 | 41,723 | 67,051 | *73,881* | 4,142 |
| | | 200,000 | 3,466 | 30,095 | 42,141 | *39,453* | 2,848 |
| | 2b) | 25,000 | 10,623 | 2,567 | 21,177 | 36,856 | -2,576 |
| | | 75,000 | 10,713 | 6,620 | 25,739 | 24,516 | -1,718 |
| | | 200,000 | 8,913 | 6,085 | 21,711 | 15,322 | -1,131 |

Table 9-2. Summary over alternatives using sector split of 2ii, $\lambda$ =0 for different cap levels alternatives and their options. Chum AEQ are estimates of the adult equivalent annual **maximum values** from 2003-2011 by alternative and option. Western Alaska is Upper Yukon combined with Coastal west Alaska, Asia include chum from Russia and Japan, the total adds these two groups and the remaining stocks. Chinook salmon are saved are the **maximum** absolute reductions (or increases if negative) in bycatch and pollock are in tons with italicized values signifying diverted catch due to closed areas and bold signifies **maximum** foregone catch as over 2003-2011.

| | | | Chum AEQ | | | | |
|---|---|---|---|---|---|---|---|
| | | Cap | Western Alaska | Asia | Total | Pollock *diverted* or **foregone** | Chinook Saved |
| **Alt 2** | **1a) B-season** | **50,000** | 95,846 | 299,162 | 504,256 | **681,927** | 46,059 |
| | | **200,000** | 61,280 | 233,591 | 372,749 | **396,835** | 35,247 |
| | | **353,000** | 28,306 | 154,570 | 228,133 | **288,184** | 33,358 |
| | **1b) June-July** | | | | | | |
| | | **50,000** | 44,826 | 10,605 | 85,198 | *274,294* | 0 |
| | | **200,000** | 38,458 | 16,355 | 80,387 | *162,748* | 0 |
| | | **353,000** | 35,586 | 15,920 | 74,051 | *153,109* | 0 |
| **Alt 3** | **1a) B-season** | | | | | | |
| | | **25,000** | 58,115 | 166,867 | 284,375 | *326,642* | 28,113 |
| | | **75,000** | 46,151 | 150,669 | 248,174 | *255,525* | 27,064 |
| | | **200,000** | 23,400 | 118,153 | 176,341 | *183,272* | 26,829 |
| | **1b) June-July** | | | | | | |
| | | **25,000** | 41,530 | 18,882 | 91,335 | *138,175* | 0 |
| | | **75,000** | 41,846 | 27,632 | 102,318 | *105,373* | 0 |
| | | **200,000** | 35,288 | 25,244 | 87,454 | *78,766* | 0 |
| | **2a) B-season** | | | | | | |
| | | **25,000** | 44,817 | 143,673 | 237,124 | *205,816* | 19,869 |
| | | **75,000** | 30,139 | 124,525 | 191,107 | *165,464* | 14,519 |
| | | **200,000** | 14,717 | 86,466 | 111,282 | *131,722* | 14,422 |
| | **2b) June-July** | | | | | | |
| | | **25,000** | 36,874 | 22,163 | 87,347 | *102,091* | 0 |
| | | **75,000** | 37,356 | 29,672 | 96,863 | *74,572* | 0 |
| | | **200,000** | 33,136 | 26,647 | 82,176 | *137,894* | 0 |

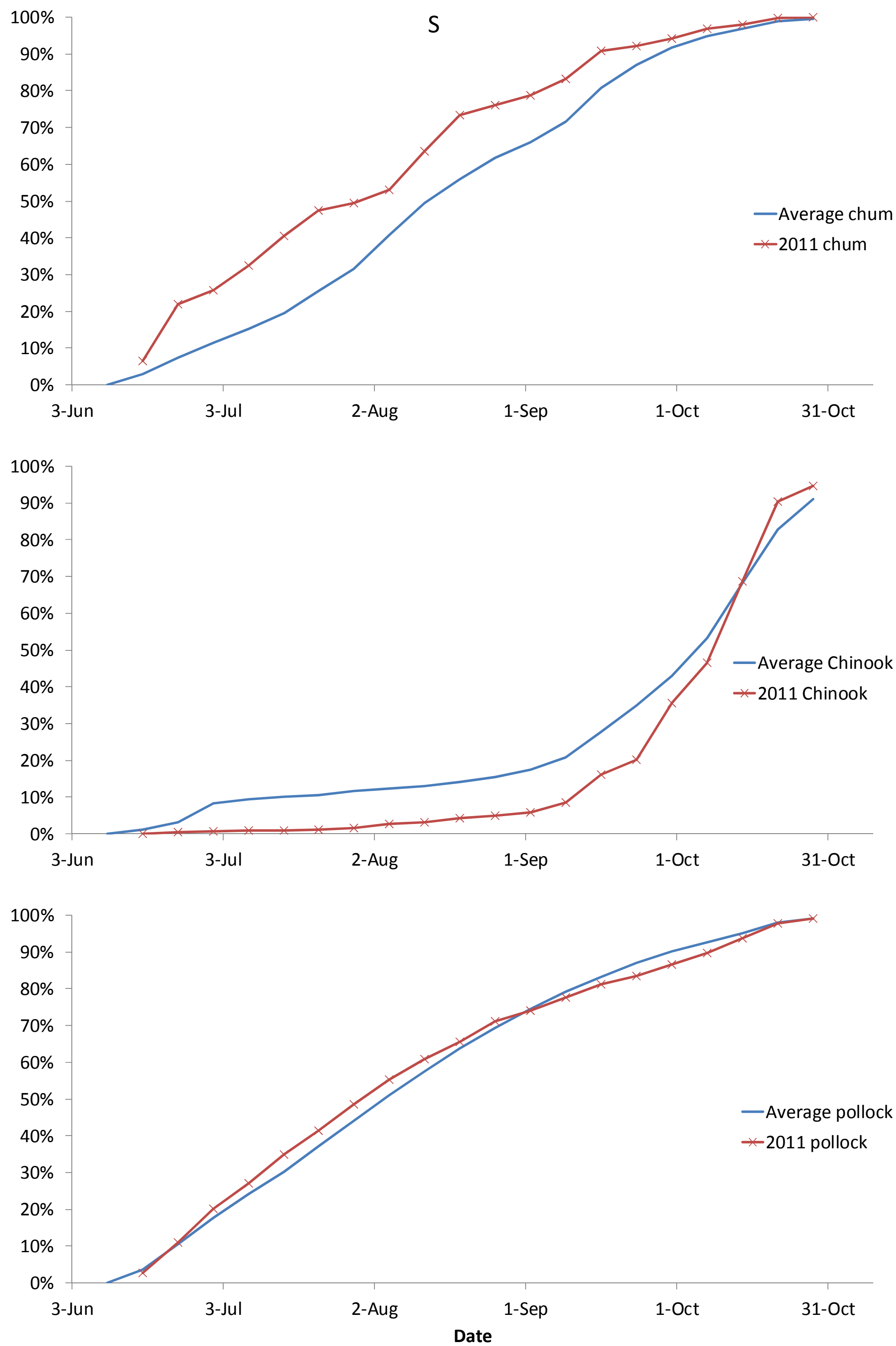


Figure 9-3. Shorebased catcher vessels' cumulative proportion of chum (top), Chinook (middle) and pollock (bottom) for 2011 compared to mean (2003-2011) values.

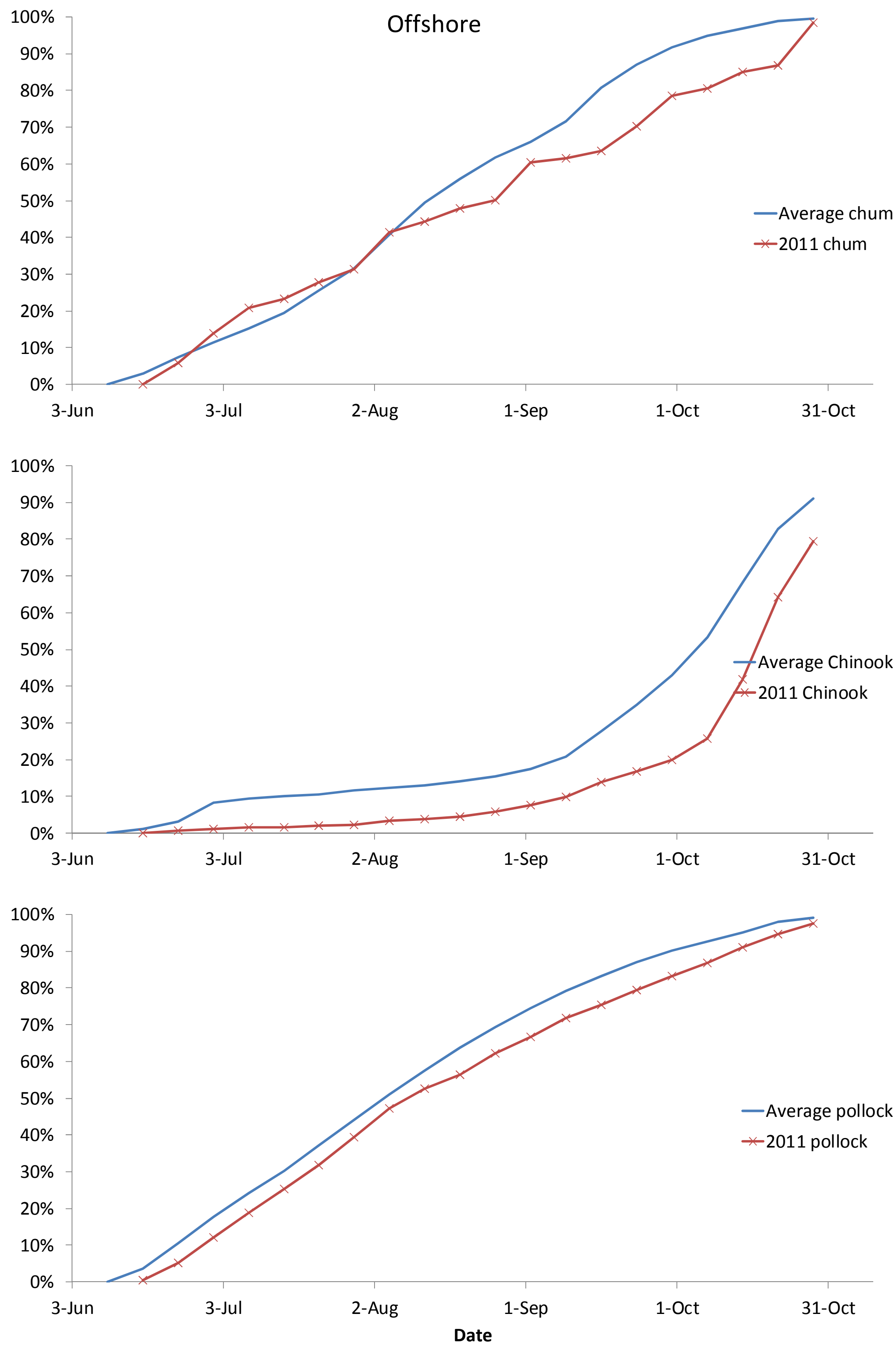


Figure 9-4. Offshore catcher processors' cumulative proportion of chum (top), Chinook (middle) and pollock (bottom) for 2011 compared to mean (2003-2011) values.

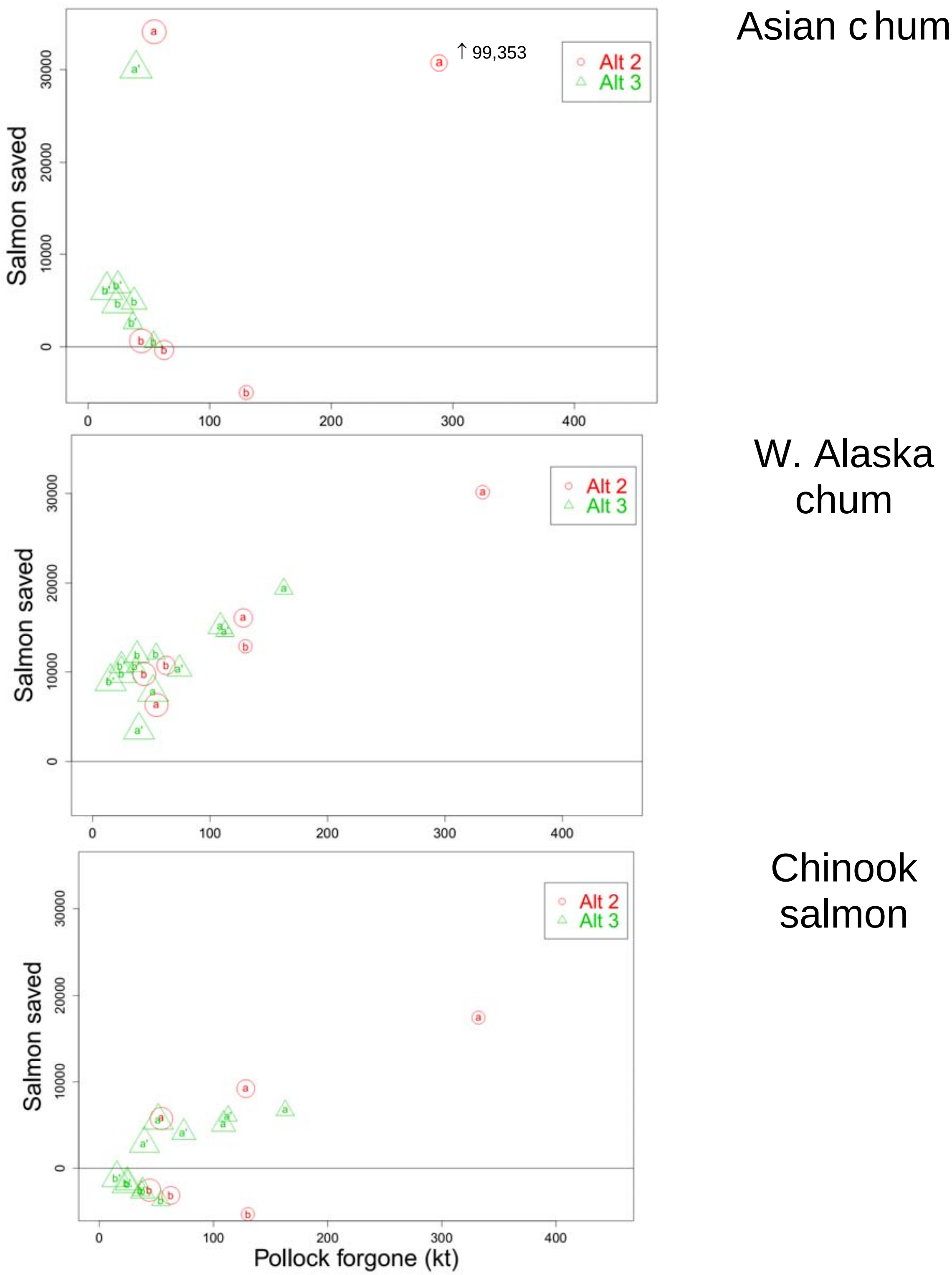


Figure 9-5. Mean expected reduction of salmon mortality (vertical axis) compared to relative amounts of pollock forgone or diverted (thousands of t) for different alternatives, caps and options. Western Alaska stocks include coastal W Alaska and Upper Yukon combined, size of symbols indicates the size of the cap, and letter designations indicate option (and a' and b' are for the 60% area closures for alternative 3 2a) and 2b) options).

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Note this list will be revised for the public review draft to include those personnel we inadvertently omitted to list for this version.

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***[Note any missing references will be included in the public review draft]***


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# Appendix 1: Council motions June 2010 and December 2009 to refine Chum bycatch management alternatives

**Council motion June 2010**

*The Council moves the following suite of alternatives for preliminary analysis of chum salmon bycatch management measures. Note bolded items are additions while strike-outs represent deletions from previous suite of alternatives.*

## C-1(b) Bering Sea Chum Salmon Bycatch

**Alternative 1 – Status Quo**

Alternative 1 retains the current program of the Chum Salmon Savings Area (SSA) closures triggered by separate non-CDQ and CDQ caps with the fleet's exemption to these closures per regulations for Amendment 84 and as modified by the Amendment 91 Chinook bycatch action.

**Alternative 2 – Hard Cap**

Component 1: Hard Cap Formulation (with CDQ allocation of 10.7%)

a) 50,000
b) 75,000
c) 125,000
d) 200,000
e) 300,000
f) 353,000

Component 2: Sector Allocation

Use blend of CDQ/CDQ partner bycatch numbers for historical average calculations.

a) No sector allocation
b) Allocations to Inshore, Catcher Processor, Mothership, and CDQ
   1) Pro-rata to pollock AFA pollock sector allocation
   2) Historical average
      i. 2007-2009
      ii. 2005-2009
      iii. 2000-2009
      iv. 1997-2009
   3) Allocation based on 75% pro-rata and 25% historical
   4) Allocation based on 50% pro-rata and 50% historical
   5) Allocation based on 25% pro-rata and 75% historical

**For Analysis:**

| CDQ | Inshore CV | Mothership | Offshore CPS |
|---|---|---|---|
| 3.4% | 81.5% | 4.0% | 11.1% |
| 6.7% | 63.3% | 6.5% | 23.6%[51] |
| 10.7% | 44.77% | 8.77% | 35.76% |

Suboption: Allocate 10.7% to CDQ, remainder divided among other sectors (**see table**).

[51] Note the actual midpoint is CDQ = 7.05%, CV 63.14%, Mothership 6.39%, CP 23.43% . However as noted by staff during Council deliberation numbers reflected in the table are an existing option as the historical average from 2005-2009 allocated 50:50 pro-rata AFA to historical average by section.

<u>Component 3</u>: Sector Transfer

a) No transfers or rollovers

b) Allow NMFS-approved transfers between sectors

Suboption: Limit transfers to the following percentage of salmon that is available to the transferring entity at the time of transfer:

1) 50%
2) 70%
3) 90%

c) Allow NMFS to roll-over unused bycatch allocation to sectors that are still fishing

<u>Component 4</u>: Cooperative Provision

a) Allow allocation at the co-op level for the inshore sector, and apply transfer rules (Component 3) at the co-op level for the inshore sector.

Suboption: Limit transfers to the following percentage of salmon that is available to the transferring entity at the time of transfer:

1) 50%
2) 70%
3) 90%

b) Allow NMFS to rollover unused bycatch allocation to inshore cooperatives that are still fishing.

**Alternative 3 – Trigger Closure**

<u>Component 1</u>: Trigger Cap Formulation

Cap level

a) 25,000
b) 50,000
c) 75,000
d) 125,000
e) 200,000

Application of Trigger Caps

a) Apply trigger to all chum bycatch
b) Apply trigger to all chum bycatch between specific dates
~~c) Apply trigger to all chum bycatch in a specific area.~~

**Trigger limit application:**

**Two options for application of trigger caps for area closure options (applied to caps under consideration)**

**1- Cumulative monthly proportion of cap (left-side of table below)**

**2- Cumulative monthly proportion AND monthly limit (left and right sides of table together. Note monthly limit should evaluate +/- 25% of distribution below)**

**Option of cumulative versus monthly limit for trigger area closures (assuming a trigger cap of 100,000 fish). Monthly limit based on minimum of monthly cumulative value and 150% of monthly historical proportion.** *NOTE: these cumulative proportions have changed slightly using updated data through 2010*

| | Cumulative | | Monthly limit | |
|---|---|---|---|---|
| Month | Cumulative Proportion | Monthly Cumulative | Monthly proportion | Monthly limit |
| June | 10.8% | 10,800 | 10.8% | 10,800 |
| July | 31.5% | 31,500 | 20.7% | 31,050 |
| August | 63.6% | 63,600 | 32.1% | 48,150 |
| September | 92.3% | 92,300 | 28.6% | 42,900 |
| October | 100.0% | 100,000 | 7.7% | 11,550 |

Component 2: Sector allocation

Use blend of CDQ/CDQ partner bycatch numbers for historical average calculations.

a) No sector allocation

b) Allocations to Inshore, Catcher Processor, Mothership, and CDQ

1) Pro-rata to pollock AFA pollock sector allocation
2) Historical average
   i. 2007-2009
   ii. 2005-2009
   iii. 2000-2009
   iv. 1997-2009
3) Allocation based on 75% pro-rata and 25% historical
4) Allocation based on 50% pro-rata and 50% historical
5) Allocation based on 25% pro-rata and 75% historical

**For Analysis:**

| CDQ | Inshore CV | Mothership | Offshore CPS |
|---|---|---|---|
| 3.4% | 81.5% | 4.0% | 11.1% |
| 6.7% | 63.3% | 6.5% | 23.6%[52] |
| 10.7% | 44.77% | 8.77% | 35.76% |

Suboption: Allocate 10.7% to CDQ, remainder divided among other sectors.

~~Component 3: Sector Transfer~~

~~a) No transfers or rollovers~~

~~b) Allow NMFS-approved transfers between sectors~~

~~Suboption: Limit transfers to the following percentage of salmon that is available to the transferring entity at the time of transfer:~~

~~1) 50%~~
~~2) 70%~~
~~3) 90%~~

~~c) Allow NMFS to roll-over unused bycatch allocation to sectors that are still fishing~~

[52] Note the actual midpoint is CDQ = 7.05%, CV 63.14%, Mothership 6.39%, CP 23.43% . However as noted by staff during Council deliberation numbers reflected in the table are an existing option as the historical average from 2005-2009 allocated 50:50 pro-rata AFA to historical average by section.

~~Suboption: Limit transfers to the following percentage of salmon that is available to the transferring entity at the time of transfer:~~
~~1) 50%~~
~~2) 70%~~
~~3) 90%~~

Component 3~~Component 4~~ : Cooperative Provisions

a) Allow allocation at the co-op level for the inshore sector, and apply transfer rules (Component 3) at the co-op level for the inshore sector.
   Suboption: Limit transfers to the following percentage of salmon that is available to the transferring entity at the time of transfer:
   1) 50%
   2) 70%
   3) 90%

b) Allow NMFS to roll-over unused bycatch allocation to cooperatives that are still fishing

Component **4** ~~Component 5~~: Area and Timing Options

~~a. Large area closure~~
~~b. Discrete, small area closures identified by staff in February Discussion paper (20 ADF&G statistical areas, identified in Table 4)~~
c. **Groupings of ADFG area closures by month that represent 40%, 50%, 60% of historical bycatch.** ~~the small area closures (as presented) (described in Option b above) into 3 zones that could be triggered independently with subarea, rather than statistical area, level closures~~

**The analysis should include quantitative analysis of the 50% closure options and qualitative analysis of the 40% and 60% closure options.**

Component **5**~~Component 6:~~ Timing Option – Dates of Area Closure

a) Trigger closure ~~of Component 5 areas~~ when the overall cap level specified under Component 1(a) was attained
b) ~~Under Component 5(b)~~ discrete small closures would close when a ~~an overall~~ cap was attained and would close for the time period corresponding to periods of high historical bycatch.~~, considering both number of salmon. a  (i.e. Table 11 in February Discussion Paper) Under Component 5(c)  Subareas within a zone would close for the time period corresponding to periods of high historical bycatch within the subarea when a zone level cap was attained.~~
c) ~~Under Component 5,  Areas close when bycatch cap is attained within that area (i.e. Table 12 in February Discussion Paper)~~
   ~~a. for the remainder of year~~
   ~~b. for specific date range~~

Component **6** ~~Component 6~~: Rolling Hot Spot (RHS) **system** ~~Exemption~~ – Similar to status quo (**with RHS system in regulation**), participants in a vessel-level (platform level for Mothership fleet) RHS would be exempt from regulatory triggered closure below.

**1. A large area trigger closure (encompassing 80% of historical bycatch).**
   ~~a)~~ Sub-option: RHS regulations would contain an ICA provision that the regulatory trigger closure (as adopted in Component **4** ~~5~~) **apply to participants with a rate in excess of 200% of the Base Rate.** ~~that do not maintain a certain level of rate-based chum salmon bycatch performance.~~

**In constructing an ICA under this component, the following aspects should be considered:**

- **Closures that would address timing & location of bycatch of Western AK chum stocks.**

In addition, include the following items in the initial review analysis:

1. Analyze discrete area approach normalized across years (i.e. proportion of salmon caught in an area in a year rather than numbers of salmon);
2. Discuss how Component **6**~~7 and suboption~~ would be applied;
3. In depth description of the rolling hot spot regulations (Amendment 84), focusing on parameters that could be adjusted if the Council found a need to refine the program to meet objectives under Component 7. **Specifically analyze:**
   a. **the base rate within the RHS program;**
   b. **the options for revising the tier system within the RHS program;**
   c. **the Council's options for revising the fine structure within the RHS program. Analysis should include a discussion of the meaningfulness of fines, including histograms of number and magnitude of fines over time as well as a comparison of penalties under the RHS program to agency penalties and enforcement actions for violating area closures.**
4. Discussion from NMFS of catch accounting for specific caps for discrete areas, and area aggregations described in Component 5 and for areas within those footprints that may have other shapes that could be defined by geographic coordinates [Component 6(c)] Discussion from NMFS on the ability to trigger a regulatory closure based on relative bycatch within a season (with respect to catch accounting system and enforcement limitations) considering changes in bycatch monitoring under Amendment 91.
5. Contrast a regulatory closure system (Components 5 and 6) to the ICA closure system (Component 7) including data limitations, enforcement, potential level of accountability (i.e., fleet-wide, sector, cooperative, or vessel level).
6. Examine differences between high bycatch years (i.e. 2005) and other years to see what contributes to high rates (i.e. timing/location, including fleet behavior and environmental conditions).
7. Examine past area closures and potential impacts of those closures on historical distribution of bycatch and on bycatch rates (qualitative); include 2008 and 2009 data and contrast bycatch distribution under VRHS versus the Chum Salmon Savings Area.

**Council motion December 2009**
**C-4(b) Bering Sea Salmon Bycatch**
**Council motion: strike-outs and underlines to indicate additions and deletions from original alternative set**

**Alternative 1 – Status Quo**

Alternative 1 retains the current program of the Chum Salmon Savings Area (SSA) closures triggered by separate non-CDQ and CDQ caps with the fleet's exemption to these closures per regulations for Amendment 84 and as modified by the Amendment 91 Chinook bycatch action.

**Alternative 2 – Hard Cap**

Component 1: Hard Cap Formulation (with CDQ allocation of 10.7%)

a) ~~58,000~~ 50,000
b) ~~206,000~~ 75,000
c) ~~353,000~~ 125,000
d) ~~488,000~~ 200,000
e) 300,000
f) 353,000

Component 2: Sector Allocation

Use blend of CDQ/CDQ partner bycatch numbers for historical average calculations.

a) No sector allocation
b) Allocations to Inshore, Catcher Processor, Mothership, and CDQ
    1) Pro-rata to pollock AFA pollock sector allocation
    2) Historical average
        i. ~~2004-2006~~ 2007-2009
        ii. ~~2002-2006~~ 2005-2009
        iii. ~~1997-2006~~ 2000-2009
        iv. 1997–2009
    3) Allocation based on 75% pro-rata and 25% historical
    4) Allocation based on 50% pro-rata and 50% historical
    5) Allocation based on 25% pro-rata and 75% historical
c) Allocate 10.7% to CDQ, remainder divided among other sectors

Component 3: Sector Transfer
a) No transfers or rollovers
b) Allow NMFS-approved transfers between sectors
    Suboption: Limit transfers to the following percentage of salmon that is available to the transferring entity at the time of transfer:
        1) 50%
        2) 70%
        3) 90%
c) Allow NMFS to roll-over unused bycatch allocation to sectors that are still fishing

Component 4: Cooperative Provision
a) Allow allocation at the co-op level for the inshore sector, and apply transfer rules (Component 3) at the co-op level for the inshore sector.
    Suboption: Limit transfers to the following percentage of salmon that is available to the transferring entity at the time of transfer:
        1) 50%
        2) 70%
        3) 90%
b) Allow NMFS to rollover unused bycatch allocation to inshore cooperatives that are still fishing.

**Alternative 3 – Trigger Closure**
Component 1: Trigger Cap Formulation
Cap level
a) ~~45,000~~ 25,000
b) ~~58,000~~ 50,000
c) ~~206,000~~ 75,000
d) ~~353,000~~ 125,000
e) ~~488,000~~ 200,000

Application of Trigger Caps
a) Apply trigger to all chum bycatch
~~b) Apply trigger to all chum bycatch in the CVOA~~
~~c)~~ b) Apply trigger to all chum bycatch between specific dates
~~d)~~ c) Apply trigger to all chum bycatch in a specific area.

Component 2: Sector allocation
Use blend of CDQ/CDQ partner bycatch numbers for historical average calculations.
a) No sector allocation

- b) Allocations to Inshore, Catcher Processor, Mothership, and CDQ
  - 1) Pro-rata to pollock AFA pollock sector allocation
  - 2) Historical average
    - i. ~~2004-2006~~ 2007-2009
    - ii. ~~2002-2006~~ 2005-2009
    - iii. ~~1997-2006~~ 2000-2009
    - iv. 1997-2009
  - 3) Allocation based on 75% pro-rata and 25% historical
  - 4) Allocation based on 50% pro-rata and 50% historical
  - 5) Allocation based on 25% pro-rata and 75% historical
- c) Allocate 10.7% to CDQ, remainder divided among other sectors

Component 3: Sector Transfer

- a) No transfers or rollovers
- b) Allow NMFS-approved transfers between sectors

  Suboption: Limit transfers to the following percentage of salmon that is available to the transferring entity at the time of transfer:
  - 1) 50%
  - 2) 70%
  - 3) 90%
- c) Allow NMFS to roll-over unused bycatch allocation to sectors that are still fishing

  Suboption: Limit transfers to the following percentage of salmon that is available to the transferring entity at the time of transfer:
  - 1) 50%
  - 2) 70%
  - 3) 90%

Components 4: Cooperative Provisions

- a) Allow allocation at the co-op level for the inshore sector, and apply transfer rules (Component 3) at the co-op level for the inshore sector.

  Suboption: Limit transfers to the following percentage of salmon that is available to the transferring entity at the time of transfer:
  - 1) 50%
  - 2) 70%
  - 3) 90%
- b) Allow NMFS to roll-over unused bycatch allocation to cooperatives that are still fishing

Component 5: Area Option

- a) Area identified in October, 2008 discussion paper (B-season chum bycatch rate-based closure described on pages 14-15 of December 2009 discussion paper)
- ~~b) Existing Chum Salmon Savings Area (differs from status quo with application of other components)~~
- b) New areas [to be identified by staff] which are small, discrete closure areas, each with its own separate cap whereby bycatch in that area only accrues towards the cap

Component 6: Timing Option – Dates of Area Closure

- ~~a) Existing closure dates (August 1 – August 31 and September 1 through October 14 if trigger is reached.)~~

b) New closure dates [to be developed from staff analysis of seasonal proportions of pollock and chum salmon by period across additional ranges of years]

Component 7: Rolling Hot Spot (RHS) Exemption – Similar to status quo, participants in a vessel-level (platform level for Mothership fleet) RHS would be exempt from regulatory triggered closure(s).

a) Sub-option: RHS regulations would contain an ICA provision that the regulatory trigger closure (as adopted in Component 5) apply to participants that do not maintain a certain level of rate-based chum salmon bycatch performance.

## Council motion on Bering Sea Non-Chinook Salmon Prohibited Species Catch

June 11, 2011

The Council requests staff revise the analysis as described below and bring it back for initial review.

Add the following option under Alternative 2, Component 1:

> Option: Apply a hard cap (non-Chinook PSC limit) to vessels participating in the directed pollock fishery during June and July, in aggregate. This hard cap, if exceeded, would require all vessels affected by the cap to stop fishing until August 1.
>
> *The components under Alternative 2 for cap level, sector allocation, sector transf er, cooperative allocation, and cooperative transfer options would apply (see J une 2011 EA pages 28-35). A hard cap applicable only to June and July will be derived from the range of options for B-season hard cap levels, adjusted to reflect the average proportion of non-Chinook salmon PSC in June and July relative to the B-season total.*

Remove current Alternative 3 as a stand-alone alternative, and incorporate elements in the alternative as described below.

1. Revise Alternative 4 to read:

(new) Alternative 3:

Rolling Hot Spot (RHS) system – with RHS in regulation, participants in a vessel-level (platform level for Mothership fleet) RHS would be exempt from:

> a large area trigger closure encompassing 80% of hist orical non-Chinook prohibited species catch with the trigger cap level options under what was formerly Alternative 3 (see June 2011 EA pages 35-36). This closure would apply to vessels that are not in an RHS system when total non-Chinook salmon PSC from all vessels (those in an RHS system and those not in an RHS system) reaches the trigger cap level, and would not be subject to sector or cooperative level allocations.

In addition to the RHS, vessels in the RHS system would be subject to:

Option 1: a trigger closure encompassing 80% of historical non-Chinook salmon PSC estimates in

> Suboption 1: the June and July pollock fishery, in aggregate. This trigger closure would only apply in June and July.
>
> Suboption 2: the B season pollock fishery. This trigger closure would apply for the full B season.

Option 2: a trigger closure encompassing 60% of historical non-Chinook salmon PSC estimates in

> Suboption 1: the June and July pollock fishery, in aggregate. This trigger closure would only apply in June and July.
> Suboption 2: the B season pollock fishery. This trigger closure would apply for the full B season.

> *Apply the components under what was formerly Alternati ve 3 for trigger cap levels, sector allocations, and cooperative provisions (see June 2011 EA pages 35-43). Trigger closures that are applicable only to June and July will be derived from the range of options for B-season trigger cap levels, adjusted to reflect the average proportion of non-Chinook salmon PSC in Ju ne and July relative to the B-season total.*

<u>Alternatives 2 and 3 are not mutually exclusive.</u>

2. Analyze parameters of the RHS program under Alternative 3 that could be adjusted by the council including:

- Modification of RHS to operate at a vessel level, instead of at the cooperative level;
- Faster reaction/closure time (shorter de lay between announcement and closure);
- Amount of closure area;
- Adjustments that would address timing and location of bycatch of Western Alaska chum stocks;
- Base rates;
- Possibilities by which the tier system may be amended to provide further incentives to reduce chum bycatch.

3. Make the following revisions to the Draft EA:

- Add caveats to all sections describing the impacts to specific stocks describing the limitations of the stock identification and AEQ information;
- Where run size impacts are presented for aggregated stocks (i.e. Western Alaska, coastal Western Alaska), clarify that these aggregations may mask impacts on smaller runs (i.e. Norton Sound);
- Revise the analysis of pollock fishery impacts and potential foregone revenue for trigger area closures to present actual numbers for each year;
- Include the discussion previously requested by the Council of for "a discussion of the meaningfulness of fines, including histograms of number and magnitude of fines over time as well as a comparison of penalties under the RHS program to agency pena lties and enforcement actions for violating area closures."
- Include a qualitative discussion of the impacts on salmon fi sheries, i.e. impacts of fishing restrictions on drying fish, lower CPUEs, gas costs, incr eased travel time, fish camps and culture;
- Include an expanded discussion of Norton Sound salmon fisheries by district including escapement and harvest information for an expanded time period and a full discussion of the tier II fishery.
- Expand discussion of cumulative effects of the Area M commercial fishery on other western Alaska stocks.

# Appendix 2: Non-Chinook ICA agreement for 2011

AMENDED AND RESTATED
BERING SEA POLLOCK FISHERY ROLLING HOT SPOT CLOSURE
NON-CHINOOK SALMON BYCATCH MANAGEMENT AGREEMENT

This AMENDED AND RESTATED BERING SEA POLLOCK FISHERY ROLLING HOT SPOT CLOSURE NON-CHINOOK SALMON BYCATCH MANAGEMENT AGREEMENT is entered into by and among POLLOCK CONSERVATION COOPERATIVE ("PCC"), the HIGH SEAS CATCHERS COOPERATIVE ("High Seas"), MOTHERSHIP FLEET COOPERATIVE ("MFC"), the "Inshore Coops", i.e., AKUTAN CATCHER VESSEL ASSOCIATION, NORTHERN VICTOR FLEET COOPERATIVE, PETER PAN FLEET COOPERATIVE, UNALASKA FLEET COOPERATIVE, UNISEA FLEET COOPERATIVE and WESTWARD FLEET COOPERATIVE, and the "CDQ Groups", i.e., ALEUTIAN PRIBILOF ISLAND COMMUNITY DEVELOPMENT ASSOCIATION, BRISTOL BAY ECONOMIC DEVELOPMENT CORPORATION, CENTRAL BERING SEA FISHERMEN'S ASSOCIATION, COASTAL VILLAGES REGION FUND, NORTON SOUND ECONOMIC DEVELOPMENT CORPORATION and YUKON DELTA FISHERIES DEVELOPMENT ASSOCIATION, and SEA STATE, INC. ("Sea State") and UNITED CATCHER BOATS ASSOCIATION ("UCB") as of ___________, 2010. PCC, High Seas, MFC, and the Inshore Coops are hereafter collectively referred to as the "Coops".

This Agreement is entered into with respect to the following facts:

RECITALS

Western Alaskans have expressed conservation and allocation concerns regarding the incidental catch of non-Chinook salmon in the Bering Sea pollock fishery. While such bycatch is regulated by the North Pacific Fishery Management Council (the "Council") and the National Marine Fisheries Service ("NMFS"), the Coops desire to address this issue by inter-cooperative agreement, out of respect for the concerns of Western Alaskans, to avoid unnecessary incidental catch of non-Chinook salmon and to obviate the need for regulatory salmon savings areas.

Now, therefore, for good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the parties agree as follows:

AGREEMENT

1. Purpose of Agreement. This Amended and Restated Non-Chinook Salmon Bycatch Management Agreement amends and supersedes that certain Salmon Bycatch Management Agreement entered into among the parties set forth above as of December 1, 2007. The purpose of this Agreement is to implement a private, contractual inter-cooperative program to reduce non-Chinook salmon bycatch in the Bering Sea directed pollock fishery, inclusive of both the Community Development Quota ("CDQ") and non-CDQ allocations (the "Fishery"). Each party to this Agreement agrees exercise all commercially reasonable efforts to achieve that purpose.

2. Monitoring and Management. The Coops shall retain Sea State to facilitate vessel bycatch avoidance behavior, information sharing, data gathering, analysis, and fleet monitoring necessary to implement the bycatch management program contemplated under this Agreement. The Coops shall retain United Catcher Boats (UCB) as the ICA representative. UCB will provide day-to-day management of inter- cooperative matters related to the performance of this Agreement.

3. Bycatch Management. The parties agree that because the bycatch of non-Chinook salmon is typically very low during the Fishery "A" season, the bycatch management of non-Chinook salmon by this Agreement will occur during the Fishery "B" season. Therefore, non-Chinook salmon bycatch in the Fishery "B" season shall be managed on an inter-cooperative basis as follows. Sea State shall use a bycatch rate (the "Base Rate") as a trigger for identifying areas to be closed to pollock fishing by certain Coops ("Chum Salmon Savings Areas"), and as a basis for determining each Coop's tier status, which in turn shall govern whether, and if so, when, each Coop's members may harvest pollock inside of a Savings Area. During "B" seasons, Sea State shall monitor non-Chinook salmon bycatch, and may announce Chum Salmon Savings Areas for non-Chinook salmon, and Sea State shall assign each Coop a bycatch tier status. In addition, Sea State shall have the authority to declare up to two Chum Salmon Savings Areas in the Bering Sea region east of 168 degrees West longitude (the "East Region") and up to two Chum Salmon Savings Areas in the Bering Sea/Aleutian Islands region west of 168 degrees West longitude (the "West Region"). The non-Chinook salmon Base Rate shall be adjusted during each "B" season in response to non-Chinook bycatch rates, to take into account fluctuations in non-Chinook salmon encounters.

a. Initial non-Chinook Base Rate. The initial "B" season non-Chinook salmon Base Rate shall be 0.19 non-Chinook salmon per metric ton of pollock.

b. Non-Chinook Base Rate In-Season Adjustment. Commencing on July 1 of each year that this Agreement is in effect, and on each Thursday through the duration of each "B" season thereafter, Sea State shall recalculate the "B" season non-Chinook salmon Base Rate. The recalculated Base Rate shall be the three week rolling average of the Fishery "B" season non-Chinook bycatch rate for the then-current year. The recalculated Base Rate shall be the governing non-Chinook salmon Base Rate for purposes of each "Thursday Announcement" of a "Friday Closure" (as defined below) following recalculation.

c. Implementation of Salmon Savings Measures. Sea State shall use Fishery "B" season bycatch data from fishing activity after June 10 of each year to provide Coops with preliminary information regarding the location and concentration of non-Chinook salmon, and to determine initial Chum Salmon Savings Area closures and Coop Tier assignments (as defined below). Sea State shall implement Chum Salmon Savings Area closures as appropriate upon non-Chinook bycatch rates exceeding the Base Rate, and thereafter through the balance of each Fishery "B" season.

d. Cooperative Tier Assignments. Rate calculations for purposes of tier assignments shall be based on each Coop's pollock catch in the Fishery for the prior two weeks (the denominator) and the aggregate amount of associated bycatch of non-Chinook salmon taken by its members (the numerator). For purposes of this Section, a Coop's non-Chinook salmon bycatch amount shall be based on observer data.

- Coops with non-Chinook salmon bycatch rates of less than 75% of the applicable Base Rate shall be assigned to "Tier 1.
- Coops with non-Chinook salmon bycatch rates equal to or greater than 75% of the applicable Base Rate but equal to or less than 125% of the Base Rate shall be assigned to "Tier 2".
- Coops with non-Chinook salmon bycatch rates greater than 125% of the applicable Base Rate shall be assigned to "Tier 3".

e. Bycatch Hot Zone Identification. When the Fishery "B" season is open to any of the inshore, catcher/processor or mothership components, on an ongoing basis Sea State shall calculate the non-Chinook bycatch rates for each Alaska Department of Fish and Game ("ADF&G") statistical area for which Sea State receives a non-Chinook salmon bycatch report, and when feasible, for each lateral half of each such statistical area. Bycatch rates shall be recalculated and updated every four (4) or seven (7) days during the season, immediately proceeding the closure announcements described in Section 4.g., below, as Sea State determines appropriate given the quality of data available for the area. The non-Chinook bycatch rates shall be calculated on the basis of reports Sea State determines to be adequately accurate, including reliable tow-by-tow estimates from the fishing grounds. In every case, rates calculated on the basis of the actual number of salmon observed per tow shall be given priority over rates based on sampling and extrapolation.

f. Chum Salmon Savings Areas. On each Thursday and on each Monday following June 10, for the duration of the Fishery "B" season, Sea State shall, subject to the criteria set forth below, provide notice to the Coops identifying one or more areas designated as "Chum Salmon Savings Areas", within which pollock fishing shall be restricted on the basis of each Coop's Tier status.

(i) Savings Area Designation Criteria. To qualify as a Chum Salmon Savings Area, (a) an amount of pollock that Sea State in its sole discretion determines to be substantial must have been taken in the Savings Area during the period on which its designation as a Savings Area is based, or the area must have been designated a Savings Area for the prior notification period and there must be evidence satisfactory to Sea State in its sole discretion that suggests that non-Chinook salmon bycatch rates in the area are not likely to have changed, and (b) the salmon bycatch rate in the area for the period on which its definition as a Chum Salmon Savings Area is based must exceed the Base Rate. For purposes of (a), above, Sea State shall consider a pollock harvest of two percent (2%) of the total amount of pollock harvested in the Fishery during the period on which a Chum Salmon Savings Area designation is based to be indicative of, but not dispositive of, whether a substantial amount of pollock has been harvested in an area.

(ii) Savings Area Boundaries and Limitations. Subject to the limits set forth in this Section, Savings Areas shall be defined by a series of latitude/longitude coordinates as Sea State determines appropriate to address salmon bycatch. Notwithstanding the foregoing, the following limits shall apply to designations of "B" season Savings Areas: (i) Chum Salmon Savings Area closures in the East Region may not exceed three thousand (3,000) square miles in total area during any single closure period; (ii) Chum Salmon Savings Areas in the West Region may not exceed one thousand (1,000) square miles in total area during any single closure period; (iii) there may be up to two (2) Savings Areas per Region per closure period.

g. Savings Area Closure Announcements. Fishery "B" season Savings Area closures announced on Thursdays (the "Thursday Announcement" of the "Friday Closures") shall be effective from 6:00 pm the following Friday through 6:00 pm the following Tuesday, and Savings Area closures announced on Mondays (the "Monday Announcement" of "Tuesday Closures") shall be effective from 6:00 pm the following Tuesday through 6:00 pm the following Friday. Upon a Chum Salmon Savings Area closure taking effect, fishing by Coop vessels participating in the Fishery shall be restricted pursuant to Subsection 4.i., below. Each Thursday Announcement shall include the following information: (i) season update on pollock harvest and non-Chinook salmon bycatch by pollock fishery sector and in total; (ii) each Coop's updated rolling two week non-Chinook salmon bycatch rate, associated Tier status, and Savings Area closure dates, times and days; (iii) the coordinates describing each Chum Salmon Savings Area, and a map of the Area; (iv) non-Chinook salmon bycatch rates for each Alaska Department of Fish and Game statistical area in which there was directed pollock fishing during the previous week; and (v) updated vessel performance lists, as defined in 4.j., below. Each Monday Announcement shall include the information described in clauses (i), (iii), (iv), and a reminder to each Coop of its chum bycatch Tier status.

h. Savings Area Implementation. During the Fishery "B" seasons, Savings Area closures shall apply to Coop member vessels as follows. Chum Salmon Savings Areas announced as Friday Closures and as updated by Tuesday Closures shall be closed to fishing by Tier 3 Coop vessels for seven days. Chum Salmon Savings Areas announced as Friday Closures shall be closed to fishing by Tier 2 Coop vessels through 6:00 pm the following Tuesday. Tier 1 Coop vessels may fish in Chum Salmon Savings Areas closed to the Tier 2 and Tier 3 Coop vessels.

i. Vessel Performance Lists. On a weekly basis, Sea State shall provide salmon bycatch performance lists to the Coops calculated on the basis of non-Chinook bycatch.

i. A list of the 20 vessels with the highest non-Chinook bycatch rates for the previous 2 weeks in excess of the Base Rate.

ii. A list of the 20 vessels with the highest non-Chinook bycatch rates for the previous week in excess of the Base Rate.

j. Throughout the Fishery "B" season, Sea State shall provide salmon "hot spot" advisory notices concerning areas of high non-Chinook salmon bycatch that do not fall within Savings Area closures.

4. Data Gathering and Reporting. The Coops acknowledge that the effectiveness of the bycatch management program being implemented under this Agreement depends on rapidly gathering, analyzing and disseminating accurate data concerning non-Chinook salmon bycatch in the Fishery. The Coops therefore agree as follows.

a. Each Coop shall require its members to take all actions necessary to release their vessels' NMFS observer reports and official landing records to Sea State as soon as commercially practicable after such documents are completed. Each Coop shall request its members' vessels to exercise commercially reasonable efforts to report to Sea State within 24 hours the location of, estimated pollock tonnage of and estimated number of non-Chinook salmon in each trawl tow. PCC may satisfy its obligation under this section 6.a. by arranging to have its members' vessels' observer reports concerning non-Chinook salmon bycatch transmitted to Sea State. MFC and High Seas may satisfy their obligations under this Section by arranging to have the pollock amounts and non-Chinook salmon counts for their members' vessels reported to Sea State by the observers on the processing vessels to which their members' vessels deliver. The Inshore Coops shall arrange for their vessels to report the crew's best estimate of the amount of pollock and the number of non-Chinook salmon in the tow when reporting its location. Each Inshore Coop shall develop its own methods and means to accurately calculate (when feasible) or estimate the amount of pollock and the number of salmon contained in each tow by its members' vessels, and to rapidly and accurately report that information to Sea State.

b. Sea State shall from time to time announce a non-Chinook bycatch rate that shall trigger an incident reporting requirement. Each Coop shall require its members' vessels to notify their coop manager (if applicable), the intercooperative manager and, if feasible, Sea State as soon as possible of any tow with a non-Chinook salmon bycatch rate that the crew estimates to be equal to or greater than the incident reporting rate threshold.

5. Savings Area Closure Enforcement. Upon a Coop receiving a Savings Area closure notice which has the effect of closing one or more Savings Areas to fishing by its members' vessels under this Agreement, the Coop shall timely notify its members. Each Coop agrees to take enforcement action with respect to any violation of a Savings Area closure notice, and to collect the assessments set forth below in cases where a vessel is found to have violated a closure.

a. Sea State shall monitor the fishing activities of all Coops' members' vessels, and shall promptly report all apparent Savings Area violations to all Coops. For purposes of this Agreement, "fishing" shall mean all activity of a vessel between the time of initial gear deployment and final gear retrieval. For purposes of this Section 5.a., "gear deployment" and "gear retrieval" shall have the meanings given them in 50 C.F.R. 679.2 or its successor, as the same may be amended from time to time. Initial gear deployment shall mean setting trawl gear with an empty codend, and final gear retrieval shall mean retrieving trawl gear to either pull a codend aboard the vessel or to deliver the codend to another vessel.

b. Upon receiving notice of an apparent violation from Sea State, the Board of Directors of the Coop to which the vessel belongs shall have one hundred and eighty (180) days to take action in connection with the apparent violation, and to provide a report of the action taken and a copy of the record supporting that action to all other Coops. When the Board of Directors to which the vessel belongs provides its report, or if the Coop Board of Directors fails to provide its report within such 180 day period, then Sea State and/or UCB shall provide each other Coop, the CDQ Groups, the Association of Village Council Presidents ("AVCP"), Bering Sea Fishermen's Association ("BSFA"), Tanana Chiefs' Conference ("TCC") and Yukon River Drainage Fishermen's Association ("YRDFA") with the Coop's report (if provided) and the record developed by Sea State in connection with the apparent violation, and each of such parties shall have standing to pursue Savings Area closure enforcement actions equivalent to such Coop's own rights with respect to its members.

c. The Coops hereby adopt a uniform assessment for a skipper's first annual violation of a Savings Area closure of Ten Thousand Dollars ($10,000.00), a uniform assessment for a skipper's second annual violation of a Savings Area closure of Fifteen Thousand Dollars ($15,000.00), and a uniform assessment of Twenty Thousand Dollars ($20,000.00) for a skipper's third and subsequent violations in a year. The Coops acknowledge that the damages resulting from violating a Savings Area closure are difficult to estimate, and that the foregoing assessment amounts are therefore intended to be a substitute in all cases for direct, indirect and consequential damages. Therefore, the Coops agree that the assessment amounts established under this Subsection 5.c are liquidated damages, the payment of which (together with reasonable costs of collection) shall satisfy a Coop's and its members' obligations related to a Savings Area closure violation. The Coops hereby waive any and all claims to direct, indirect or consequential damages related to such violation.

d. The Coops agree that any funds collected in connection with a violation of this agreement, in excess of those necessary to reimburse the prevailing party for its costs and attorneys fees, shall be used to support research concerning salmon taken incidentally in the Fishery. The Coops agree to consult with the CDQ Groups, AVCP, BSFA, TCC and YRDFA regarding the most appropriate use of such funds.

e. For purposes of this Section 5, State and Federal landing reports, observer data, VMS tracking data, vessel log books and plotter data and Coop catch data produced by the Sea State in conformance with NMFS catch accounting and bycatch estimation procedures shall be presumed accurate and sufficient for determining whether a vessel violated a Savings Area closure, absent a clear and compelling demonstration of manifest error. The Coops agree to take all actions and execute all documents necessary to give effect to this provision.

f. The Coops agree to require their members to obtain and maintain an operational VMS unit approved by Sea State on their vessels, provided that such units are available on a commercially reasonable basis. The Coops agree to cause their members to release their VMS tracking data to Sea State. Sea State agrees not to disclose any such information, other than as specifically authorized under this Agreement, as necessary to fulfill the intents and purposes of this Agreement, or with prior consent from the affected vessel owner. The Coops agree that the damages resulting from vessels operating in non-compliance with this subsection are difficult to estimate, and the Coops therefore hereby adopt a uniform assessment of One Thousand Dollars ($1,000.00) per day for each consecutive day over thirty (30) consecutive days that a Coop member's vessel is employed in the Fishery without an operational VMS unit approved by Sea State, provided such unit is available on a commercially reasonable basis.

6. Release and Waiver of All Claims Against SeaState and United Catcher Boats; Indemnification and Hold Harmless. The parties acknowledge that the effectiveness of this Agreement depends to a significant extent on Sea State's and UCB's discretion and judgment in designating and defining Savings Areas, determining each Coop's Tier status, monitoring compliance with Savings Area closures, and initiating and supporting enforcement actions under circumstances where a Coop member appears to have violated this Agreement. The parties further acknowledge that if Sea State or UCB were potentially liable for simple negligence in connection with such actions, it would be necessary for Sea State and UCB to charge a substantially larger fee for the services they provide in connection with this Agreement, to offset that potential liability. It is therefore in the parties' interest to reduce Sea State's and UCB's potential liability under this Agreement. Therefore, the Coops and the CDQ Groups hereby waive and release any and all claims against Sea State and UCB arising out of or relating to Sea State's or UCB's services in connection with this Agreement, other than those arising out of gross negligence or willful misconduct by Sea State or UCB. Further, the Coops jointly and severally agree to indemnify, defend and hold Sea State and UCB harmless against any third party claims asserted against Sea State or UCB arising out of or relating to Sea State's or UCB's services in connection with this Agreement, other than those arising out of gross negligence or willful misconduct by Sea State or UCB.

7. ICA Representative contact information:

United Catcher Boats
4005 20th Ave. West, Suite 116
Seattle, WA 98199
Phone: 206-282-2599
Fax: 206-282-2414
E-mail: penguin@ucba.org

8. Coop Membership Agreement Amendments. To give effect to this Agreement, the Coops agree to cause each of their Membership Agreements to include the following provisions.

a. Each member shall acknowledge that its vessel's operations are governed by this Agreement, and shall agree to comply with its terms.

b. Each member shall authorize its Coop's Board of Directors to take all actions and execute all documents necessary to give effect to this Agreement.

c. Each member shall authorize its Coop Board of Directors to enforce this Agreement, and if the Board fails to do so within one hundred eighty (180) days of receiving notice from Sea State that a cooperative member may have failed to comply with the Agreement, each member shall authorize each other Coop, each of the CDQ groups, AVCP, BSFA, TCC and YRDFA to individually or collectively enforce this Agreement.

d. Each member shall agree to maintain an operational VMS unit approved by Sea State on its vessel at all times that its vessel is participating in the Fishery, provided such VMS unit is available on a commercially reasonable basis, and shall agree to cause its vessel's VMS tracking data to be released to Sea State on a basis that permits Sea State to determine whether the member's vessel has operated in compliance with this Agreement. Each Coop member shall release to Sea State its State and Federal landing reports, observer data, VMS tracking data, and vessel log books and plotter data for purposes of determining its compliance with this Agreement, and agrees that in the event Sea State concludes that its vessel may have violated a hot spot closure, Sea State may release such data as Sea State in its sole discretion determines appropriate to facilitate enforcement of this Agreement.

e. Each member shall agree that the information contained in the records identified in d., above, shall be presumed accurate absent a clear and compelling demonstration of manifest error, and shall be presumed sufficient to determine its compliance with this Agreement.

f. Each member shall agree that the damages resulting from violating a Savings Area closure are difficult to estimate, and that the assessment amounts provided under this Agreement are therefore intended to be a substitute in all cases for direct, indirect and consequential damages. Each member shall agree that its Coop Board of Directors may modify Savings Area violation assessment amounts from time to time, as necessary to maintain an effective deterrent to Savings Area violations. Each member shall agree that each trawl tow during which the member's vessel fishes in a Savings Area in violation of this Agreement shall constitute a separate violation for purposes of assessment calculation. Each member shall agree that damages for violating this Agreement shall apply on a strict liability basis, regardless of a member's lack of knowledge of the violation or intent to violate the agreement. Each member shall agree that actual damages for violating this Agreement would be difficult to calculate, and shall therefore agree to pay the assessment amounts established under this Agreement, as amended from time to time, as liquidated damages. Each member agrees to modify its skipper contracts to make its skipper(s) fully responsible for the assessments levied in connection with a breach of the agreement. Further, each member agrees that in the event a skipper fails to assume such assignment of liability, or in the event such assumption of liability is deemed invalid, the member shall be liable for the full amount of such assessment, and all related costs and attorneys' fees.

g. Each member shall agree that in connection with any action taken to enforce this Agreement, the prevailing party shall be entitled to the costs and fees it incurs in connection with such action, including attorneys' fees.

h. Each member shall agree that in addition to legal remedies, the Board of Directors of each cooperative, each of the CDQ groups, BSFA and YRDFA shall be entitled to injunctive relief in connection with the second and subsequent violations of this Agreement.

i. Each member shall agree to waive and release any and all claims against Sea State and UCB arising out of or relating to Sea State's or UCB's services in connection with this Agreement, other than those arising out of gross negligence or willful misconduct by Sea State or UCB.

j. Each member shall acknowledge that, notwithstanding the definition of "fishing" used in this Agreement (which is the consistent with the definition used by NMFS for logbook entries and observer reporting purposes), it is the Coops' policy that no member's vessel will be present in a Savings Area that is closed to fishing by such Coops' members' vessels unless and until such vessel's trawl doors have been fully retrieved or stored. Further, each member shall agree that, absent extenuating circumstances, such member exercise its best efforts to comply with this policy.

9. <u>Term</u>. This Agreement shall take effect as of November 30, 2010. The initial term of this Agreement shall extend through November 1, 2013. The term of this Agreement shall be automatically extended for an additional year as of September 15 each year it remains in effect, i.e., as of September 15, 2011, the new expiration date of this Agreement shall be November 1, 2014, and so on. A party to this Agreement may terminate its status as a party by providing written notice to all other parties to this Agreement to that effect, provided that the effective date of such party's termination shall be the expiration date of this Agreement in effect at the time the termination notice is delivered. For example, if a Coop provides termination notice on August 15, 2011, its termination shall not be effective until November 1, 2013. If a Coop provides termination notice on October 1, 2011, its termination shall not be effective until November 1, 2014. Notwithstanding any party's termination of its participation in this Agreement or the expiration of its term, the enforcement provisions of Section 7, above, shall survive with full force and effect.

10. <u>Breach and Termination of Exemption</u>. Each Coop acknowledges that, as of the opening of the 2011 "B" season Fishery, NMFS is expected to issue an annual exemption to the regulatory salmon savings closures (the "Exemptions") to each Coop that is a party to and complies with this Agreement. Further, each Coop acknowledges that a Coop's material breach of this Agreement that is not timely cured shall result in forfeiture of such Coop's right to retain its Exemption. The following shall constitute material breaches of this Agreement:

(i) a Coop failing to take enforcement action within one hundred eighty (180) days of being notified by Sea State of an apparent violation of a Savings Area closure by one or more of its members, as provided in Section 5.b, above;

(ii) a Coop failing to collect and/or disburse an assessment in compliance with this Agreement within one hundred eighty (180) days of a determination that its member(s) violated a Savings Area closure, as provided in Sections 5.c and 5.d, above;

(iii) a Coop failing to collect and/or disburse an assessment in compliance with this Agreement within one hundred eighty (180) days of a determination that a member of the Coop failed to maintain an available, operational VMS unit approved by Sea State on its vessel as provided in Section 5.f of this Agreement and/or failed to cause such vessel(s) to release their VMS tracking data to Sea State as provided in Section 5.f of this Agreement.

In the event of a material breach of this Agreement by a Coop that is not cured within thirty (30) days of such Coop's authorized representative receiving written notice of such breach from one or more other Coop(s), a CDQ Group, AVCP, BSFA, TCC or YRDFA, any one of such parties may demand that the breaching Coop tender its Exemption to NMFS, and such Coop shall do so within ten (10) days. If a Coop fails to timely tender its Exemption, any of such parties may seek injunctive relief requiring such Coop to tender its Exemption.

11. Annual Compliance Audit. The Coops shall annually retain an entity that is not a party to this Agreement (the "Compliance Auditor") to review and prepare a report concerning Sea State's performance of its monitoring and notification obligations under this Agreement and actions taken by the Coops in response to all notifications from Sea State to the Coops regarding potential violations of this Agreement. All parties to this Agreement will be provided an opportunity to participate in selecting the non-party Compliance Auditor. Sea State and the Coops shall cooperate fully with the Compliance Auditor, and shall provide any information the Compliance Auditor requires to complete its review and report. If the Compliance Auditor identifies a failure to comply with this Agreement as part of its review, the Compliance Auditor shall notify all parties to this Agreement of the failure to comply, shall distribute to all parties to this Agreement the information used to identify the failure to comply, and shall provide notice of any such failures in the Compliance Auditor's final report.

12. Miscellaneous.

a. No amendment to this Agreement shall be effective against a party hereto unless in writing and duly executed by such party. The parties agree to amend this Agreement as reasonably necessary to conform with changes in law or circumstances.

b. This Agreement shall be governed by and construed in accordance with applicable federal law and the laws of the State of Washington.

c. This Agreement may be executed in counterparts which, when taken together, shall have the same effect as a fully executed original. Delivery of a signed copy of this Agreement by telefacsimile shall have the same effect as delivering a signed original.

d. The parties agree to execute any documents necessary or convenient to give effect to the intents and purposes of this Agreement.

e. All notices required to be given under this Agreement shall be deemed given five (5) days following deposit in certified first class U.S. mail, postage prepaid, with the correct address, or upon the first business day following confirmed telefacsimile or e-mail transmission to the recipient. Each party to this Agreement agrees to provide the name, postal address, telefacsimile number and e-mail address of its duly authorized representative(s) for purposes of receiving notices under this Agreement within three (3) days of executing this Agreement.

f. In the event that any provision of this Agreement is held to be invalid or unenforceable, such provision shall be deemed to be severed from this Agreement, and such holding shall not affect in any respect whatsoever the validity of the remainder of this Agreement.

g. Each Coop agrees to use its best efforts to resolve any disputes arising under this Agreement through direct negotiations. Breaches of this Agreement for which a party seeks a remedy other than injunctive relief that are not resolved through direct negotiation shall be submitted to arbitration in Seattle, Washington upon the request of any party to this Agreement. The party's written request will include the name of the arbitrator selected by the party requesting arbitration. The other party will have ten (10) days to provide written notice of the name of the arbitrator it has selected, if any. If the other party timely selects a second arbitrator, the two arbitrators will select a third arbitrator within ten (10) days. If the other party does not timely select the second arbitrator, there shall be only the one arbitrator. The single arbitrator or the three (3) arbitrators so selected will schedule the arbitration hearing as soon as possible thereafter. Every arbitrator, however chosen, must have no material ties to any Coop or Coop member. The decision of the arbitrator (or in the case of a three (3) arbitrator panel, the decision of the majority) will be final and binding. The arbitration will be conducted under the rules of (but not by) the American Arbitration Association. The parties will be entitled to limited discovery as determined by the arbitrator(s) in its or their sole discretion. The arbitrator(s) will also determine the "prevailing party" and that party will be entitled to its reasonable costs, fees and expenses, including attorneys' and arbitrator fees, incurred in the action by said party. In no event will arbitration be available pursuant to this paragraph after the date when commencement of such legal or equitable proceedings based on such claim, dispute, or other matter in question would be barred by the applicable statute of limitations.

Entered into as of the date first set forth above.

Pollock Conservation Cooperative

By ________________________________
Its ______________________________

High Seas Catchers Cooperative

By ________________________________
Its ______________________________

Mothership Fleet Cooperative

By ________________________________
Its ______________________________

Akutan Catcher Vessel Association

By ________________________________
Its ______________________________

Northern Victor Fleet Cooperative

By ________________________________
Its ______________________________

Peter Pan Fleet Cooperative

By ________________________________
Its ______________________________

Unalaska Fleet Cooperative

By ________________________________
Its ______________________________

Unisea Fleet Cooperative

By ________________________________
Its ______________________________

Westward Fleet Cooperative

By ________________________________
Its ______________________________

Aleutian Pribilof Island Community Development

By ________________________________
Its ______________________________

Bristol Bay Economic Development Corporation

By ________________________________
Its ______________________________

Central Bering Sea Fishermen's Association

By ________________________________
Its ______________________________

Coastal Villages Region Fund

By ________________________________
Its ______________________________

Norton Sound Economic Development Corporation

By ________________________________
Its ______________________________

Yukon Delta Fisheries Development Association

By ________________________________
Its ______________________________

Sea State Inc.

By ________________________________
Its ______________________________

United Catcher Boats Association

By ________________________________
Its ______________________________

## Appendix 3: RHS B-Season Closure Periods 2003-2009

The following table, Table 10-2, provides detailed information on chum and Chinook bycatch during periods that RHS closures were implemented for 2003-2009. The table provides detailed information on the pollock fishing and bycatch for 1) the 5-day period before each closure – *inside the closure*, 2) the 5-day period before each closure – *outside the closure*, and 3) the 5-day period *after* each closure – in all locations.

We present this information for informational purposes. In the analyses above, the changes ranging from 1-3 days before and after each closure are examined most thoroughly.

For each of the three 5-days groups, the following information is listed:

- Date the closure began
- Type of closure – chum or Chinook
- Number of hauls occurring
- Chum, Chinook, and pollock – the numbers are extrapolated to the Region's total as done elsewhere in this EA.
- Proportions of (extrapolated) chum, Chinook, and pollock occurring in the closure area prior to the closure

Several caveats should be noted when examining the table:

- As noted in the data description section, when a closure is extended, it is reported as one closure period and the length of the closure is reported.
- Double counting occurs for several reasons:
    - With simultaneous closures, because fishing that occurs outside of all of the closures in place at any one time listed for each closure. The fishing that occurs in the other closure(s) in place at the same time also is noted in for each closure.
    - Hauls may occur within 5 days of simultaneous closures.
- As noted above, the 2003-2005 closures are designated here as 'Chum*' but some of these closures may be re-designated as Chinook in future analyses.

Table 11-1. Comparison of pollock and bycatch activity in and out of RHS Closures Before implementation and After Closures in All Locations

| | | | Information for 5 days before RHS closure -- Inside the Closure | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start date | Days closed | Closure type | Hauls | Chum | Chinook | Pollock | Proportion Chum | Proportion Chinook | Proportion Pollock | Chum rate | Chinook rate | Duration (hours) |
| 07/11/03 | 7 | Chum* | 5 | 3 | 0 | 118 | 0.00 | 0.00 | 0.00 | 0.026 | 0.000 | 5 |
| 07/11/03 | 7 | Chum* | 25 | 262 | 2 | 4459 | 0.20 | 0.05 | 0.12 | 0.059 | 0.000 | 46 |
| 07/18/03 | 7 | Chum* | | | | | | | | | | |
| 07/18/03 | 7 | Chum* | 32 | 313 | 4 | 5412 | 0.18 | 0.36 | 0.18 | 0.058 | 0.001 | 185 |
| 07/25/03 | 7 | Chum* | 31 | 146 | 0 | 1788 | 0.09 | 0.00 | 0.07 | 0.081 | 0.000 | 76 |
| 08/08/03 | 7 | Chum* | 83 | 6018 | 9 | 12414 | 0.59 | 0.10 | 0.35 | 0.485 | 0.001 | 519 |
| 08/15/03 | 7 | Chum* | 94 | 9937 | 8 | 12175 | 0.74 | 0.11 | 0.39 | 0.816 | 0.001 | 648 |
| 08/15/03 | 7 | Chum* | 13 | 394 | 17 | 936 | 0.03 | 0.23 | 0.03 | 0.421 | 0.018 | 24 |
| 08/22/03 | 7 | Chum* | 41 | 1953 | 4 | 6261 | 0.22 | 0.03 | 0.17 | 0.312 | 0.001 | 178 |
| 08/22/03 | 7 | Chum* | 3 | 555 | 3 | 250 | 0.06 | 0.02 | 0.01 | 2.223 | 0.013 | 8 |
| 08/29/03 | 7 | Chum* | 36 | 3750 | 28 | 3565 | 0.58 | 0.12 | 0.10 | 1.052 | 0.008 | 124 |
| 09/09/03 | 3 | Chum* | 5 | 97 | 29 | 459 | 0.02 | 0.09 | 0.01 | 0.211 | 0.063 | 22 |
| 09/12/03 | 7 | Chum* | 15 | 704 | 57 | 2092 | 0.09 | 0.11 | 0.06 | 0.336 | 0.027 | 72 |
| 09/12/03 | 7 | Chum* | 11 | 147 | 14 | 1027 | 0.02 | 0.03 | 0.03 | 0.143 | 0.014 | 55 |
| 09/26/03 | 7 | Chum* | 52 | 4322 | 124 | 4554 | 0.21 | 0.22 | 0.18 | 0.949 | 0.027 | 371 |
| 10/03/03 | 7 | Chum* | | | | | | | | | | |
| 10/10/03 | 7 | Chum* | 31 | 287 | 137 | 1144 | 0.05 | 0.07 | 0.10 | 0.251 | 0.120 | 181 |
| 10/17/03 | 7 | Chum* | 14 | 1583 | 233 | 1301 | 0.46 | 0.28 | 0.14 | 1.217 | 0.179 | 109 |
| 07/02/04 | 7 | Chum* | 4 | 247 | 0 | 445 | 0.08 | 0.00 | 0.01 | 0.555 | 0.000 | 8 |
| 07/02/04 | 7 | Chum* | 14 | 124 | 2 | 2303 | 0.04 | 0.03 | 0.08 | 0.054 | 0.001 | 67 |
| 07/09/04 | 7 | Chum* | 22 | 325 | 11 | 1909 | 0.11 | 0.06 | 0.04 | 0.170 | 0.006 | 78 |
| 07/16/04 | 7 | Chum* | 8 | 334 | 6 | 435 | 0.13 | 0.06 | 0.01 | 0.769 | 0.015 | 28 |
| 07/23/04 | 7 | Chum* | 9 | 958 | 3 | 1039 | 0.18 | 0.03 | 0.03 | 0.922 | 0.002 | 18 |
| 07/23/04 | 7 | Chum* | 15 | 978 | 4 | 1324 | 0.19 | 0.05 | 0.04 | 0.739 | 0.003 | 62 |
| 07/30/04 | 7 | Chum* | 16 | 1432 | 16 | 1050 | 0.33 | 0.23 | 0.03 | 1.363 | 0.015 | 36 |
| 08/06/04 | 7 | Chum* | | | | | | | | | | |
| 08/06/04 | 4 | Chum* | 27 | 4468 | 16 | 4345 | 0.12 | 0.07 | 0.19 | 1.028 | 0.004 | 128 |
| 08/10/04 | 3 | Chum* | 32 | 16069 | 25 | 3261 | 0.53 | 0.12 | 0.11 | 4.928 | 0.008 | 128 |
| 08/13/04 | 7 | Chum* | 14 | 6311 | 23 | 2624 | 0.42 | 0.10 | 0.07 | 2.405 | 0.009 | 115 |
| 08/17/04 | 14 | Chum* | 52 | 6591 | 106 | 5592 | 0.60 | 0.43 | 0.17 | 1.179 | 0.019 | 443 |
| 08/17/04 | 14 | Chum* | | | | | | | | | | |
| 08/24/04 | 7 | Chum* | 50 | 23968 | 210 | 4160 | 0.67 | 0.20 | 0.15 | 5.761 | 0.051 | 350 |
| 08/27/04 | 4 | Chum* | | | | | | | | | | |
| 08/31/04 | 7 | Chum* | 6 | 183 | 13 | 628 | 0.02 | 0.02 | 0.02 | 0.291 | 0.021 | 57 |
| 08/31/04 | 3 | Chum* | | | | | | | | | | |
| 09/03/04 | 4 | Chum* | 3 | 800 | 17 | 190 | 0.06 | 0.01 | 0.00 | 4.213 | 0.087 | 26 |
| 09/10/04 | 7 | Chum* | 36 | 23655 | 103 | 3948 | 0.36 | 0.10 | 0.11 | 5.992 | 0.026 | 315 |

| | Information for 5 days before RHS closure -- Outside the Closure | | | | | | | Information for 5 days after RHS closure -- Outside the Closure | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start date | Hauls | Chum | Chinook | Pollock | Duration (hours) | Chum rate | Chinook rate | Hauls | Chum | Chinook | Pollock | Duration (hours) | Chum rate | Chinook rate |
| 07/11/03 | 312 | 1309 | 42 | 35809 | 819 | 0.037 | 0.001 | 395 | 2193 | 30 | 43220 | 1279 | 0.051 | 0.001 |
| 07/11/03 | 292 | 1050 | 40 | 31467 | 778 | 0.033 | 0.001 | 395 | 2193 | 30 | 43220 | 1279 | 0.051 | 0.001 |
| 07/18/03 | 231 | 1735 | 10 | 29496 | 807 | 0.059 | 0.000 | 375 | 2668 | 33 | 34410 | 1421 | 0.078 | 0.001 |
| 07/18/03 | 199 | 1422 | 7 | 24085 | 622 | 0.059 | 0.000 | 375 | 2668 | 33 | 34410 | 1421 | 0.078 | 0.001 |
| 07/25/03 | 243 | 1566 | 10 | 25123 | 1159 | 0.062 | 0.000 | 522 | 2494 | 95 | 54600 | 1369 | 0.046 | 0.002 |
| 08/08/03 | 221 | 4187 | 83 | 22609 | 728 | 0.185 | 0.004 | 433 | 9702 | 95 | 44038 | 1853 | 0.220 | 0.002 |
| 08/15/03 | 186 | 3534 | 66 | 19068 | 738 | 0.185 | 0.003 | 396 | 6920 | 176 | 41064 | 1416 | 0.169 | 0.004 |
| 08/15/03 | 265 | 13034 | 57 | 29990 | 1336 | 0.435 | 0.002 | 396 | 6920 | 176 | 41064 | 1416 | 0.169 | 0.004 |
| 08/22/03 | 329 | 6986 | 149 | 31128 | 1356 | 0.224 | 0.005 | 516 | 8521 | 280 | 46155 | 1832 | 0.185 | 0.006 |
| 08/22/03 | 367 | 8384 | 150 | 37139 | 1526 | 0.226 | 0.004 | 516 | 8521 | 280 | 46155 | 1832 | 0.185 | 0.006 |
| 08/29/03 | 327 | 2685 | 197 | 30395 | 1180 | 0.088 | 0.006 | 441 | 6951 | 836 | 44559 | 1274 | 0.156 | 0.019 |
| 09/09/03 | 304 | 4871 | 282 | 32159 | 1278 | 0.151 | 0.009 | 367 | 9916 | 719 | 36421 | 1835 | 0.272 | 0.020 |
| 09/12/03 | 291 | 6808 | 446 | 31486 | 1413 | 0.216 | 0.014 | 364 | 10175 | 557 | 34311 | 1955 | 0.297 | 0.016 |
| 09/12/03 | 295 | 7365 | 489 | 32551 | 1430 | 0.226 | 0.015 | 364 | 10175 | 557 | 34311 | 1955 | 0.297 | 0.016 |
| 09/26/03 | 227 | 16476 | 433 | 20871 | 1208 | 0.789 | 0.021 | 262 | 3914 | 876 | 20458 | 1793 | 0.191 | 0.043 |
| 10/03/03 | 278 | 8704 | 1197 | 17105 | 1897 | 0.509 | 0.070 | 220 | 10073 | 2431 | 14769 | 1329 | 0.682 | 0.165 |
| 10/10/03 | 159 | 5788 | 1893 | 10164 | 950 | 0.569 | 0.186 | 132 | 7113 | 1661 | 11060 | 875 | 0.643 | 0.150 |
| 10/17/03 | 76 | 1891 | 603 | 8054 | 415 | 0.235 | 0.075 | 42 | 273 | 184 | 3280 | 225 | 0.083 | 0.056 |
| 07/02/04 | 262 | 3011 | 61 | 29996 | 969 | 0.100 | 0.002 | 424 | 2355 | 119 | 39596 | 1677 | 0.059 | 0.003 |
| 07/02/04 | 252 | 3134 | 59 | 28139 | 911 | 0.111 | 0.002 | 424 | 2355 | 119 | 39596 | 1677 | 0.059 | 0.003 |
| 07/09/04 | 432 | 2549 | 168 | 42864 | 1637 | 0.059 | 0.004 | 454 | 3220 | 153 | 43224 | 1482 | 0.075 | 0.004 |
| 07/16/04 | 411 | 2244 | 96 | 41141 | 1396 | 0.055 | 0.002 | 443 | 6133 | 87 | 42550 | 1708 | 0.144 | 0.002 |
| 07/23/04 | 327 | 4227 | 77 | 36322 | 1329 | 0.116 | 0.002 | 424 | 4154 | 88 | 46738 | 1567 | 0.089 | 0.002 |
| 07/23/04 | 321 | 4207 | 75 | 36038 | 1285 | 0.117 | 0.002 | 424 | 4154 | 88 | 46738 | 1567 | 0.089 | 0.002 |
| 07/30/04 | 268 | 2892 | 53 | 31591 | 1201 | 0.092 | 0.002 | 378 | 16554 | 127 | 36849 | 1442 | 0.449 | 0.003 |
| 08/06/04 | 170 | 38307 | 240 | 23112 | 929 | 1.657 | 0.010 | 495 | 18075 | 207 | 48471 | 1923 | 0.373 | 0.004 |
| 08/06/04 | 143 | 33839 | 224 | 18767 | 801 | 1.803 | 0.012 | 495 | 18075 | 207 | 48471 | 1923 | 0.373 | 0.004 |
| 08/10/04 | 229 | 14237 | 188 | 26961 | 1067 | 0.528 | 0.007 | 501 | 13935 | 278 | 48525 | 2192 | 0.287 | 0.006 |
| 08/13/04 | 335 | 8574 | 212 | 35374 | 1525 | 0.242 | 0.006 | 434 | 9343 | 291 | 38801 | 1969 | 0.241 | 0.007 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08/17/04 | 302 | 4311 | 143 | 27939 | 1341 | 0.154 | 0.005 | 374 | 27992 | 629 | 32423 | 1911 | 0.863 | 0.019 |
| 08/17/04 | 351 | 10796 | 243 | 33289 | 1751 | 0.324 | 0.007 | 374 | 27992 | 629 | 32423 | 1911 | 0.863 | 0.019 |
| 08/24/04 | 286 | 11891 | 828 | 24093 | 1437 | 0.494 | 0.034 | 485 | 13996 | 758 | 40813 | 2535 | 0.343 | 0.019 |
| 08/27/04 | 313 | 18964 | 991 | 27234 | 1895 | 0.696 | 0.036 | 453 | 10419 | 951 | 46210 | 1959 | 0.225 | 0.021 |
| 08/31/04 | 331 | 9895 | 673 | 31479 | 1780 | 0.314 | 0.021 | 466 | 14354 | 1463 | 50451 | 1678 | 0.285 | 0.029 |
| 08/31/04 | 337 | 10078 | 686 | 32108 | 1838 | 0.314 | 0.021 | 466 | 14354 | 1463 | 50451 | 1678 | 0.285 | 0.029 |
| 09/03/04 | 366 | 12128 | 1150 | 42824 | 1357 | 0.283 | 0.027 | 440 | 54622 | 1300 | 40024 | 2152 | 1.365 | 0.032 |
| 09/10/04 | 344 | 42675 | 949 | 30857 | 1843 | 1.383 | 0.031 | 487 | 54211 | 2732 | 35393 | 2610 | 1.532 | 0.077 |

| | | | **Information for 5 days before RHS closure -- Inside the Closure** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start date | Days closed | Closure type | Hauls | Chum | Chinook | Pollock | Proportion Chum | Proportion Chinook | Proportion Pollock | Chum rate | Chinook rate | Duration (hours) |
| 06/24/05 | 7 | Chum | 63 | 6470 | 167 | 11605 | 0.47 | 0.41 | 0.29 | 0.557 | 0.014 | 306 |
| 06/24/05 | 4 | Chum | 22 | 251 | 1 | 1221 | 0.02 | 0.00 | 0.03 | 0.205 | 0.001 | 84 |
| 06/28/05 | 3 | Chum | 18 | 713 | 6 | 906 | 0.09 | 0.02 | 0.03 | 0.787 | 0.007 | 96 |
| 06/28/05 | 3 | Chum | 9 | 145 | 7 | 1118 | 0.02 | 0.02 | 0.03 | 0.129 | 0.006 | 33 |
| 07/01/05 | 4 | Chum | 14 | 180 | 9 | 423 | 0.04 | 0.03 | 0.01 | 0.425 | 0.022 | 101 |
| 07/01/05 | 4 | Chum | 25 | 472 | 4 | 904 | 0.12 | 0.01 | 0.03 | 0.522 | 0.005 | 124 |
| 07/05/05 | 3 | Chum | 48 | 3756 | 59 | 6292 | 0.26 | 0.31 | 0.22 | 0.597 | 0.009 | 369 |
| 07/05/05 | 3 | Chum | 116 | 9120 | 128 | 13849 | 0.63 | 0.67 | 0.49 | 0.659 | 0.009 | 780 |
| 07/08/05 | 4 | Chum | 7 | 11872 | 0 | 1812 | 0.35 | 0.00 | 0.06 | 6.552 | 0.000 | 64 |
| 07/08/05 | 4 | Chum | 8 | 1081 | 8 | 779 | 0.04 | 0.04 | 0.03 | 1.388 | 0.010 | 60 |
| 07/12/05 | 3 | Chum | 34 | 15608 | 28 | 3005 | 0.73 | 0.40 | 0.12 | 5.193 | 0.009 | 163 |
| 07/15/05 | 4 | Chum | 4 | 2466 | 4 | 459 | 0.23 | 0.03 | 0.02 | 5.371 | 0.008 | 22 |
| 07/19/05 | 3 | Chum | 7 | 2138 | 6 | 397 | 0.04 | 0.04 | 0.01 | 5.383 | 0.016 | 65 |
| 07/22/05 | 4 | Chum | 20 | 17932 | 12 | 2916 | 0.22 | 0.07 | 0.08 | 6.150 | 0.004 | 96 |
| 07/29/05 | 7 | Chum | 15 | 3841 | 7 | 339 | 0.10 | 0.04 | 0.02 | 11.338 | 0.019 | 107 |
| 08/05/05 | 4 | Chum | 25 | 30676 | 47 | 4275 | 0.28 | 0.24 | 0.15 | 7.176 | 0.011 | 199 |
| 08/09/05 | 7 | Chum | | | | | | | | | | |
| 08/09/05 | 3 | Chum | | | | | | | | | | |
| 08/12/05 | 4 | Chinook | 4 | 2141 | 17 | 330 | 0.11 | 0.03 | 0.01 | 6.481 | 0.052 | 61 |
| 08/16/05 | 3 | Chum | 26 | 8523 | 35 | 2598 | 0.26 | 0.06 | 0.11 | 3.281 | 0.013 | 159 |
| 08/19/05 | 4 | Chum | 43 | 20944 | 128 | 4166 | 0.30 | 0.22 | 0.14 | 5.027 | 0.031 | 321 |
| 08/19/05 | 4 | Chum | 50 | 3083 | 46 | 5088 | 0.05 | 0.08 | 0.18 | 0.606 | 0.009 | 148 |
| 08/23/05 | 3 | Chum | 4 | 1269 | 4 | 227 | 0.08 | 0.00 | 0.01 | 5.591 | 0.016 | 25 |
| 08/26/05 | 3 | Chum | 12 | 2142 | 38 | 2361 | 0.15 | 0.03 | 0.11 | 0.907 | 0.016 | 39 |
| 09/06/05 | 3 | Chum | 28 | 9623 | 10 | 2948 | 0.48 | 0.02 | 0.13 | 3.265 | 0.003 | 104 |
| 09/09/05 | 4 | Chum | 11 | 1208 | 29 | 760 | 0.19 | 0.04 | 0.03 | 1.589 | 0.038 | 71 |
| 09/13/05 | 3 | Chum | | | | | | | | | | |
| 09/16/05 | 7 | Chum | 46 | 4460 | 97 | 6552 | 0.47 | 0.09 | 0.31 | 0.681 | 0.015 | 260 |
| 09/27/05 | 3 | Chum | 3 | 373 | 106 | 174 | 0.03 | 0.06 | 0.01 | 2.145 | 0.611 | 25 |
| 09/27/05 | 3 | Chum | 25 | 3434 | 733 | 2290 | 0.29 | 0.45 | 0.17 | 1.500 | 0.320 | 267 |
| 09/30/05 | 4 | Chum | 8 | 3153 | 88 | 454 | 0.32 | 0.05 | 0.04 | 6.938 | 0.194 | 70 |
| 10/07/05 | 4 | Chum | 30 | 5808 | 2313 | 3110 | 0.43 | 0.53 | 0.28 | 1.867 | 0.744 | 354 |
| 10/11/05 | 10 | Chum | 4 | 936 | 284 | 480 | 0.06 | 0.08 | 0.06 | 1.949 | 0.592 | 58 |
| 10/14/05 | 7 | Chum | 35 | 4190 | 1528 | 1249 | 0.27 | 0.30 | 0.13 | 3.354 | 1.223 | 200 |
| 10/21/05 | 4 | Chum | | | | | | | | | | |

| Start date | Information for 5 days before RHS closure -- Outside the Closure | | | | | | | Information for 5 days after RHS closure -- Outside the Closure | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hauls | Chum | Chinook | Pollock | Duration (hours) | Chum rate | Chinook rate | Hauls | Chum | Chinook | Pollock | Duration (hours) | Chum rate | Chinook rate |
| 06/24/05 | 325 | 7153 | 240 | 27967 | 1108 | 0.256 | 0.009 | 441 | 5760 | 322 | 34547 | 1928 | 0.167 | 0.009 |
| 06/24/05 | 362 | 12225 | 392 | 37046 | 1299 | 0.330 | 0.011 | 441 | 5760 | 322 | 34547 | 1928 | 0.167 | 0.009 |
| 06/28/05 | 398 | 7416 | 282 | 32963 | 1713 | 0.225 | 0.009 | 360 | 7563 | 269 | 38418 | 1841 | 0.197 | 0.007 |
| 06/28/05 | 407 | 7984 | 282 | 32751 | 1776 | 0.244 | 0.009 | 360 | 7563 | 269 | 38418 | 1841 | 0.197 | 0.007 |
| 07/01/05 | 363 | 3888 | 286 | 33825 | 1699 | 0.115 | 0.008 | 352 | 19242 | 220 | 33046 | 1422 | 0.582 | 0.007 |
| 07/01/05 | 352 | 3596 | 291 | 33344 | 1677 | 0.108 | 0.009 | 352 | 19242 | 220 | 33046 | 1422 | 0.582 | 0.007 |
| 07/05/05 | 226 | 10640 | 133 | 21983 | 1073 | 0.484 | 0.006 | 523 | 30458 | 158 | 42152 | 1551 | 0.723 | 0.004 |
| 07/05/05 | 158 | 5276 | 64 | 14427 | 662 | 0.366 | 0.004 | 523 | 30458 | 158 | 42152 | 1551 | 0.723 | 0.004 |
| 07/08/05 | 311 | 22502 | 192 | 28519 | 962 | 0.789 | 0.007 | 504 | 12701 | 88 | 40228 | 1609 | 0.316 | 0.002 |
| 07/08/05 | 308 | 27398 | 184 | 28766 | 940 | 0.952 | 0.006 | 504 | 12701 | 88 | 40228 | 1609 | 0.316 | 0.002 |
| 07/12/05 | 307 | 5668 | 41 | 22325 | 965 | 0.254 | 0.002 | 469 | 32926 | 168 | 46781 | 1573 | 0.704 | 0.004 |
| 07/15/05 | 276 | 8333 | 110 | 27529 | 1005 | 0.303 | 0.004 | 494 | 81010 | 177 | 48009 | 1731 | 1.687 | 0.004 |
| 07/19/05 | 254 | 48520 | 155 | 28954 | 959 | 1.676 | 0.005 | 444 | 66011 | 196 | 50532 | 1646 | 1.306 | 0.004 |
| 07/22/05 | 303 | 63750 | 172 | 34922 | 1065 | 1.826 | 0.005 | 376 | 38089 | 173 | 41640 | 1641 | 0.915 | 0.004 |
| 07/29/05 | 177 | 35200 | 170 | 20813 | 901 | 1.691 | 0.008 | 466 | 82224 | 224 | 41832 | 1792 | 1.966 | 0.005 |
| 08/05/05 | 249 | 80370 | 150 | 23579 | 993 | 3.408 | 0.006 | 438 | 44220 | 523 | 42408 | 1884 | 1.043 | 0.012 |
| 08/09/05 | 326 | 49822 | 417 | 29869 | 1607 | 1.668 | 0.014 | 492 | 13309 | 655 | 43900 | 1667 | 0.303 | 0.015 |
| 08/09/05 | 326 | 49822 | 417 | 29869 | 1607 | 1.668 | 0.014 | 492 | 13309 | 655 | 43900 | 1667 | 0.303 | 0.015 |
| 08/12/05 | 258 | 17019 | 491 | 26379 | 1113 | 0.645 | 0.019 | 485 | 55344 | 625 | 42829 | 1737 | 1.292 | 0.015 |
| 08/16/05 | 257 | 24811 | 511 | 21629 | 1160 | 1.147 | 0.024 | 312 | 51813 | 827 | 40910 | 1363 | 1.267 | 0.020 |
| 08/19/05 | 225 | 47823 | 444 | 24610 | 999 | 1.943 | 0.018 | 308 | 22518 | 987 | 36664 | 1312 | 0.614 | 0.027 |
| 08/19/05 | 216 | 65037 | 520 | 23530 | 1157 | 2.764 | 0.022 | 308 | 22518 | 987 | 36664 | 1312 | 0.614 | 0.027 |
| 08/23/05 | 195 | 13771 | 770 | 26105 | 989 | 0.528 | 0.029 | 431 | 19349 | 1519 | 39358 | 1680 | 0.492 | 0.039 |
| 08/26/05 | 203 | 11873 | 1132 | 19987 | 1018 | 0.594 | 0.057 | 435 | 19196 | 1269 | 40161 | 1767 | 0.478 | 0.032 |
| 09/06/05 | 221 | 10616 | 593 | 20017 | 915 | 0.530 | 0.030 | 321 | 7397 | 1327 | 34207 | 1298 | 0.216 | 0.039 |
| 09/09/05 | 249 | 5303 | 766 | 23050 | 855 | 0.230 | 0.033 | 268 | 8873 | 1313 | 30898 | 1245 | 0.287 | 0.042 |
| 09/13/05 | 134 | 3034 | 553 | 11210 | 555 | 0.271 | 0.049 | 341 | 14458 | 1267 | 33920 | 1894 | 0.426 | 0.037 |
| 09/16/05 | 116 | 5051 | 947 | 14835 | 671 | 0.341 | 0.064 | 321 | 8458 | 1110 | 23664 | 1795 | 0.357 | 0.047 |
| 09/27/05 | 169 | 11588 | 1530 | 13076 | 956 | 0.886 | 0.117 | 224 | 12675 | 2601 | 23419 | 1342 | 0.541 | 0.111 |
| 09/27/05 | 147 | 8527 | 903 | 10960 | 714 | 0.778 | 0.082 | 224 | 12675 | 2601 | 23419 | 1342 | 0.541 | 0.111 |
| 09/30/05 | 139 | 6691 | 1638 | 12410 | 674 | 0.539 | 0.132 | 189 | 11019 | 3173 | 17985 | 1356 | 0.613 | 0.176 |
| 10/07/05 | 110 | 7808 | 2048 | 7913 | 745 | 0.987 | 0.259 | 201 | 16939 | 4155 | 10510 | 1319 | 1.612 | 0.395 |
| 10/11/05 | 147 | 14697 | 3488 | 7499 | 1064 | 1.960 | 0.465 | 143 | 17005 | 4387 | 12557 | 983 | 1.354 | 0.349 |
| 10/14/05 | 104 | 11564 | 3574 | 8434 | 771 | 1.371 | 0.424 | 101 | 8744 | 1637 | 7657 | 778 | 1.142 | 0.214 |
| 10/21/05 | 85 | 5482 | 1469 | 5904 | 669 | 0.929 | 0.249 | 56 | 4419 | 1169 | 4101 | 414 | 1.078 | 0.285 |

| Start date | Days closed | Closure type | Information for 5 days before RHS closure -- Inside the Closure | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Hauls | Chum | Chinook | Pollock | Proportion Chum | Proportion Chinook | Proportion Pollock | Chum rate | Chinook rate | Duration (hours) |
| 06/20/06 | 7 | Chinook | 48 | 6911 | 82 | 3016 | 0.35 | 0.32 | 0.17 | 2.292 | 0.027 | 427 |
| 06/20/06 | 7 | Chum | 24 | 133 | 2 | 1145 | 0.01 | 0.01 | 0.06 | 0.116 | 0.002 | 111 |
| 06/27/06 | 7 | Chum | 56 | 3575 | 43 | 2147 | 0.37 | 0.41 | 0.16 | 1.665 | 0.020 | 605 |
| 07/04/06 | 3 | Chum | 26 | 3112 | 74 | 2021 | 0.16 | 0.37 | 0.08 | 1.540 | 0.037 | 150 |
| 07/07/06 | 4 | Chinook | 6 | 505 | 16 | 377 | 0.04 | 0.12 | 0.02 | 1.339 | 0.043 | 51 |
| 07/07/06 | 4 | Chum | 26 | 699 | 0 | 1102 | 0.05 | 0.00 | 0.05 | 0.634 | 0.000 | 108 |
| 07/11/06 | 3 | Chum | 5 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | | | 21 |
| 07/11/06 | 3 | Chum | 38 | 2047 | 22 | 1522 | 0.21 | 0.22 | 0.07 | 1.345 | 0.015 | 327 |
| 07/14/06 | 4 | Chum | 23 | 2812 | 9 | 1192 | 0.25 | 0.11 | 0.06 | 2.358 | 0.008 | 209 |
| 07/14/06 | 4 | Chum | 11 | 538 | 8 | 305 | 0.05 | 0.09 | 0.02 | 1.763 | 0.026 | 105 |
| 07/18/06 | 3 | Chum | 8 | 125 | 1 | 126 | 0.04 | 0.02 | 0.01 | 0.993 | 0.007 | 42 |
| 07/21/06 | 4 | Chum | 4 | 723 | 4 | 175 | 0.13 | 0.02 | 0.01 | 4.140 | 0.022 | 10 |
| 07/25/06 | 3 | Chum | 3 | 68 | 0 | 111 | 0.01 | 0.00 | 0.00 | 0.614 | 0.000 | 13 |
| 07/28/06 | 4 | Chum | 7 | 3467 | 8 | 355 | 0.22 | 0.08 | 0.01 | 9.755 | 0.023 | 40 |
| 08/01/06 | 3 | Chum | 9 | 5411 | 7 | 468 | 0.26 | 0.07 | 0.03 | 11.549 | 0.016 | 71 |
| 08/04/06 | 4 | Chum | 30 | 6332 | 25 | 2188 | 0.22 | 0.18 | 0.09 | 2.893 | 0.012 | 161 |
| 08/08/06 | 3 | Chum | 4 | 136 | 1 | 169 | 0.00 | 0.00 | 0.01 | 0.804 | 0.005 | 24 |
| 08/11/06 | 4 | Chinook | 14 | 15617 | 87 | 1658 | 0.59 | 0.66 | 0.08 | 9.421 | 0.053 | 95 |
| 08/15/06 | 7 | Chum | 26 | 3580 | 24 | 1302 | 0.21 | 0.15 | 0.06 | 2.750 | 0.018 | 188 |
| 08/22/06 | 10 | Chum | 46 | 1208 | 18 | 1556 | 0.32 | 0.08 | 0.07 | 0.777 | 0.011 | 297 |
| 08/25/06 | 7 | Chum | 3 | 434 | 7 | 224 | 0.09 | 0.02 | 0.01 | 1.935 | 0.032 | 27 |
| 09/01/06 | 7 | Chinook | 4 | 133 | 27 | 283 | 0.06 | 0.09 | 0.01 | 0.470 | 0.097 | 48 |
| 09/08/06 | 7 | Chum | 26 | 234 | 39 | 1539 | 0.14 | 0.20 | 0.18 | 0.152 | 0.025 | 163 |
| 09/15/06 | 4 | Chinook | 54 | 1450 | 1093 | 4004 | 0.32 | 0.52 | 0.25 | 0.362 | 0.273 | 526 |
| 09/22/06 | 7 | Chinook | 15 | 755 | 708 | 1273 | 0.30 | 0.29 | 0.04 | 0.594 | 0.556 | 115 |
| 09/29/06 | 7 | Chinook | 19 | 563 | 403 | 1494 | 0.34 | 0.48 | 0.08 | 0.377 | 0.270 | 204 |
| 10/06/06 | 7 | Chinook | 33 | 2097 | 1058 | 3094 | 0.51 | 0.46 | 0.15 | 0.678 | 0.342 | 218 |
| 10/10/06 | 3 | Chum | | | | | | | | | | |
| 10/13/06 | 4 | Chinook | 7 | 103 | 772 | 717 | 0.13 | 0.25 | 0.08 | 0.143 | 1.077 | 74 |
| 10/17/06 | 7 | Chinook | 56 | 687 | 1673 | 6124 | 0.44 | 0.55 | 0.39 | 0.112 | 0.273 | 432 |
| 10/24/06 | 7 | Chinook | 18 | 120 | 529 | 1297 | 0.21 | 0.35 | 0.22 | 0.092 | 0.408 | 233 |

| Start date | Hauls | Chum | Chinook | Pollock | Duration (hours) | Chum rate | Chinook rate | Hauls | Chum | Chinook | Pollock | Duration (hours) | Chum rate | Chinook rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 06/20/06 | 131 | 12750 | 174 | 15197 | 795 | 0.839 | 0.011 | 287 | 7676 | 122 | 28066 | 1842 | 0.274 | 0.004 |
| 06/20/06 | 155 | 19529 | 255 | 17068 | 1111 | 1.144 | 0.015 | 287 | 7676 | 122 | 28066 | 1842 | 0.274 | 0.004 |
| 06/27/06 | 146 | 6192 | 63 | 11640 | 972 | 0.532 | 0.005 | 413 | 43731 | 409 | 42243 | 2216 | 1.035 | 0.010 |
| 07/04/06 | 278 | 15952 | 128 | 22761 | 1601 | 0.701 | 0.006 | 427 | 8495 | 96 | 29758 | 1980 | 0.285 | 0.003 |
| 07/07/06 | 297 | 13326 | 113 | 22098 | 1649 | 0.603 | 0.005 | 408 | 11302 | 115 | 31358 | 2019 | 0.360 | 0.004 |
| 07/07/06 | 277 | 13132 | 129 | 21373 | 1592 | 0.614 | 0.006 | 408 | 11302 | 115 | 31358 | 2019 | 0.360 | 0.004 |
| 07/11/06 | 310 | 9725 | 101 | 20595 | 1603 | 0.472 | 0.005 | 433 | 7620 | 61 | 39639 | 1970 | 0.192 | 0.002 |
| 07/11/06 | 279 | 7684 | 79 | 19083 | 1304 | 0.403 | 0.004 | 433 | 7620 | 61 | 39639 | 1970 | 0.192 | 0.002 |
| 07/14/06 | 182 | 8355 | 76 | 17400 | 991 | 0.480 | 0.004 | 402 | 4703 | 158 | 41801 | 1641 | 0.113 | 0.004 |
| 07/14/06 | 194 | 10629 | 77 | 18287 | 1095 | 0.581 | 0.004 | 402 | 4703 | 158 | 41801 | 1641 | 0.113 | 0.004 |
| 07/18/06 | 124 | 3321 | 58 | 11560 | 638 | 0.287 | 0.005 | 349 | 8658 | 204 | 38738 | 1318 | 0.224 | 0.005 |
| 07/21/06 | 212 | 4733 | 190 | 26274 | 847 | 0.180 | 0.007 | 407 | 17157 | 135 | 38496 | 1556 | 0.446 | 0.004 |
| 07/25/06 | 297 | 11213 | 111 | 27894 | 1101 | 0.402 | 0.004 | 442 | 15866 | 106 | 38648 | 1858 | 0.411 | 0.003 |
| 07/28/06 | 297 | 12079 | 94 | 25731 | 1223 | 0.469 | 0.004 | 482 | 27830 | 155 | 44826 | 1847 | 0.621 | 0.003 |
| 08/01/06 | 180 | 15295 | 100 | 16390 | 813 | 0.933 | 0.006 | 467 | 31027 | 167 | 41280 | 1895 | 0.752 | 0.004 |
| 08/04/06 | 219 | 22155 | 113 | 21807 | 843 | 1.016 | 0.005 | 424 | 32527 | 171 | 41132 | 1872 | 0.791 | 0.004 |
| 08/08/06 | 252 | 32329 | 167 | 27042 | 1153 | 1.196 | 0.006 | 483 | 23210 | 93 | 45685 | 2088 | 0.508 | 0.002 |
| 08/11/06 | 203 | 11058 | 45 | 19169 | 1019 | 0.577 | 0.002 | 423 | 24400 | 187 | 38496 | 1873 | 0.634 | 0.005 |
| 08/15/06 | 217 | 13250 | 129 | 20041 | 1016 | 0.661 | 0.006 | 478 | 8190 | 144 | 42389 | 1965 | 0.193 | 0.003 |
| 08/22/06 | 212 | 2574 | 197 | 20158 | 892 | 0.128 | 0.010 | 507 | 5230 | 401 | 37051 | 2197 | 0.141 | 0.011 |
| 08/25/06 | 207 | 4434 | 299 | 15701 | 1090 | 0.282 | 0.019 | 433 | 3413 | 410 | 35821 | 2219 | 0.095 | 0.011 |
| 09/01/06 | 331 | 2218 | 287 | 19135 | 1693 | 0.116 | 0.015 | 423 | 2381 | 337 | 25796 | 2132 | 0.092 | 0.013 |
| 09/08/06 | 135 | 1451 | 159 | 7061 | 750 | 0.205 | 0.022 | 307 | 5428 | 2483 | 32006 | 1765 | 0.170 | 0.078 |
| 09/15/06 | 115 | 3061 | 1001 | 12177 | 540 | 0.251 | 0.082 | 351 | 2598 | 2038 | 35179 | 1750 | 0.074 | 0.058 |
| 09/22/06 | 266 | 1726 | 1692 | 28552 | 1252 | 0.060 | 0.059 | 350 | 2184 | 1029 | 29964 | 1562 | 0.073 | 0.034 |
| 09/29/06 | 174 | 1087 | 431 | 16145 | 825 | 0.067 | 0.027 | 253 | 4208 | 1954 | 27455 | 1476 | 0.153 | 0.071 |
| 10/06/06 | 174 | 2038 | 1262 | 16987 | 1105 | 0.120 | 0.074 | 222 | 1167 | 2437 | 13633 | 1465 | 0.086 | 0.179 |
| 10/10/06 | 145 | 1245 | 1023 | 10658 | 1078 | 0.117 | 0.096 | 281 | 1176 | 4063 | 14653 | 1786 | 0.080 | 0.277 |
| 10/13/06 | 158 | 668 | 2279 | 7968 | 967 | 0.084 | 0.286 | 228 | 1389 | 2525 | 16321 | 1564 | 0.085 | 0.155 |
| 10/17/06 | 151 | 868 | 1356 | 9399 | 1016 | 0.092 | 0.144 | 222 | 1121 | 2648 | 13724 | 2025 | 0.082 | 0.193 |
| 10/24/06 | 78 | 449 | 992 | 4726 | 763 | 0.095 | 0.210 | 110 | 185 | 984 | 4125 | 827 | 0.045 | 0.239 |

| | | | Information for 5 days before RHS closure -- Inside the Closure | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start date | Days closed | Closure type | Hauls | Chum | Chinook | Pollock | Proportion Chum | Proportion Chinook | Proportion Pollock | Chum rate | Chinook rate | Duration (hours) |
| 07/06/07 | 7 | Chum | 26 | 401 | 13 | 1785 | 0.18 | 0.18 | 0.07 | 0.225 | 0.007 | 113 |
| 07/10/07 | 3 | Chinook | | | | | | | | | | |
| 07/17/07 | 3 | Chum | 9 | 73 | 3 | 621 | 0.12 | 0.06 | 0.03 | 0.118 | 0.004 | 44 |
| 07/20/07 | 11 | Chum | | | | | | | | | | |
| 07/24/07 | 7 | Chum | 22 | 97 | 0 | 1908 | 0.07 | 0.00 | 0.10 | 0.051 | 0.000 | 70 |
| 07/31/07 | 7 | Chum | 28 | 363 | 0 | 1648 | 0.16 | 0.00 | 0.09 | 0.220 | 0.000 | 92 |
| 08/03/07 | 4 | Chum | 10 | 352 | 13 | 648 | 0.11 | 0.14 | 0.04 | 0.543 | 0.019 | 94 |
| 08/07/07 | 3 | Chum | 9 | 240 | 5 | 418 | 0.11 | 0.12 | 0.06 | 0.575 | 0.013 | 59 |
| 08/10/07 | 7 | Chum | 36 | 455 | 4 | 1402 | 0.23 | 0.07 | 0.16 | 0.324 | 0.003 | 276 |
| 08/21/07 | 3 | Chum | 30 | 1024 | 28 | 3161 | 0.11 | 0.07 | 0.11 | 0.324 | 0.009 | 237 |
| 08/17/07 | 7 | Chum | 66 | 1385 | 216 | 6850 | 0.42 | 0.47 | 0.20 | 0.202 | 0.032 | 215 |
| 08/21/07 | 3 | Chum | 7 | 2884 | 33 | 367 | 0.31 | 0.09 | 0.01 | 7.860 | 0.089 | 36 |
| 08/21/07 | 7 | Chum | 20 | 1727 | 45 | 1314 | 0.18 | 0.12 | 0.05 | 1.314 | 0.034 | 85 |
| 08/21/07 | 7 | Chum | 11 | 4349 | 54 | 641 | 0.46 | 0.14 | 0.02 | 6.782 | 0.084 | 52 |
| 08/17/07 | 4 | Chum | 52 | 571 | 0 | 4468 | 0.17 | 0.00 | 0.13 | 0.128 | 0.000 | 416 |
| 08/28/07 | 3 | Chinook | 13 | 662 | 49 | 844 | 0.09 | 0.08 | 0.04 | 0.784 | 0.058 | 115 |
| 08/31/07 | 4 | Chinook | 9 | 209 | 22 | 400 | 0.04 | 0.03 | 0.02 | 0.522 | 0.055 | 72 |
| 08/31/07 | 4 | Chum | 10 | 379 | 23 | 970 | 0.07 | 0.03 | 0.06 | 0.391 | 0.023 | 57 |
| 09/04/07 | 3 | Chinook | 48 | 1100 | 334 | 3797 | 0.18 | 0.29 | 0.22 | 0.290 | 0.088 | 201 |
| 09/04/07 | 7 | Chum | 5 | 76 | 17 | 95 | 0.01 | 0.01 | 0.01 | 0.799 | 0.176 | 33 |
| 09/11/07 | 7 | Chum | 14 | 57 | 37 | 504 | 0.01 | 0.02 | 0.03 | 0.114 | 0.074 | 114 |
| 09/11/07 | 3 | Chinook | 16 | 1241 | 701 | 1628 | 0.19 | 0.45 | 0.10 | 0.762 | 0.430 | 137 |
| 09/14/07 | 4 | Chinook | 7 | 26 | 76 | 581 | 0.00 | 0.02 | 0.04 | 0.045 | 0.131 | 28 |
| 09/21/07 | 7 | Chinook | 51 | 789 | 817 | 2808 | 0.59 | 0.66 | 0.53 | 0.281 | 0.291 | 512 |
| 09/25/07 | 10 | Chinook | 16 | 163 | 229 | 559 | 0.14 | 0.21 | 0.05 | 0.291 | 0.409 | 177 |
| 09/25/07 | 10 | Chinook | 28 | 117 | 57 | 753 | 0.10 | 0.05 | 0.07 | 0.155 | 0.076 | 149 |
| 10/05/07 | 4 | Chinook | 8 | 13 | 68 | 384 | 0.02 | 0.01 | 0.02 | 0.034 | 0.176 | 55 |
| 10/09/07 | 3 | Chinook | 3 | 21 | 163 | 177 | 0.03 | 0.05 | 0.02 | 0.116 | 0.917 | 20 |
| 10/09/07 | 3 | Chinook | | | | | | | | | | |
| 10/12/07 | 7 | Chinook | 51 | 131 | 3121 | 3446 | 0.20 | 0.44 | 0.26 | 0.038 | 0.906 | 581 |
| 10/12/07 | 7 | Chinook | 11 | 75 | 170 | 810 | 0.11 | 0.02 | 0.06 | 0.093 | 0.210 | 108 |
| 10/19/07 | 14 | Chinook | 23 | 38 | 1260 | 1545 | 0.04 | 0.23 | 0.07 | 0.024 | 0.816 | 198 |
| 10/23/07 | 3 | Chinook | 58 | 82 | 542 | 2501 | 0.14 | 0.10 | 0.13 | 0.033 | 0.217 | 285 |

| | Information for 5 days before RHS closure -- Outside the Closure | | | | | | | Information for 5 days after RHS closure -- Outside the Closure | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start date | Hauls | Chum | Chinook | Pollock | Duration (hours) | Chum rate | Chinook rate | Hauls | Chum | Chinook | Pollock | Duration (hours) | Chum rate | Chinook rate |
| 07/06/07 | 285 | 1834 | 56 | 24991 | 1123 | 0.073 | 0.002 | 396 | 411 | 28 | 38600 | 1553 | 0.011 | 0.001 |
| 07/10/07 | 208 | 568 | 32 | 18975 | 827 | 0.030 | 0.002 | 364 | 469 | 61 | 37935 | 1751 | 0.012 | 0.002 |
| 07/17/07 | 174 | 541 | 48 | 18029 | 794 | 0.030 | 0.003 | 394 | 1887 | 58 | 35330 | 1622 | 0.053 | 0.002 |
| 07/20/07 | 278 | 1634 | 48 | 24033 | 1093 | 0.068 | 0.002 | 401 | 1230 | 43 | 32956 | 1752 | 0.037 | 0.001 |
| 07/24/07 | 226 | 1246 | 35 | 16925 | 925 | 0.074 | 0.002 | 364 | 1530 | 36 | 28596 | 1834 | 0.054 | 0.001 |
| 07/31/07 | 268 | 1908 | 46 | 17281 | 1618 | 0.110 | 0.003 | 492 | 3078 | 60 | 49116 | 2300 | 0.063 | 0.001 |
| 08/03/07 | 223 | 2965 | 74 | 14379 | 1453 | 0.206 | 0.005 | 452 | 2480 | 39 | 33520 | 1965 | 0.074 | 0.001 |
| 08/07/07 | 128 | 2025 | 39 | 6132 | 821 | 0.330 | 0.006 | 394 | 1692 | 93 | 30932 | 2079 | 0.055 | 0.003 |
| 08/10/07 | 93 | 1491 | 51 | 7617 | 531 | 0.196 | 0.007 | 457 | 3315 | 422 | 42462 | 2238 | 0.078 | 0.010 |
| 08/21/07 | 280 | 8412 | 351 | 24660 | 1163 | 0.341 | 0.014 | 428 | 10263 | 692 | 38057 | 2277 | 0.270 | 0.018 |
| 08/17/07 | 278 | 1901 | 244 | 28162 | 1379 | 0.068 | 0.009 | 347 | 10538 | 405 | 33476 | 1484 | 0.315 | 0.012 |
| 08/21/07 | 303 | 6552 | 346 | 27454 | 1364 | 0.239 | 0.013 | 428 | 10263 | 692 | 38057 | 2277 | 0.270 | 0.018 |
| 08/21/07 | 290 | 7709 | 334 | 26507 | 1315 | 0.291 | 0.013 | 428 | 10263 | 692 | 38057 | 2277 | 0.270 | 0.018 |
| 08/21/07 | 299 | 5087 | 325 | 27179 | 1348 | 0.187 | 0.012 | 428 | 10263 | 692 | 38057 | 2277 | 0.270 | 0.018 |
| 08/17/07 | 292 | 2715 | 460 | 30545 | 1178 | 0.089 | 0.015 | 347 | 10538 | 405 | 33476 | 1484 | 0.315 | 0.012 |
| 08/28/07 | 221 | 6469 | 529 | 18454 | 1171 | 0.351 | 0.029 | 402 | 9677 | 1351 | 27311 | 2506 | 0.354 | 0.049 |
| 08/31/07 | 212 | 4880 | 671 | 15667 | 1234 | 0.312 | 0.043 | 409 | 9288 | 1398 | 29406 | 2534 | 0.316 | 0.048 |
| 08/31/07 | 211 | 4710 | 671 | 15098 | 1248 | 0.312 | 0.044 | 409 | 9288 | 1398 | 29406 | 2534 | 0.316 | 0.048 |
| 09/04/07 | 196 | 5054 | 824 | 13086 | 1299 | 0.386 | 0.063 | 416 | 9276 | 1380 | 27112 | 2562 | 0.342 | 0.051 |
| 09/04/07 | 239 | 6079 | 1141 | 16788 | 1468 | 0.362 | 0.068 | 416 | 9276 | 1380 | 27112 | 2562 | 0.342 | 0.051 |
| 09/11/07 | 256 | 6358 | 1522 | 16329 | 1893 | 0.389 | 0.093 | 370 | 8302 | 4461 | 22891 | 2597 | 0.363 | 0.195 |
| 09/11/07 | 254 | 5174 | 858 | 15205 | 1870 | 0.340 | 0.056 | 370 | 8302 | 4461 | 22891 | 2597 | 0.363 | 0.195 |
| 09/14/07 | 206 | 8485 | 3930 | 13274 | 1666 | 0.639 | 0.296 | 308 | 2520 | 1823 | 17011 | 2147 | 0.148 | 0.107 |
| 09/21/07 | 70 | 543 | 414 | 2513 | 482 | 0.216 | 0.165 | 336 | 1394 | 1068 | 13775 | 2599 | 0.101 | 0.077 |
| 09/25/07 | 257 | 985 | 845 | 9801 | 1979 | 0.101 | 0.086 | 229 | 2228 | 1999 | 10029 | 1890 | 0.222 | 0.199 |
| 09/25/07 | 245 | 1031 | 1017 | 9608 | 2007 | 0.107 | 0.106 | 229 | 2228 | 1999 | 10029 | 1890 | 0.222 | 0.199 |
| 10/05/07 | 161 | 783 | 4777 | 15239 | 1300 | 0.051 | 0.313 | 294 | 829 | 4739 | 14211 | 2384 | 0.058 | 0.333 |
| 10/09/07 | 187 | 574 | 3336 | 10274 | 1490 | 0.056 | 0.325 | 301 | 828 | 7019 | 15844 | 2893 | 0.052 | 0.443 |
| 10/09/07 | 190 | 594 | 3499 | 10451 | 1510 | 0.057 | 0.335 | 301 | 828 | 7019 | 15844 | 2893 | 0.052 | 0.443 |
| 10/12/07 | 187 | 530 | 4014 | 9803 | 1761 | 0.054 | 0.409 | 303 | 922 | 4416 | 17448 | 2535 | 0.053 | 0.253 |
| 10/12/07 | 227 | 586 | 6965 | 12439 | 2233 | 0.047 | 0.560 | 303 | 922 | 4416 | 17448 | 2535 | 0.053 | 0.253 |
| 10/19/07 | 264 | 869 | 4105 | 19952 | 2054 | 0.044 | 0.206 | 294 | 581 | 6119 | 16945 | 2144 | 0.034 | 0.361 |
| 10/23/07 | 248 | 515 | 5150 | 16134 | 1940 | 0.032 | 0.319 | 263 | 327 | 4903 | 11733 | 2003 | 0.028 | 0.418 |

| | | | Information for 5 days before RHS closure -- Inside the Closure | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start date | Days closed | Closure type | Hauls | Chum | Chinook | Pollock | Proportion Chum | Proportion Chinook | Proportion Pollock | Chum rate | Chinook rate | Duration (hours) |
| 07/04/08 | 14 | Chum | | | | | | | | | | |
| 07/11/08 | 7 | Chum | 20 | 314 | 3 | 1665 | 0.48 | 0.23 | 0.14 | 0.188 | 0.002 | 114 |
| 07/18/08 | 14 | Chum | 26 | 614 | 11 | 2350 | 0.72 | 0.77 | 0.30 | 0.261 | 0.005 | 194 |
| 08/01/08 | 11 | Chum | 3 | 216 | 0 | 188 | 0.45 | 0.00 | 0.05 | 1.152 | 0.000 | 22 |
| 08/15/08 | 7 | Chum | 3 | 4 | 0 | 218 | 0.01 | 0.00 | 0.01 | 0.019 | 0.000 | 14 |
| 08/29/08 | 7 | Chum | 14 | 419 | 7 | 636 | 0.47 | 0.12 | 0.05 | 0.658 | 0.011 | 102 |
| 09/09/08 | 7 | Chum | 6 | 40 | 5 | 151 | 0.03 | 0.02 | 0.02 | 0.268 | 0.034 | 56 |
| 09/16/08 | 10 | Chinook | 75 | 294 | 105 | 1323 | 0.50 | 0.51 | 0.27 | 0.222 | 0.079 | 696 |
| 09/26/08 | 4 | Chinook | | | | | | | | | | |
| 10/03/08 | 7 | Chum | 15 | 21 | 21 | 372 | 0.05 | 0.07 | 0.12 | 0.056 | 0.055 | 191 |
| 10/10/08 | 7 | Chinook | 8 | 28 | 92 | 397 | 0.16 | 0.35 | 0.18 | 0.071 | 0.231 | 73 |
| 10/17/08 | 7 | Chinook | 57 | 80 | 925 | 4811 | 0.67 | 0.80 | 0.85 | 0.017 | 0.192 | 654 |
| 10/24/08 | 8 | Chinook | 7 | 4 | 174 | 181 | 1.00 | 1.00 | 0.98 | 0.025 | 0.962 | 107 |
| 06/29/09 | 4 | Chum | 36 | 274 | 6 | 2613 | 0.14 | 0.01 | 0.11 | 0.105 | 0.002 | 204 |
| 07/03/09 | 4 | Chum | 85 | 1053 | 46 | 5872 | 0.68 | 0.57 | 0.26 | 0.179 | 0.008 | 632 |
| 07/03/09 | 7 | Chum | 5 | 8 | 1 | 279 | 0.01 | 0.01 | 0.01 | 0.029 | 0.003 | 33 |
| 07/07/09 | 3 | Chum | 16 | 248 | 27 | 1166 | 0.10 | 0.33 | 0.05 | 0.212 | 0.023 | 72 |
| 07/10/09 | 4 | Chum | 10 | 605 | 5 | 547 | 0.20 | 0.12 | 0.03 | 1.105 | 0.010 | 73 |
| 07/14/09 | 7 | Chum | 40 | 1235 | 7 | 2059 | 0.61 | 0.30 | 0.10 | 0.600 | 0.004 | 417 |
| 07/28/09 | 7 | Chum | 13 | 2361 | 48 | 946 | 0.61 | 0.57 | 0.04 | 2.495 | 0.051 | 126 |
| 08/14/09 | 21 | Chum | 4 | 0 | 0 | 523 | 0.00 | 0.00 | 0.06 | 0.000 | 0.000 | 33 |
| 08/21/09 | 7 | Chum | 4 | 359 | 5 | 178 | 0.26 | 0.15 | 0.01 | 2.018 | 0.027 | 28 |
| 08/28/09 | 7 | Chum | 25 | 1065 | 22 | 2072 | 0.33 | 0.17 | 0.17 | 0.514 | 0.011 | 140 |
| 09/04/09 | 7 | Chum | 7 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | | | 58 |
| 09/08/09 | 7 | Chinook | 22 | 11 | 67 | 1412 | 0.00 | 0.25 | 0.18 | 0.008 | 0.047 | 117 |
| 09/11/09 | 4 | Chinook | 21 | 2632 | 97 | 1756 | 0.92 | 0.70 | 0.31 | 1.499 | 0.055 | 204 |
| 09/18/09 | 7 | Chinook | 20 | 941 | 129 | 1830 | 0.81 | 0.54 | 0.48 | 0.514 | 0.071 | 180 |
| 09/25/09 | 4 | Chinook | | | | | | | | | | |
| 09/29/09 | 3 | Chinook | | | | | | | | | | |
| 10/02/09 | 7 | Chinook | | | | | | | | | | |
| 10/09/09 | 4 | Chinook | 3 | 0 | 0 | 945 | 0.00 | 0.00 | 0.37 | 0.000 | 0.000 | 28 |

| | Information for 5 days before RHS closure -- Outside the Closure | | | | | | | Information for 5 days after RHS closure -- Outside the Closure | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start date | Hauls | Chum | Chinook | Pollock | Duration (hours) | Chum rate | Chinook rate | Hauls | Chum | Chinook | Pollock | Duration (hours) | Chum rate | Chinook rate |
| 07/04/08 | 191 | 81 | 3 | 14325 | 861 | 0.006 | 0.000 | 384 | 337 | 8 | 26233 | 2105 | 0.013 | 0.000 |
| 07/11/08 | 157 | 346 | 9 | 10089 | 924 | 0.034 | 0.001 | 306 | 592 | 18 | 25356 | 1644 | 0.023 | 0.001 |
| 07/18/08 | 89 | 243 | 3 | 5569 | 491 | 0.044 | 0.001 | 367 | 404 | 133 | 32274 | 2065 | 0.013 | 0.004 |
| 08/01/08 | 58 | 260 | 6 | 3401 | 357 | 0.076 | 0.002 | 335 | 304 | 27 | 24908 | 2026 | 0.012 | 0.001 |
| 08/15/08 | 236 | 577 | 13 | 16663 | 1388 | 0.035 | 0.001 | 444 | 895 | 46 | 28833 | 2741 | 0.031 | 0.002 |
| 08/29/08 | 200 | 467 | 50 | 11196 | 1441 | 0.042 | 0.004 | 379 | 757 | 83 | 23884 | 2870 | 0.032 | 0.003 |
| 09/09/08 | 158 | 1392 | 283 | 7516 | 1379 | 0.185 | 0.038 | 306 | 1055 | 275 | 12746 | 2438 | 0.083 | 0.022 |
| 09/16/08 | 91 | 289 | 99 | 3664 | 643 | 0.079 | 0.027 | 354 | 291 | 49 | 27380 | 1750 | 0.011 | 0.002 |
| 09/26/08 | 43 | 396 | 168 | 2839 | 332 | 0.139 | 0.059 | 176 | 285 | 166 | 7085 | 1529 | 0.040 | 0.023 |
| 10/03/08 | 75 | 398 | 285 | 2797 | 793 | 0.142 | 0.102 | 190 | 329 | 344 | 6781 | 1595 | 0.048 | 0.051 |
| 10/10/08 | 87 | 144 | 169 | 1843 | 640 | 0.078 | 0.092 | 130 | 150 | 763 | 5853 | 1231 | 0.026 | 0.130 |
| 10/17/08 | 43 | 40 | 225 | 881 | 281 | 0.045 | 0.255 | 121 | 30 | 508 | 5126 | 1132 | 0.006 | 0.099 |
| 10/24/08 | 6 | 0 | 0 | 3 | 29 | 0.000 | 0.000 | 41 | 5 | 155 | 1784 | 346 | 0.003 | 0.087 |
| 06/29/09 | 253 | 1725 | 670 | 21258 | 1559 | 0.081 | 0.032 | 407 | 1671 | 90 | 27203 | 2367 | 0.061 | 0.003 |
| 07/03/09 | 230 | 484 | 35 | 16410 | 1286 | 0.030 | 0.002 | 321 | 2758 | 63 | 21093 | 1765 | 0.131 | 0.003 |
| 07/03/09 | 310 | 1529 | 80 | 22002 | 1885 | 0.069 | 0.004 | 321 | 2758 | 63 | 21093 | 1765 | 0.131 | 0.003 |
| 07/07/09 | 296 | 2120 | 54 | 20285 | 1626 | 0.105 | 0.003 | 394 | 2991 | 50 | 23259 | 2353 | 0.129 | 0.002 |
| 07/10/09 | 284 | 2353 | 39 | 17514 | 1694 | 0.134 | 0.002 | 384 | 1949 | 21 | 27826 | 2154 | 0.070 | 0.001 |
| 07/14/09 | 232 | 800 | 18 | 17704 | 1192 | 0.045 | 0.001 | 343 | 987 | 17 | 29253 | 1883 | 0.034 | 0.001 |
| 07/28/09 | 238 | 1514 | 37 | 24621 | 974 | 0.061 | 0.001 | 337 | 9552 | 33 | 32140 | 1548 | 0.297 | 0.001 |
| 08/14/09 | 118 | 986 | 10 | 8751 | 706 | 0.113 | 0.001 | 227 | 2129 | 43 | 21344 | 1150 | 0.100 | 0.002 |
| 08/21/09 | 130 | 1035 | 26 | 12112 | 712 | 0.085 | 0.002 | 246 | 4088 | 124 | 19717 | 1324 | 0.207 | 0.006 |
| 08/28/09 | 130 | 2134 | 111 | 9881 | 730 | 0.216 | 0.011 | 176 | 781 | 61 | 11243 | 975 | 0.069 | 0.005 |
| 09/04/09 | 75 | 773 | 77 | 5068 | 482 | 0.153 | 0.015 | 174 | 4621 | 249 | 11321 | 1023 | 0.408 | 0.022 |
| 09/08/09 | 100 | 4696 | 195 | 6618 | 660 | 0.710 | 0.030 | 147 | 676 | 116 | 9704 | 832 | 0.070 | 0.012 |
| 09/11/09 | 61 | 227 | 41 | 3840 | 354 | 0.059 | 0.011 | 137 | 928 | 193 | 9366 | 813 | 0.099 | 0.021 |
| 09/18/09 | 35 | 218 | 109 | 1982 | 244 | 0.110 | 0.055 | 105 | 1718 | 203 | 9546 | 653 | 0.180 | 0.021 |
| 09/25/09 | 65 | 1172 | 63 | 5501 | 399 | 0.213 | 0.011 | 89 | 426 | 169 | 3949 | 442 | 0.108 | 0.043 |
| 09/29/09 | 57 | 289 | 159 | 2613 | 302 | 0.111 | 0.061 | 120 | 288 | 51 | 2928 | 573 | 0.098 | 0.017 |
| f10/02/09 | 103 | 417 | 142 | 1909 | 505 | 0.219 | 0.075 | 58 | 34 | 33 | 3078 | 302 | 0.011 | 0.011 |
| 10/09/09 | 22 | 18 | 37 | 1604 | 130 | 0.011 | 0.023 | 1 | * | * | * | * | * | * |

# Appendix 4 Rural Outreach Report

## Summary of outreach on proposed action to limit non-Chinook (chum) salmon bycatch in the Bering Sea pollock fishery

**June 2011**

### Genesis for outreach plan

As a result of one of the North Pacific Fishery Management Council's (Council) policy priorities, it is focusing on improving outreach and communications with rural stakeholders and developing a method for systematic documentation of Alaska Native and community participation in the development of fishery management actions.[53] Upon review of several suggestions to expand both ongoing communication and outreach specific to particular projects,[54] the Council initiated a small workgroup to further review potential approaches and provide recommendations. Upon review of the workgroup report in February 2009, the Council approved the workgroup's primary recommendation to initiate a standing committee (the Rural Community Outreach Committee) to provide input to the Council on ways to improve outreach to communities and Alaska Native entities. The committee has three primary tasks: 1) to advise the Council on how to provide opportunities for better understanding and participation from Native Alaska and rural communities; 2) to provide feedback on community impacts sections of specific analyses; and 3) to provide recommendations regarding which proposed Council actions need a specific outreach plan and prioritize multiple actions when necessary. The committee was initiated in June 2009.

In addition to the stated Council policy priority, the need to improve the stakeholder participation process was highlighted during development of the Chinook salmon bycatch analysis. The Council made efforts to solicit and obtain input on the proposed action from Alaska Natives, rural communities, and other affected stakeholders. This outreach effort, specific to Chinook salmon bycatch management, dovetailed with the Council's overall community and Alaska Native stakeholder participation policy.

The Council's Rural Community Outreach Committee met in August 2009 and recommended that the non-Chinook (chum)[55] salmon bycatch issue be a priority for rural outreach. The Council agreed with this recommendation, to undertake an outreach effort with affected community and Native stakeholders prior to and during the development of the draft EA/RIR/IRFA (analysis), prior to final Council action. The committee met again in November 2009, with the primary purpose of helping to develop an outreach plan for this issue, given that the Council was scheduled to review the chum bycatch alternatives at its December 2009 meeting. Note that in October, the Council's Salmon Bycatch Workgroup also recommended that outreach begin prior to approval of the final alternatives. Both the workgroup and November committee report are on the Council website. The Rural Community Outreach Committee met again in February 2010, in part to review and finalize the outreach plan.

The outreach plan for chum salmon bycatch management was developed by Council staff with input from NMFS, the Council, the Rural Community Outreach Committee, and affected stakeholders. It is intended to improve the Council's decision-making processes on the proposed action, as well as enable the Council to maintain ongoing and proactive relations with Alaska Native and rural communities. Another of the objectives of the plan is to coordinate with NMFS' tribal consultation activities, to prevent a duplication of efforts between the Council and NMFS, which includes not confusing the public with divergent

[53] This policy priority is identified in the Council's workplan resulting from the Programmatic SEIS.
[54] http://www.fakr.noaa.gov/npfmc/Tasking/community_stakeholder.pdf
[55] While the proposed action would regulate all non-Chinook salmon bycatch, including sockeye, coho, pink, and chum salmon, chum salmon comprises over 99.6% of the total catch in this category. Thus, the proposed action is commonly referred to as the chum salmon bycatch issue.

processes or providing inconsistent information. The entire outreach plan is provided here: http://www.fakr.noaa.gov/npfmc/current_issues/bycatch/ChumOutreach1210.pdf.

This report will be included, in part or in whole, in the analysis submitted to the Council prior to its final recommendation. A broad overview of the primary steps of and results from the chum salmon bycatch outreach plan follows.

## Outreach components

The following sections outline the general components of the outreach plan for the proposed action on chum salmon bycatch in the Bering Sea pollock fisheries**.** These include: direct mailings to stakeholders; community outreach meetings; additional outreach (statewide teleconference, radio/newspaper, press releases); and documentation of rural outreach meeting results.

Note also that NMFS undertook scoping for the alternatives in late March 2009, and the scoping report was provided to the Council in June 2009. Through the notice of intent, NMFS notified the public that a NEPA analysis and decision-making process for the proposed action has been initiated so that interested or affected people may participate and contribute to the final decision. Scoping is accomplished through written communications and consultations with agency officials, interested members of the public and organizations, Alaska Native representatives, and State and local governments. The formal scoping period began with the publication of a Notice of Intent in the *Federal Register* on January 8, 2009 (74 FR 798). Public comments were due to NMFS by March 23, 2009. In the Notice of Intent, NMFS requested written comments from the public on the range of alternatives to be analyzed and on the environmental, social, and economic issues to be considered in the analysis.

The scoping report summarizes the comments received during the January 8, 2009 to March 23, 2009, scoping period, and summarizes the issues associated with the proposed action and describes alternative management measures raised in public comment during the scoping process. The purpose of the report is to inform the Council and the public of the results of scoping and to assist in the development of the range alternatives and analysis. NMFS received four written comments from the public and interested parties. (Appendix 1 to the Scoping Report contains copies of the comments.) The NMFS Alaska Region web site contains the notice of intent, the scoping report, and related additional information.[56]

## Direct mailings to stakeholders

On September 18, 2009, the Council provided a mailing to over 600 stakeholders, including community governments, regional and village Native corporations, regional non-profit Native corporations, tribal entities, Federal Subsistence Regional Advisory Council coordinators, Community Development Quota corporations, ADF&G Regional Coordinators, and other community or Native entities. The mailing was also sent to previous contacts or individuals that have contacted the Council on salmon bycatch issues, and State legislature and Congressional representatives.

The mailing included a two-page flyer for potential posting in communities. It provided a brief summary of the issue, including bycatch trends, and solicited input from stakeholders identified as being potentially affected by the proposed action. It also provided a summary of the Council's schedule on this issue, methods of contacting the Council, and a website reference to the current suite of alternatives and options. The flyer was intended to inform individuals and communities as to the current stage of the process that the Council was undertaking in December 2009 (i.e., refining alternatives and options and establishing a timeline for analysis). In addition, the flyer noted that pending Council direction in December, it is likely that an outreach plan will be developed for the proposed action, which would likely include regional

[56] http://www.fakr.noaa.gov/sustainablefisheries/bycatch/salmon/non_chinook/default.htm.

outreach meetings in rural Alaska, in order to explain the proposed action, provide preliminary analysis, and receive feedback from rural communities.

The Council sent a letter and another mailing to the same group of stakeholders March 31, 2010, to notify the public of the May 4 Statewide teleconference and the scheduled action for the June 2010 Council meeting. The Council was scheduled to conduct a final review and possible revision of the proposed alternatives and options for analysis at the June meeting. The intent of the mailing was to ensure awareness of the current Council schedule, the suite of proposed alternatives, the statewide teleconference, and to solicit feedback on the alternatives and options to be analyzed.

Finally, the Council sent a third mailing in May 2011 to the same group of stakeholders prior to the Council meeting at which initial review is scheduled (June 2011, in Nome). The intent of this mailing was to ensure awareness of the suite of alternatives, the range of impacts analyzed, the schedule for final action, and to solicit input on the selection of a preliminary preferred alternative, should one be selected.

In addition, the draft analysis (EA/RIR/IRFA), associated documents, outreach materials, and powerpoint presentations, are posted on the Council website as available, and prior to the Council's scheduled meeting for final action. In addition, the Council newsletter reports upon progress and relevant meetings. The public is also able to listen to all Council meetings real-time via the internet if they cannot attend in person. The Council will also consider a follow-up mailing to potentially affected entities as to the results of the Council's final recommendation for chum salmon bycatch reduction measures to the Secretary of Commerce, if, at that point, the website and Council newsletter are not considered sufficient means to reach potentially affected stakeholders.

### Statewide teleconference (May 2010)

In order to get feedback prior to the Council's suite of alternatives, staff conducted a statewide teleconference on May 4, 2010. The primary purpose was an orientation for the public, such that people understand the basics of the alternatives proposed and ways to provide formal input to the Council (e.g., written and oral testimony), prior to the June 2010 Council meeting. A secondary purpose of the call is to document public input on the suite of alternatives, which was provided to the Council in June 2010. A short presentation was provided on the proposed action and Council process, and using most of the time for questions and concerns from the public.

Other guidance that staff followed, as suggested by the Rural Community Outreach Committee, included:

- Limit the call to 2 - 3 hours.
- Clearly articulate the purpose of the call.
- Provide a 2 or 3 minute time limit for questions.
- Provide a mailing/flyer to the list of community and Native contacts that includes: the suite of alternatives; the schedule for action, including community outreach meetings; information on the teleconference; and notice that those who RSVP with the Council that they will attend the teleconference will have the first priority for asking questions.
- In addition to the RSVP list, attempt to take questions from a broad geographic range.
- Work with regional organizations to provide hub sites, where many community members could call in together. Examples provided: Kawerak in Nome, Northwest Arctic Borough in Kotzebue, AVCP in Bethel, Unalakleet.
- Make the powerpoint presentation available on the Council website prior to the call.
- Use a phone line without a limit on the number of callers that can participate.
- Close the call with a reminder of how to participate in the Council process, and the opportunity to provide formal input to the Council in late May/June.

The presentation provided by Council staff during the teleconference is posted here: http://www.fakr.noaa.gov/npfmc/current_issues/bycatch/chumPPT410.pdf. The audio recording of the teleconference is provided here: http://www.box.net/shared/j37fjfq8i1. The report on the teleconference is attached as **Appendix 1**, which includes the public comments provided, staff presentation, call log, and the public notice for the teleconference.

## Community outreach meetings (late 2010 – early 2011)

An important component of the outreach plan was to conduct outreach on the issue in remote villages that depend heavily on salmon for subsistence. Transportation and access to Council meetings by residents of communities in western and interior Alaska is costly and difficult. The outreach plan intended to schedule outreach in various villages, regional hubs and otherwise, in order to promote two-way communication between Council members, staff, and subsistence, recreational, and commercial salmon users. The outreach was intended to help the Council understand the concerns and needs of these communities, facilitate revision of the analysis in accordance with new information, and provide information to residents on the proposed action and Council process such that they may comment and participate in a meaningful way.

Upon informal consultation with community and Native coordinators, as well as the Rural Community Outreach Committee, staff determined that the most effective approach to community outreach meetings is to work with established community representatives and Native entities within the affected regions and attend annual or recurring regional meetings, in order to reach a broad group of stakeholders in the affected areas. Working with established entities which have regular in-region meetings tends to reach more stakeholders than if the Council hosted its own outreach meeting in the community. It was determined that Council staff would convene individual outreach meetings only as necessary and appropriate, if a regional or Council meeting was not scheduled in a particular area during a timeframe in which Council staff and/or members could attend sufficiently prior to final action.

Staff scheduled outreach in rural Alaska in order to correspond with regularly scheduled regional meetings and the release of a preliminary analysis, but prior to the release and Council review of the first formal initial review draft impact analysis (June 2011) and selection of a preferred alternative. The intent was to allow the public time to review and provide comments early in the process, such that changes can be made prior to completion of the final analysis, and allow the Council to receive community input prior to its selection of a preferred alternative.

With regard to outreach meetings, Council staff consulted with the coordinators of five of the Federal Subsistence Regional Advisory Councils (RACs), the Association of Village Council Presidents (AVCP), the Tanana Chiefs Conference (TCC), the Yukon River Drainage Fisheries Association (YRDFA), Kawerak, Inc., and the Yukon River Panel, in order to evaluate the potential for time on the agendas of their annual or biannual regional meetings. There was a recognized conflict between the AVCP annual meeting October 5 – 7, 2010, in Bethel, and the Council meeting October 4 – 12, in Anchorage, so staff and Council members were unable to attend the October AVCP meeting.[57] A schedule conflict with another outreach meeting also prevented staff from attending the Seward Peninsula RAC meeting in Nome (February 15 – 16). However, the June 2011 Council meeting is scheduled in Nome, which will provide ample agenda time for this issue and public comment. In addition, NMFS staff attended the Bering Strait regional conference in Nome in February and provided the Council presentation; Council staff did not attend due to weather.

[57]The AVCP represents 56 tribes in the Yukon-Kuskokwim Delta.

In sum, the outreach schedule included attending seven regional meetings, and at least two meetings with the Yukon River Panel in Anchorage. Through coordination with the meeting sponsors, Council staff was allocated agenda time to discuss the chum salmon bycatch proposed action at each of the following public meetings.

| | |
|---|---|
| Yukon River Panel | April and Dec 6 – 9, 2010; Anchorage |
| Yukon River Drainage Fisheries Assn annual meeting | Feb 14 – 17, 2011; Mountain Village |
| Bering Strait Regional Conference | Feb 22 – 24, 2011; Nome |
| Yukon-Kuskokwim Delta Regional Advisory Council | Feb 23 – 24, 2011; Mountain Village |
| Western Interior Regional Advisory Council | March 1 – 2, 2011; Galena |
| Eastern Interior Regional Advisory Council | March 3 – 4, 2011; Fairbanks |
| Bristol Bay Regional Advisory Council | March 9 – 10, 2011; Naknek |
| Tanana Chiefs Conference annual meeting | Mar 15 – 19, 2011; Fairbanks |

Each of the above organizations represents an area that encompasses several member villages and/or tribes. While it is recognized that there is some overlap in representation between the various entities, the participants that attend the meetings may be very different. However, all of the groups represent rural communities, most of which are small in population and removed from the road system. Kawerak, Inc., organizes the Bering Strait Regional Conference, and is a regional consortium of tribal governments organized as a nonprofit corporation with headquarters in Nome, Alaska. Kawerak provides services to 20 Native villages located on or near the Bering Straits. The Yukon-Kuskokwim Delta RAC represents 42 villages in its management area. The Eastern Interior RAC represents 13 villages along the Yukon or Tanana Rivers and an additional 17 villages within the region. The Western Interior RAC represents 27 villages along the Yukon and Kuskokwim Rivers. The Bristol Bay RAC represents 31 Bristol Bay subsistence communities. The Tanana Chiefs Conference is a tribal consortium of 42 villages in interior Alaska, along the Yukon, Tanana, and Kuskokwim Rivers. Please refer to the maps provided in **Appendix 2** to see the geographic representation of these entities.

Two Council members and two Council staff analysts attended a portion of each regional meeting, with the exception of the Bering Straits Regional Conference, to which weather prevented attendance. NMFS staff also attended the Bering Straits Regional Conference and the Tanana Chiefs Conference annual meeting. At each meeting, Council staff provided a 30 to 45 minute presentation on the Council process, outreach efforts, a review of the Council's previous action on Bering Sea Chinook salmon bycatch, and the proposed action on chum salmon bycatch reduction measures. Council members and staff were then available to answer questions.

In addition, Council staff provided a presentation of the proposed action at the Yukon River Panel meeting in April 2010, and again in December 2010 in Anchorage. The Yukon River Panel is an international advisory body established under the Yukon River Salmon Agreement[58] for the conservation, management, restoration, and harvest sharing of Canadian-origin salmon between the U.S. and Canada. Three Council staff members attended the December meeting and responded to questions on both the Bering Sea chum salmon bycatch action and the proposed action on Chinook salmon bycatch reduction measures in the GOA pollock fishery.

## Documenting Results

This summary report was prepared to document the outreach process and results of the regional meetings and statewide teleconference. This report will be presented to the Council, in conjunction with the initial review draft analysis, in June 2011, when the Council is scheduled to review that analysis and could select a preliminary preferred alternative if desired. As stated previously, this report will also be included

[58]This agreement constitutes Chapter 8 of the Pacific Salmon Treaty: www.psc.org/pubs/treaty.pdf.

in the final analysis submitted to the Secretary of Commerce after the Council selects a final preferred alternative.

Council staff documented comments provided at the regional meetings, including public testimony.[59] A short summary of each meeting is provided below, as a brief reference. Note that the dates provided below refer to the date on which the Council presentation and comments occurred, recognizing that each meeting was typically two to three days. Resolutions or motions on the issue resulting from these meetings are provided as **Appendix 3**.

### Yukon River Drainage Fisheries Association annual meeting; February 15, 2011, Mountain Village

The YRDFA Board of Directors is comprised of 30 members from Yukon River communities that represent the various fishing districts, including: Alakanuk, Kotlik, Mountain Village, St. Mary's, Holy Cross, Galena, Kaltag, Tanana, Minto, Nenana, Huslia, Eagle, Scammon Bay, Marshall, Anvik, Nulato, Allakaket, Fort Yukon, Whitehorse, and Haines Junction. The Board is representative of subsistence, commercial, and sportfish salmon users, and processors, and YRDFA has members along the entire Yukon River drainage, which encompasses more than 50 communities. In addition to YRDFA Board members and staff,

The YRDFA Board was concerned with the very limited recent Yukon River fall chum salmon runs. Members emphasized that there seems to be a correlation between high bycatch and the number of salmon returning to the rivers; but that when a species natural productivity is low, even low bycatch years can exacerbate the problem. Thus, there needs to be an effort and incentives to reduce bycatch in both high and low years.

Similar to other regions, the Board was concerned with the 'waste' associated with salmon bycatch, and the need to retain chum and Chinook bycatch as food. The Board pressed for efforts to figure out how to retain more salmon bycatch of a food-grade quality for distribution to village residents in western Alaska. Others related the difficulty in maintaining subsistence fishing, given the high price of gas and the limited fishing windows (e.g., burning 25 gallons per 24-hour window, and harvesting much fewer, smaller, salmon). Members emphasized that this type of information, and the cultural importance and dependence on salmon as the mainstay of the village diet, should be included in the impact analysis.

Members were concerned with subsistence users, both western Alaska residents and tribal members, not being heard in the Council process. Several members noted that tribes and tribal members have their own questions and concerns that need to be addressed, and that there should be a priority to start and continue a dialogue between the tribes and the Council. A direct, consistent relationship, and the ability to have this type of one-on-one communication, is essential. One member stated that the hope is that the salmon stocks will start increasing, and that the Council and YRDFA need to show each other that they are engaged in meaningful efforts to facilitate a rebound. Mandatory, year-round closure areas were mentioned by multiple members as an approach the Council should take.

The Board also had many specific questions about the way the pollock fishery operates, the seasons, the number of vessels in the various sectors, the status of salmon excluder devices, observer coverage, monitoring and enforcement of the provision of Amendment 91, and the differences between the timing of Chinook and chum bycatch in the Bering Sea. They also wanted a summary of the effectiveness of the current voluntary rolling hotspot closure system, as many residents along the river have varying perspectives and have heard conflicting information.

[59] In addition, all of the Federal Subsistence RAC meetings are recorded and transcribed.

Public comment was also taken – two people testified on the importance of chum salmon to the communities in the region and Alaska Native culture.

### Bering Strait Regional Conference; February 23, 2011; Nome

This conference was organized by Kawerak, Inc. and brought together residents of 20 villages in the Norton Sound region to discuss education, health care, and natural resource issues. Due to weather, Council staff was unable to get to Nome, so NMFS (Sally Bibb, AKR) participated in the panel discussion on resource issues in their place, and presented an overview of the Council process, the chum salmon bycatch analysis, and the Northern Bering Sea Research Plan to approximately 75 people. Conference participants made the following comments: (1) Norton Sound is one of the areas hit hardest by poor chum salmon returns and is the only area of the state that has Tier II management for subsistence fishing for chum salmon, (2) the hard cap for Chinook salmon implemented under BSAI Amendment 91 is too high and represents a level of bycatch that is above the actual bycatch levels of most of the last 20 years, (3) the Seward Peninsula Federal Subsistence Regional Advisory Council recommended a hard cap of 30,000 chum salmon for the Bering Sea pollock fishery, which is a cap level that currently is not included in the Council's range of alternatives, and (4) trawling should not be allowed in the Northern Bering Sea Research Area because of the sensitivity of the shallow bottom and the importance of the resources in this area to the people of Norton Sound.

NMFS AKR also manned a table at the conference with Protected Resources, Alaska Fisheries Science Center, and US Fish and Wildlife Service staff to have one-on-one conversations with conference attendees and to answer questions about protected resources and fisheries management issues. Most people stopping by the table were interested in marine mammal issues, specifically walrus and ice seals, although several people reiterated the comments that they made relevant to the panel presentation.

### Yukon-Kuskokwim Delta Subsistence Regional Advisory Council; February 23, 2011, Mountain Village

The Yukon-Kuskokwim Delta RAC is comprised of 12 members, from the communities of Kalskag, Kwethluk, Tuluksak, Eek, Tuntutuliak, Bethel, Alakanuk, Pilot Station, Kotlik, Hooper Bay, and Mountain Village. Approximately 40 people attended, including State and Federal agency staff and local residents. The discussion included both Chinook and chum salmon bycatch. The majority of the discussion on chum salmon was about accounting reliability, salmon discards and retention requirements, and the potential to use more chum bycatch for food through the food bank system. The RAC requested further information on the Sea Share program and the percentage of salmon bycatch that is retained for food through that program. The RAC was very concerned with whether discards of salmon were occurring, and the general reliability of the observer and catch accounting information.

### Western Interior Subsistence Regional Advisory Council; March 2, 2011, Galena

The Western Interior RAC meeting attendees included RAC members, State and Federal agency staff, YRDFA staff, and community members (estimate of 60 total participants). The region the RAC represents encompasses 27 villages along the Yukon and Kuskokwim rivers, and the 10 RAC members are from McGrath, Ruby, Aniak, Galena, Wiseman, Allakaket, Holy Cross, Anvik, and Huslia.

The RAC asked how a hard cap system is different from an allocation of salmon bycatch, and asked what types of incentives are in place to keep the pollock fleet from fishing up to the cap every year. It was later discussed that the Council should focus on disincentives to catching salmon as bycatch, as opposed to incentives. One disincentive could be requiring the retention, freezing, and distribution of salmon bycatch to Western Alaska communities and tribal councils, for both genetic sampling and food. The RAC conveyed that there needs to be strong disincentives to reduce the destruction and waste of such an important food source. Members also discussed the substitutability of salmon species: if subsistence users must give up Chinook salmon to bycatch or other factors, (fall) chum salmon becomes increasingly important to mid – to upper Yukon River communities. At the same time, it was noted that additional salmon in the food bank provides limited benefits; it does not help meet annual or long-term escapement goals. Members emphasized the vulnerability of the salmon stocks; in a year that escapement goals are not met, it lowers the productivity of the river for many years.

The RAC also wanted an explanation of how the Council balances the national standards of minimizing bycatch (e.g., of salmon) and achieving optimum yield (e.g., in the pollock fishery). There were questions about how flexible each Council may be in interpreting the national standards, and whether any priority system or guidance is formalized. The RAC also questioned the need to maximize pollock catch, and whether there is an inherent problem with not meeting optimum yield.

The RAC strongly recommended that additional funding for new genetics data be provided for salmon stocks of concern, in order to better delineate stock of origin. Specific stocks mentioned were the Norton Sound and Chukchi chum salmon stocks. This spurred discussion of the current state of the genetics data and how refined the analysis will be in terms of breaking out (bycatch) stocks by river system.

In terms of alternatives, RAC members stated that a shorter pollock season is a feasible alternative that should be included for consideration, since the fleet is on the water for 9+ months of the year. While bycatch in the pollock fishery is not the only contributing factor to lower salmon returns, the Council should consider a management strategy to reduce the fishing pressure for a period during the year, since salmon spend so much of their life cycle in marine waters. A similar alternative was recommended by the RAC for consideration under the Chinook salmon bycatch reduction measures, but was not included by the Council for analysis.

Ethics issues and appointments were also discussed, as RAC members asked about the current composition of the Council and the perception that it is skewed toward the trawl industry. Staff reviewed the representation of the currently appointed members of the Council and reiterated the appointment process and terms. The RAC was interested in who to contact regarding having a seat on the Council that represents subsistence and tribal issues.

The agenda item closed with a resolution to work with YRDFA, tribes, and communities to develop a position on the chum salmon bycatch issue prior to or during the June 2011 Council meeting. In addition, the RAC approved sending a member to attend the June 2011 Council meeting.

### Eastern Interior Subsistence Regional Advisory Council; March 3, 2011, Fairbanks

The Eastern Interior RAC is comprised of 12 members, from the communities of Eagle, Tok, Tanana, Fort Yukon, Central, Manley Hot Springs, North Pole, and Venetie. The Eastern Interior RAC meeting was comprised primarily of RAC members and State and Federal agency staff, with a few community members and non-profit groups represented (estimate of 60 total participants). The Eastern Interior RAC represents thirteen villages along the Yukon or Tanana rivers and an additional seventeen villages within the region.

Overall, the RAC emphasized the severe dependence in the Upper Yukon on chum salmon, both to provide food for local residents and to support dog teams for transportation.

The Eastern Interior RAC was very concerned with the level and preciseness of genetics data, and asked for further explanation of the new ‘census approach’ to sampling under BSAI Amendment 91, compared to the previous system of sub-sampling of catch. There were detailed questions about how the sampling is done, and whether otoliths are used for genetic sampling, to determine the level of hatchery salmon in the bycatch. Staff committed to researching and responding to this question after the meeting.[60]

The RAC also questioned whether the Bering Sea pollock fleet is generally able to catch the entire pollock TAC; discussion ensued about this being the first year of implementation for Amendment 91 and that the fleet stood-down for about the first 10 days of the A season in an effort to avoid Chinook salmon. Members were concerned with the significant increase in the pollock TAC in 2011 and possible ramifications relative to bycatch. They questioned whether they should assume a higher TAC means that the fleet will be fishing longer. The response and discussion centered on the concept that a higher TAC does not necessarily mean higher bycatch or bycatch rates. The pollock TAC is higher as a result of increased pollock abundance resulting from the annual stock assessment; in effect, it may reduce the need to prospect for pollock, and allow the pollock fleet an opportunity to look for better, cleaner fishing grounds. The pollock seasons would not be affected, and it is uncertain whether the duration of the fishery would change. The RAC also asked for an update on the research and use of salmon excluder devices.

At the close of the agenda item, the RAC related concerns with the length of time it takes to have a management action implemented. From the time a problem is identified (such as salmon bycatch) to a solution being implemented, it can take 3 to 4 years. Members asked whether the Council has discussed the possibility of reducing the Federal requirements associated with its analytical process (i.e., NEPA) and made recommendations to that end to the Federal government. The RAC stated appreciation for the face-to-face dialogue with Council members and staff, and reiterated the need to continue to strengthen a working relationship.

### Bristol Bay Subsistence Regional Advisory Council; March 9, 2011, Naknek

The Bristol Bay RAC is comprised of 10 members, from the communities of Togiak, Naknek, King Salmon, Chignik Lake, Dillingham, Manokotak, and Iliamna. The Bristol Bay RAC meeting was comprised primarily of RAC members and Federal agency staff, with a few public participants and one ADF&G staff person (estimate of 25 total participants). The Bristol Bay RAC represents 31 Bristol Bay subsistence communities and rural residents.

Regarding Chinook salmon measures, the RAC emphasized the importance of Chinook salmon as a subsistence food and noted lower returns (and smaller fish) in their region. They asked on what the existing (performance) cap of 47,591 Chinook salmon was based under Amendment 91. For chum salmon, one RAC member noted that hard caps should be targeted (more restrictive) during the months in which the data indicate that a higher proportion of the bycatch is salmon originating from western Alaska river systems (e.g., under Alternative 3).

The RAC also supported requiring that bycaught salmon is received, stored, and donated in a condition fit for human consumption, and wanted the industry to make progress on providing the infrastructure for distribution to rural Alaska residents in areas that are experiencing very low salmon returns. One member noted that salmon not fit for human consumption could still be used to feed dog teams. The requirement to count and then discard salmon is counter-intuitive to the concept of not wasting salmon under any abundance conditions. Like the Western Interior RAC, the Bristol Bay RAC emphasized the need for disincentives to encounter salmon (i.e., the cost of retaining, freezing, storing, and distributing to food banks) as opposed to incentives for cleaner fishing. Like other RACs, the Bristol Bay RAC requested the specific amount and percentage of salmon bycatch that is currently processed and distributed to food banks.

[60]The response was provided from Diana Stram, Council staff, to KJ Mushovic, coordinator for the EI RAC, USFWS, via email on April 20, 2011.

The RAC was also interested in the areas identified for closure under Alternative 3, specifically, what years were used to identify those areas (2003 – 2010), and whether a more restrictive trigger cap could be established for specific months to avoid more western Alaska bound chum salmon. They also asked whether it is typically the majority of the fleet that operates in those high bycatch areas or just a few vessels, and whether the closures identified for each month represent a 40%, 50%, or 60% reduction in historical bycatch for each month, across the entire B season, or both.

The RAC emphasized that the Council and analysis should recognize that while the genetic data limit the analysis to impacts on river systems on an aggregate basis (e.g., western Alaska; upper and middle Yukon River), there are some very small, vulnerable streams whose relatively small runs are crucial to various subsistence communities. The example provided was the Naknek River: the entire Chinook run may be 5,000 fish, but this is a very important food source to many tribes and communities in the Bristol Bay region. A similar situation exists for chum salmon. The RAC was interested in how impacts on subsistence users would be addressed in the analysis, and whether other potential pollock trawl impacts, such as on marine mammal species and habitat, would be addressed.

Public testimony was taken; one person (WWF) testified that the RAC should recommend a hard cap on chum salmon bycatch in the Bering Sea pollock fisheries. This testimony also provided notice of a roundtable discussion with tribal leaders being scheduled for June 2011 in Nome, during the Council meeting, in order to increase tribal consultation and participation in the Federal fisheries management process. This notice was also distributed at the other RAC meetings attended by Council staff.

### Tanana Chiefs Conference annual convention; March 14, 2011, Fairbanks

The Tanana Chiefs Conference is a tribal consortium of 42 villages in interior Alaska, along the Yukon, Tanana, and Kuskokwim Rivers. Their annual delegate and board of directors meeting was March 14 – 17, in Fairbanks, and the Council presentation was provided under the ‘subsistence issues’ agenda item. About 250 people attended, including the 42 delegates from each of the member villages. After the presentation, a question and answer period was provided for an hour for all attendees.

Overall, participants at the TCC convention emphasized the need to be treated fairly and to participate in the development of fisheries management plans and policies. This participation must be based on meaningful consultation and communication between Federal agencies, the TCC, and Alaska Native villages. One member noted that it is also important to talk to people and conduct outreach in their own villages, as they may be hesitant to speak at the convention.

Members were frustrated by current State management of the commercial and subsistence salmon fisheries that create conflict between upper and lower river salmon users, while at the same time, the Bering Sea pollock fishery is allowed an unlimited amount of salmon bycatch. Yukon River fishermen and communities have been conserving and sacrificing, but the pollock industry could do much more than they have been. Members were frustrated by the level of Chinook bycatch, the waste it represents, believed that there is a direct correlation between high bycatch years and low returns to the river in subsequent years, and reiterated that the current cap is too high. All testifiers implored the Council to recognize that there is a long cultural, spiritual, and dietary dependence on salmon and the ability to subsistence harvest salmon. Residents of remote villages do not have access to substitute foods, and they also need salmon to feed their dogs through the winter.

One testifier stated that the advisory status Alaska Natives are afforded in the Federal and State fisheries management processes in Alaska lead to frustrated attempts to getting the real issues on the table; by contrast, participation by tribes in the Pacific Northwest appears result in more meaningful dialogue and positive outcomes. The discussion included mention that there is not a designated tribal seat on the North Pacific Council, as there is on the Pacific Council, and there needs to be more Alaska Native representation on the current Council. In addition, the North Pacific salmon recovery fund sponsors participation by OR and WA tribes in the management process; the new budget, when passed, amends the provisions of this fund such that Alaska tribes will also have access to these monies.

Another member noted that the 10 year average for Chinook bycatch is decreasing, specifically the years since 2007. They support a lower cap on chum (and Chinook, recognizing the Council has already taken action) and want to encourage a meaningful dialogue to debate the issue prior to a decision. The goal is to pass the right to fish for salmon (both subsistence and commercially) to future generations. A meeting was mentioned in April for salmon users to discuss reducing their take on the lower river to allow salmon to get to the spawning grounds. One member questioned whether ANILCA applies to Council decisions.