Bering Sea Chinook Salmon Bycatch Management

Volume I
FINAL ENVIRONMENTAL IMPACT STATEMENT

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Abstract: The Environmental Impact Statement (EIS) provides decision-makers and the public with an evaluation of the environmental effects of alternative measures to minimize Chinook salmon bycatch in the Bering Sea pollock fishery. The alternatives analyzed in this EIS generally involve limits or "caps" on the number of 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 Chinook salmon bycatch cap is reached, even if the entire pollock total allowable catch has not yet been harvested. This document addresses the requirements of the National Environmental Policy Act and other applicable federal law. The Regulatory Impact Review, in Volume II, provides decision-makers and the public with an evaluation of the social and economic effects of these alternatives to address the requirements of Executive Order 12866, Executive Order 12898, and other applicable federal law.

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EXECUTIVE SUMMARY

This executive summary summarizes the Bering Sea Chinook Salmon Bycatch Management Final Environmental Impact Statement (EIS) and Final Regulatory Impact Review (RIR). The EIS and RIR provide decision-makers and the public with an evaluation of the predicted environmental, social, and economic effects of alternative measures to minimize Chinook salmon bycatch in the Bering Sea pollock fishery. The North Pacific Fishery Management Council's (Council or NPFMC) preferred alternative would be Amendment 91 to the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI FMP). The Draft EIS/RIR/Initial Regulatory Flexibility Analysis served as the central decision-making document for the Council to recommend Amendment 91 to the Secretary of Commerce. This Final EIS is intended to serve as the central decision-making document for the Secretary of Commerce to approve, disapprove, or partially approve Amendment 91, and for the National Marine Fisheries Service (NMFS or NOAA Fisheries) to implement Amendment 91 through federal regulations. This Final EIS, Volume I, complies with the National Environmental Policy Act (NEPA) and other applicable federal law. The Final RIR, Volume II, complies with Executive Order 12866 and Executive Order 12898 and other applicable federal law. The final Initial Regulatory Flexibility Analysis will be published in the classifications section of the preamble to the proposed rule.

The proposed action is to amend the FMP and federal regulations to establish new measures to minimize Chinook 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 up to 95 percent of the Chinook salmon taken incidentally as bycatch in the Bering Sea and Aleutian Islands (BSAI) groundfish fisheries.

Amendment 91 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, Amendment 91 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, Amendment 91 must minimize Chinook salmon bycatch in the Bering Sea pollock fishery to the extent practicable while achieving optimum yield. Minimizing Chinook salmon bycatch while achieving optimum yield is necessary to maintain a healthy marine ecosystem, ensure long-term conservation and abundance of Chinook salmon, provide maximum benefit to fishermen and communities that depend on Chinook salmon and pollock resources, and comply with the Magnuson-Stevens Act and other applicable federal law.

This EIS examines five alternatives to minimize Chinook salmon bycatch in the Bering Sea pollock fishery. The EIS evaluates the environmental consequences of each of these alternatives with respect to ten resource categories:

- Pollock
- Chinook salmon
- Chum salmon
- Other groundfish species
- Other prohibited species (steelhead trout, Pacific halibut, Pacific herring, and crab)
- Forage fish
- Marine mammals
- Seabirds
- Essential fish habitat
- 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 2007, the total value of pollock harvested off Alaska was estimated to be $1.248 billion. In 2008, the total value of pollock increased to an estimated $1.415 billion. 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 2009.

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 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 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. Currently, NMFS allocates 10 percent of the pollock TAC and 7.5 percent of the Bering Sea Chinook salmon prohibited species catch limit to the CDQ Program.

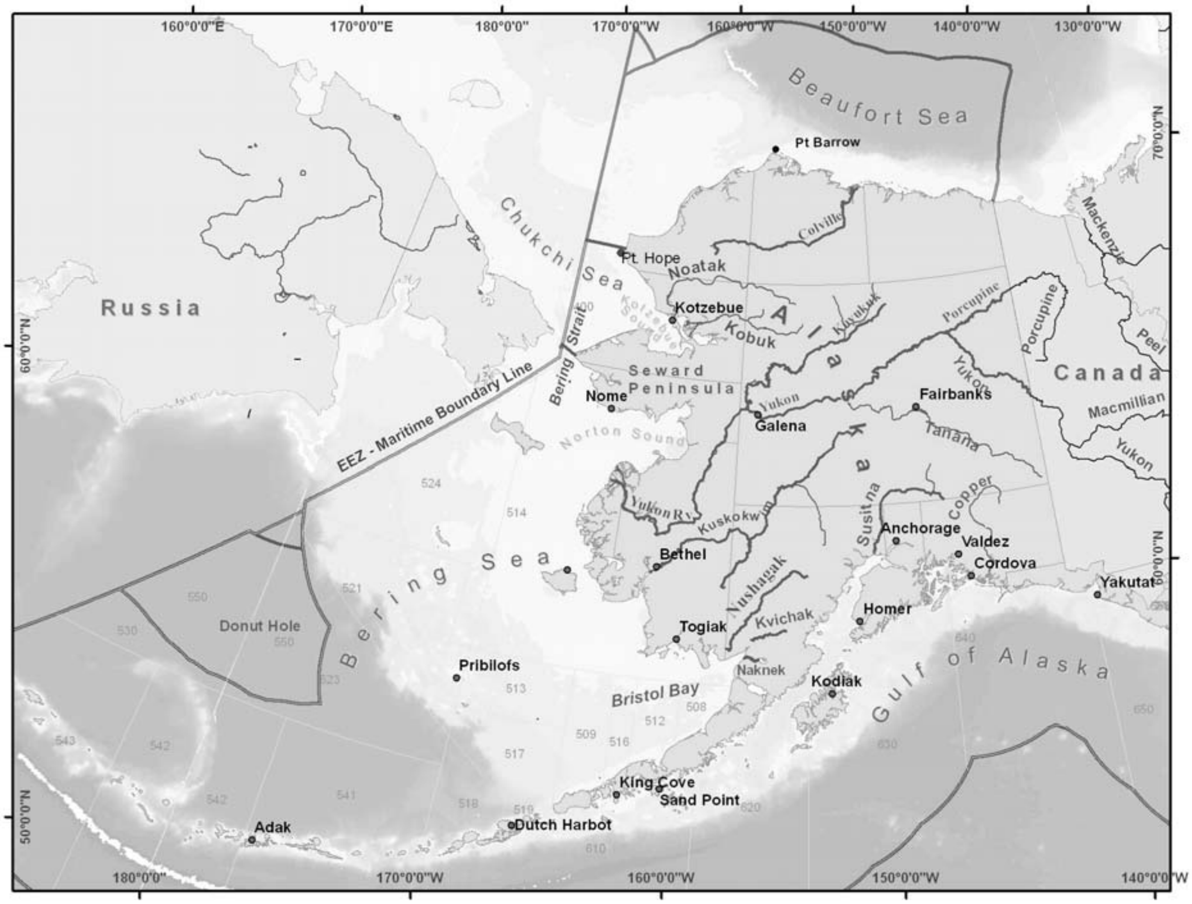

Fig.ES -1 Map of the Bering Sea and major connected salmon producing rivers in Alaska and Northwest Canada

Salmon Bycatch in the 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.

NMFS recognizes the cultural and economic significance of salmon. NMFS also recognizes that 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) 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 and NMFS decided to give priority to Chinook salmon bycatch management and limited the scope of this action to Chinook salmon, because Chinook salmon is a highly valued species and specific protection measures are warranted. The Council and NMFS are considering how to address non-Chinook salmon (primarily chum salmon) bycatch in the Bering Sea pollock trawl fishery is a separate action. Until then, existing non-Chinook salmon bycatch control measures will remain in effect.

Several management measures are currently used to reduce salmon bycatch in the Bering Sea pollock fishery. In the mid-1990s, the Chinook Salmon Savings Areas, which are large area closures, and year-round accounting of Chinook salmon bycatch in the trawl fisheries were implemented. After several amendments to the management measures since 1995, the current regulations require that once Chinook salmon bycatch in the Bering Sea pollock fishery reaches 29,000 salmon, the Chinook Salmon Savings Areas are closed to pollock fishing. The savings areas were adopted based on areas of high historic observed salmon bycatch rates and were designed to avoid areas and times of high salmon bycatch.

From 1992 through 2002, the annual average Chinook salmon bycatch in the pollock fishery was 32,665 Chinook salmon. Chinook salmon bycatch numbers increased substantially from 2003 to 2007. The average bycatch from 2003 to 2007 was 74,067 Chinook salmon, with a peak of approximately 122,000 Chinook salmon taken as bycatch in 2007. Table ES-1 shows the number of Chinook salmon taken as bycatch from 2003 to 2009. In 2008 and 2009, Chinook salmon bycatch in the Bering Sea pollock fishery decreased substantially from these historic high levels. The 2008 Chinook salmon bycatch estimate was 20,559 Chinook salmon. The preliminary estimate for 2009 is 12,410 Chinook salmon.

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 Chinook salmon taken as bycatch from 2003 to 2009 (data retrieved on 11/05/2009).[1]

Year	Number of pollock fishing vessels	Pollock TAC (t)	Chinook salmon bycatch (numbers of fish)
2003	107	1,491,760	45,794
2004	109	1,492,000	51,696
2005	106	1,478,000	67,396
2006	103	1,487,756	82,694
2007	105	1,394,000	121,638
2008	106	1,000,000	20,559
2009	103	815,000	12,410

Variation in the total number of Chinook salmon taken each year, and in the seasonal and sector distribution of that catch, is significant. The unpredictability of Chinook salmon encounters in the pollock fishery results from the current lack of understanding of the biological and oceanographic

[1] Chinook salmon bycatch is estimated using the NMFS Catch Accounting System (CAS). The CAS continually revises past bycatch estimates based on new information. Therefore, these numbers change slightly depending on when the analyst retrieved the data from the CAS. NMFS periodically revises the bycatch estimates and posts the most recent estimates on the NMFS Alaska Region webpage at: http://www.fakr.noaa.gov/sustainablefisheries/inseason/chinook_salmon_mortality.pdf. EIS Chapter 3 provides more detailed information on the CAS.

conditions that result in these encounters. In years of historically high Chinook salmon losses to the Bering Sea pollock fishery (2003-2007), the rate of Chinook salmon bycatch averaged 52 Chinook salmon per 1,000 tons of pollock harvested. At this catch rate, Chinook salmon encounters are difficult to predict, let alone to avoid, without vessel cooperation to share information about areas of high Chinook salmon encounters rates. The causes of the decline in Chinook salmon bycatch in 2008 and 2009 are unknown but most likely are a result of a combination of factors including changes in Chinook salmon and pollock abundance and distribution, and changes in fleet behavior to avoid bycatch.

As Chinook salmon bycatch increased in the Bering Sea pollock fishery thought 2007, many Chinook salmon runs in western Alaska declined. Although there are many factors potentially contributing to the reductions in historic run strength, measures to minimize Chinook salmon losses to the trawl fishery could allow more Chinook salmon to remain in the ocean and return to in-river systems. Salmon dependent communities rely on strong salmon runs with more Chinook salmon entering river systems to spawn than are necessary to meet the minimum escapement thresholds. Historically, Chinook salmon numbers returning to western Alaska's rivers have typically exceeded the escapement level needed to sustain the run. This amount of Chinook salmon, over and above the escapement goal, is fully allocated to subsistence, commercial, recreational, or personal-use fisheries.

The Council started considering revisions to existing Chinook salmon bycatch management measures in 2004 when information from the fishing fleet indicated that it was experiencing increases in Chinook salmon bycatch following the regulatory closure of the Chinook Salmon Savings Area. Contrary to the original intent of the savings area closure, Chinook salmon bycatch 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 Chinook salmon bycatch that were more flexible and adaptive.

Since 2006, the pollock fleet has been exempted from regulatory closures of the Chinook Salmon Savings Areas if they participated in a salmon intercooperative agreement (ICA) with a voluntary rolling hotspot system (VRHS). The fleet started the VRHS for Chinook salmon in 2002. It 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. The exemption to area closures for vessels that participated in the VHRS 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 Chinook Salmon Savings Areas in the Bering Sea.

In light of the high amount of Chinook salmon bycatch through 2007, the Council and NMFS are considering new measures to minimize bycatch to the extent practicable while achieving optimum yield. While the VRHS ICA reports on Chinook salmon bycatch indicate that the VRHS has reduced Chinook salmon bycatch rates compared with what they would have been without the measures, and despite the 2008 and 2009 decrease in Chinook salmon bycatch, concerns remain that, under the status quo, the potential exists for a high amount of Chinook salmon bycatch such as experienced in 2007.

Description of Alternatives

EIS Chapter 2 describes and compares five alternatives for minimizing Chinook salmon bycatch, including detailed options and suboptions for each alternative.

Alternative 1: Status Quo (No Action)

Alternative 2: Hard cap

Alternative 3: Triggered closures

Alternative 4: Hard caps with an intercooperative agreement

Alternative 5: Preferred Alternative - Hard caps with incentive plan agreements and a performance standard

The alternatives analyzed in the EIS and RIR generally involve limits or "caps" on the number of Chinook salmon 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 Chinook salmon bycatch cap is reached even if the entire pollock TAC has not yet been harvested.

Alternative 1: Status Quo (No Action)

Alternative 1 would retain the current Chinook Salmon Savings Area (SSA) closures and the exemption for vessels that participate in the VRHS ICA. Only vessels fishing for pollock are subject to the SSA closures and VRHS ICA regulations. Once the pollock fleet reaches the Chinook salmon prohibited species catch limit of 29,000 Chinook salmon, the SSA areas are closed for the remainder of the season. The Chinook salmon prohibited species catch limit is apportioned to the non-CDQ and CDQ fisheries. The pollock fishery can continue to harvest pollock outside of the closed areas. Pollock vessels participating in the VRHS ICA, under regulations implemented for BSAI FMP Amendment 84, are exempt from these closures.

Alternative 2: Hard cap

Alternative 2 would establish separate Chinook salmon bycatch caps for the pollock fishery A and B seasons which, when reached, would require all directed pollock fishing to cease for the remainder of that season.

Alternative 2 contains components, and options for each component, to determine (1) the total hard cap amount and how to divide the total cap between the A and B season, (2) whether and how to allocate the cap to sectors, (3) whether and how salmon can be transferred among sectors, and (4) whether and how the cap is allocated to and transferred among CV cooperatives.

Setting the Hard Cap

Under this alternative, an annual hard cap would be chosen from a specified range of eight caps from 29,323 Chinook salmon to 87,500 Chinook salmon (Table ES-2). These possible cap levels represent a range of historical averages over specified years, as described in Chapter 2.

Table ES-2 Range of Chinook salmon hard cap suboptions, in numbers of fish

Suboption	Overall fishery cap	CDQ cap	Non-CDQ cap (all sectors combined)
i)	87,500	6,562	80,938
ii)	68,392	5,129	63,263
iii)	57,333	4,300	53,033
iv)	47,591	3,569	44,022
v)	43,328	3,250	40,078
vi)	38,891	2,917	35,974
vii)	32,482	2,436	30,046
viii)	29,323	2,199	27,124

For the analysis, a subset of four caps that include the upper and lower endpoints of the range, and two equidistant midpoints, were used to understand the impacts of Alternative 2 (Table ES-3).

Table ES-3 Range of Chinook salmon hard caps, in numbers of fish, for use in the analysis

Chinook	CDQ	Non-CDQ
87,500	6,563	80,938
68,100	5,108	62,993
48,700	3,653	45,048
29,300	2,198	27,103

Seasonal division of the hard cap

The annual cap would then be divided between the A and B seasons based on one of four percentage splits (Table ES-4).

Table ES-4 Seasonal distribution of caps between the A and B seasons

Seasonal Distribution Options	A season	B season
Option 1-1	70%	30%
Option 1-2	58%	42%
Option 1-3	55%	45%
Option 1-4	50%	50%
Suboption	Rollover unused salmon from the A season to the B season, within a sector and a calendar year	

The suboption would allow the "rollover" of unused Chinook salmon bycatch from the A season to the B season. Rollovers are management actions by NMFS to move Chinook salmon bycatch from one account to another. In this case, rollovers could occur when a sector or cooperative has harvested all of its pollock allocation, but has not reached its A season Chinook salmon bycatch cap. With this suboption, NMFS could move that sector's or cooperative's unused salmon bycatch from its A season account to that sector's or cooperative's B season account.

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-5. 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.

Table ES-5 Sector apportionment options for the Chinook salmon bycatch cap

Options	CDQ	Inshore CV	Mothership	Offshore CP
No sector allocation	7.5%; allocated and managed at the CDQ group level	92.5%; managed at the combined fishery-level for all three sectors		
Option 1 (AFA pollock allocations)	10%	45%	9%	36%
Option 2a (hist. avg. 2004-06)	3%	70%	6%	21%
Option 2b (hist. avg. 2002-06)	4%	65%	7%	25%
Option 2c (hist. avg. 1997-06)	4%	62%	9%	25%
Option 2d (midpoint)	6.5%	57.5%	7.5%	28.5%

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-6).

If sector level caps are 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 then be prohibited from exceeding its allocation and would be subject to an enforcement action if it exceeded its allocation.

With 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-6 Transfers and rollovers options

	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%

Alternative 3: Triggered Closures

Alternative 3 would establish time and area closures that are triggered when specified cap levels are reached. The cap levels for triggered closures would be set in the same way as those described under Alternative 2 and may be apportioned to sectors. Also similar to Alternative 2, the caps may be allocated to sectors as transferable allocations. Closures would be of a single area in the A season and three areas in the B season. Once specified areas are closed, pollock fishing could continue outside of the closure areas until either the pollock allocation is reached or the pollock fishery reaches a seasonal (June 10) or annual (November 1) closure date.

Management

Triggered area closures could be managed either by NMFS or by the industry through a NMFS-approved ICA. Under NMFS management, once the single trigger cap for the non-CDQ pollock fisheries was reached, NMFS would close the trigger areas to directed fishing for pollock by all vessels fishing for the non-CDQ sectors. The trigger cap allocation to the CDQ Program would be further divided among the six CDQ groups as occurs under status quo. Each CDQ group would be prohibited from fishing inside the closure area(s) once the group's trigger cap is reached.

A NMFS-approved ICA would allow the pollock industry to manage, through its contract, any subdivision of the seasonal trigger caps at the sector level, inshore cooperative, or individual vessel level. The ICA would close areas for the designated group or entity when subdivided caps established by the ICA are reached. The subdivision of the trigger caps under the ICA would not be prescribed by federal regulations. The ICA would decide how to manage participating vessels to avoid reaching the trigger closures as long as possible during each season.

Area Closures

One A season and three B season closure areas in the Bering Sea are proposed for Chinook salmon under Alternative 3. For the A season closure (Fig. ES-2), once the closure is triggered, the area would remain closed for the remainder of the season. For the B season closures (Fig. ES-3), all three areas close simultaneously. If the B season caps are reached before August 15, the B season areas would not close until August 15. If triggered anytime after August 15, the area would close immediately and remain closed for the duration of the season. Fig. ES-1 provides a map of the larger area.

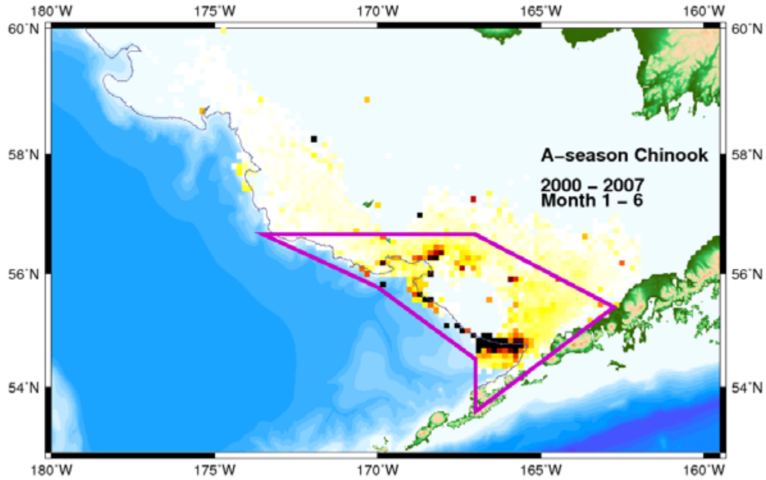

Fig. ES-2 Proposed A season area closure under Alternative 3.

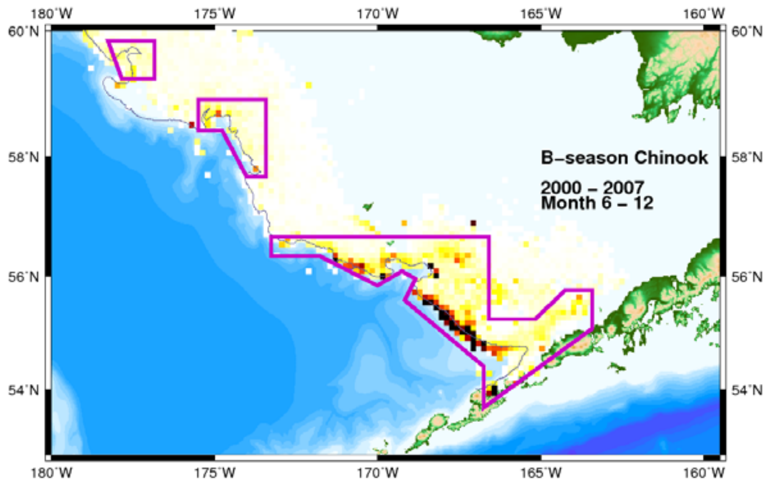

Fig. ES-3 Proposed B season area closures under Alternative 3. Note: all three areas would close simultaneously on or after August 15.

Alternative 4: Hard caps with an intercooperative agreement

Alternative 4 consists of two separate annual scenarios with different caps for each scenario. Under each scenario, a Chinook salmon bycatch cap is established for each pollock fishing season which, when reached, would require all pollock fishing to cease for the remainder of that season. Annual scenario 1 (AS1) contains a dual cap system, with a high cap of 68,392 Chinook salmon for vessels that participate in the NMFS-approved salmon bycatch ICA which provides explicit incentives to avoid Chinook salmon bycatch, and a "backstop" cap of 32,482 Chinook salmon for vessels that do not participate in the ICA. The primary purpose of the ICA is to keep Chinook salmon bycatch as far as practicable below the cap level. Annual scenario 2 (AS2) contains a cap of 47,591 Chinook salmon and does not contain a provision for an ICA. The prescribed sector level caps (and provisions to allocate the caps as transferrable allocations and divide the sector level caps at the inshore CV cooperative level and among CDQ groups) are identical for both the AS1 high cap and the AS2 cap. Each cap would be apportioned 70 percent to the A season and 30 percent to the B season.

Annual Scenario 1 (AS1)

If an ICA is in place that provides explicit incentives for each participant to avoid Chinook salmon bycatch in all years, then the overall cap would be 68,392 Chinook salmon. For each season, the high cap would be divided into separate sector level caps for the CDQ sector, the inshore CV sector, the mothership sector, and the CP sector. All Chinook salmon bycatch by vessels in these sectors that were party to the NMFS-approved ICA with incentives to reduce salmon bycatch would accrue against the sector's specific seasonal cap. If a sector forms the necessary legal entity, NMFS would issue that sector's cap as a transferable allocation. Cooperatives and CDQ groups would receive a transferable allocation. When a sector level cap or transferable allocation is reached, the sector, CDQ group, or cooperative would stop fishing or be subject to an enforcement action if it exceeded its allocation.

Sectors with transferable allocations, CDQ groups, and cooperatives could request NMFS to transfer a specific amount of a salmon bycatch allocation from that entity's account to another entity's account during a fishing season. Allocations would be fully transferable among entities.

Rollovers could occur when a sector, CDQ group, or cooperative has harvested all of its pollock allocation but has not reached its A season Chinook salmon bycatch cap. NMFS would move up to 80 percent of that sector's, CDQ group's, or cooperative's unused salmon bycatch from its A season account its B season account. No rollover would occur from the B season to the A season.

Table ES-7 provides the three cap amounts under Alternative 4 and the associated sector and seasonal allocations.

Table ES-7 A and B season caps, in numbers of Chinook salmon, for Alternative 4, showing both the sector allocation as a percentage and in numbers of Chinook salmon

	Annual scenario 1 (AS1)				Annual scenario 2 (AS2) Cap	
	High Cap		Backstop Cap			
Overall cap		**68,392**		**32,482**		**47,591**
A season allocation (70%):		47,874		22,737		33,314
CDQ	9.3%	4,452	7.5%	1,705	9.3%	3,098
Inshore CV	49.8%	23,841			49.8%	16,590
Mothership	8%	3,830			8%	2,665
Offshore CP	32.9%	15,751	92.5%	21,032	32.9%	10,960
B season allocation (30%):		20,518		9,745		14,277
CDQ	5.5%	1,128	7.5%	731	5.5%	785
Inshore CV	69.3%	14,219			69.3%	9,894
Mothership	7.3%	1,498			7.3%	1,042
Offshore CP	17.9%	3,673	92.5%	9,014	17.9%	2,556

Operations that choose not to participate in the ICA would fish under the backstop cap of 32,482 Chinook salmon. The backstop cap would not be allocated to sectors or cooperatives. Instead, it would be divided between the CDQ (2,436) and non-CDQ (30,046) fisheries. Any AFA vessels or CDQ groups not participating in the ICA would be managed as a group under the backstop cap and prohibited by NMFS from directed fishing for pollock once the backstop cap is reached. Chinook salmon bycatch by the CDQ groups, including the CDQ groups participating in the ICA, would accrue against the CDQ portion of the backstop cap. Chinook salmon bycatch by all non-CDQ vessels directed fishing for pollock, including those vessels participating in the ICA, would accrue against the non-CDQ portion of the backstop cap. This means that salmon bycatch by the ICA vessels would accrue against both the high cap and the backstop cap, but the bycatch by non-ICA participants would only accrue against the backstop cap.

Annual Scenario 2 (AS2)

Under AS2, the Bering Sea pollock industry would be subject to a hard cap of 47,591 Chinook salmon, regardless of whether the industry operated under an ICA with incentives to avoid salmon bycatch. The 47,591 Chinook salmon cap would be subject to the same seasonal apportionments, sector allocations, and rollover and transfer provisions described for the 68,392 Chinook salmon high cap (Table ES-7).

Annual Scenario 1 combined with Annual Scenario 2

If AS1 and AS2 were combined, the Bering Sea pollock fleet would be subject to a cap of 47,591 Chinook salmon, unless industry submits, and NMFS approves an ICA which provides explicit incentives for salmon avoidance. NMFS would increase the cap to 68,392 Chinook salmon if the fishery participant submits, and NMFS approves, an ICA meeting all of the applicable regulatory requirements. Vessels that choose not to participate in the ICA would be subject to the backstop cap.

Alternative 5: Preferred Alternative - Hard caps with incentive plan agreements and a performance standard

Alternative 5 contains two different overall Chinook salmon caps (60,000 Chinook salmon and 47,591 Chinook salmon). The high cap would be available if some or all of the pollock industry participates in a private contractual arrangement, called an incentive plan agreement (IPA),[2] that establishes an incentive program to keep Chinook salmon bycatch below the 60,000 Chinook salmon cap. Alternative 5 would rely on the cap to limit Chinook salmon bycatch in all years and, if the IPA works as intended by the Council, it would provide incentives to keep bycatch below the cap. The 47,591 Chinook salmon cap would apply fleet-wide if industry does not form any IPAs. Both caps would be divided between the A and B seasons and allocated to sectors, cooperatives, and CDQ groups.

Alternative 5’s combination of the high cap, transferable allocations, and one or more IPAs is intended to provide a more flexible and responsive approach to minimizing salmon bycatch than would be achieved by a cap alone. The high bycatch cap of 60,000 Chinook salmon alone would be unlikely to meet the conservation objectives of the Council and would not be expected to minimize Chinook salmon bycatch in most years. Likewise, the bycatch cap of 47,591 Chinook salmon on its own would not provide the desired flexibility to accommodate the high variability in Chinook salmon encounters and the difficulty of avoiding salmon encounters in certain years. Therefore, the Council combined the 60,000 Chinook salmon hard cap with an IPA to encourage Chinook salmon avoidance in all years with the goal that actual salmon bycatch would be below the cap.

To ensure Chinook salmon savings regardless of whether an IPA successfully minimizes bycatch at all levels of salmon encounters, Alternative 5 contains a sector level performance standard. For a sector to continue to receive Chinook salmon bycatch allocations under the 60,000 Chinook salmon cap, that sector may not exceed its performance standard in any three years within seven consecutive years. If a sector

[2] The term IPA under Alternative 5 is the same concept as the ICA under Alternative 4. The term IPA is used under Alternative 5 because participation in the IPA is not limited to AFA cooperatives as it may include individual vessel owners or CDQ groups. In addition, more than one IPA may be approved and an IPA could be created by a single cooperative (so it does not have to involve more than one cooperative or be an agreement among cooperatives).

fails this performance standard, it will permanently be allocated a portion of the 47,591 Chinook salmon cap.

Hard Cap Allocations

Under Alternative 5, each year NMFS would determine the amount of transferable Chinook salmon bycatch allocations available to sectors, cooperatives, and CDQ groups based on their participation in a NMFS-approved IPA and a sector's past bycatch relative to its performance standard. Once each sector, cooperative, or CDQ group reaches its specific allocation in a season, vessels in that sector would be prohibited from pollock fishing for the remainder of that season.

In the absence of any NMFS-approved IPAs, the 47,591 Chinook salmon would be available to the fleet. If some or all fishery participants form one or more IPAs that meet the criteria in regulations, then the high cap of 60,000 Chinook salmon would be available to the fleet. Both the 60,000 Chinook salmon cap and the 47,591 Chinook salmon cap would be allocated to sectors, cooperatives, and the CDQ Program using a method that recognizes that sectors have different fishing patterns and needs for Chinook salmon bycatch in order to harvest their AFA pollock allocation. Table ES-8 shows the percentage allocations and the corresponding Chinook salmon cap levels in each season for each sector. Under the 60,000 and the 47,591 Chinook salmon caps, the inshore and CDQ sector allocations would be further allocated among the inshore cooperatives, inshore open access fishery, and six CDQ groups based on the NMFS-approved percentage allocations of pollock that have been in effect since 2005 (71 FR 51804; August 31, 2006).

Table ES-8 Alternative 5 A and B season allocation percentages and corresponding cap levels for each sector.

Alternative 5	Allocation Percentages	60,000 Chinook salmon	47,591 Chinook salmon
A season allocation:	70.0%	42,000	33,314
CDQ	9.3%	3,906	3,098
Inshore CV	49.8%	20,916	16,591
Mothership	8.0%	3,360	2,665
Offshore CP	32.9%	13,818	10,960
B season allocation:	30.0%	18,000	14,277
CDQ	5.5%	990	785
Inshore CV	69.3%	12,474	9,894
Mothership	7.3%	1,314	1,042
Offshore CP	17.9%	3,222	2,556

Each year, any sector, cooperative, CDQ group, or individual vessel could choose not to participate in, or opt-out of, an IPA. These vessels would then fish under a backstop cap. Each year, NMFS would calculate the amount of the backstop cap as the sum of each opt-out participant's portion of 28,496 Chinook salmon. NMFS would then subtract this backstop cap amount from the 60,000 Chinook salmon hard cap before allocating the resulting cap among sectors according to the percentages in Table ES-8. NMFS would allocate the backstop cap 70 % for the A season and 30 % for the B season. NMFS would manage all vessels fishing under the backstop cap, including vessels fishing on behalf of a CDQ group, as a group under the seasonal backstop cap. NMFS would close directed fishing for pollock by vessels under the backstop cap before the seasonal backstop cap has been reached.

Incentive Plan Agreements

An IPA is a private contract among vessel owners, cooperatives, or CDQ groups that establishes incentives for participants to reduce Chinook salmon bycatch. Alternative 5 includes IPA content requirements, participation requirements, and deadlines for submission to NMFS for approval. Each IPA would be required to be submitted and approved by NMFS prior to fishing under the IPA. If NMFS approves an IPA, those participating in the IPA would fish under the 60,000 Chinook salmon hard cap.

To accomplish reductions in Chinook salmon bycatch, the IPA concept includes two components (1) the NMFS-approved IPA contract that contains the elements of the incentive program that all vessel owners and CDQ groups agree to follow, and (2) the annual report to the Council on performance under the IPA in the previous year.

Transferability and Rollovers

Alternative 5 contains two provisions to provide the fleet the flexibility to fully harvest the pollock TAC while maintaining the overall Chinook salmon bycatch at or below the cap. Transferable Chinook salmon bycatch allocations would enable eligible participants to transfer bycatch allocations among sectors, cooperatives, and CDQ groups, under either the 60,000 or 47,591 Chinook salmon hard caps. Transferability is expected to mitigate the variation in the encounter rates of salmon bycatch among sectors, CDQ groups, and cooperatives in a given season by allowing eligible participants to obtain a larger portion of the bycatch allocation in order to harvest their full pollock allocation or to transfer surplus allocation to other sectors. Additionally, NMFS would rollover any unused Chinook salmon allocation remaining at the end of the A season to the B season for all sectors, cooperatives, or CDQ groups fishing under either the 60,000 or 47,591 Chinook salmon hard caps.

Performance Standard

Alternative 5 includes a performance standard as an additional tool to ensure sectors do not fully harvest the Chinook salmon bycatch allocations under the 60,000 Chinook salmon hard cap every year. With the performance standard, for each sector to continue to receive its allocation of the 60,000 Chinook salmon cap, it could not exceed its annual portion of 47,591 Chinook salmon in any three years within a seven consecutive year period. The performance standard was designed to account for the unpredictability of high Chinook salmon encounters and the fact that a sector may not be able to avoid exceeding its portion of 47,591 Chinook salmon in certain years.

Managing and Monitoring the Alternatives

EIS Chapter 2 also describes how management of the pollock fisheries would change under each of the alternatives and how Chinook salmon bycatch would be monitored. Estimated management and enforcement costs and the impacts of these changes on the pollock fishery are discussed in RIR Chapter 6.

Each of the four alternatives to the status quo includes a cap, or limit, on the amount of Chinook salmon bycatch that may be caught in the Bering Sea pollock fishery. Under Alternatives 2, 4, and 5, all pollock fishing must cease once this cap is reached. Reaching the bycatch cap under Alternative 3 would result in the closure of certain areas important to pollock fishing. Each of the alternatives analyzed includes options that would allocate these Chinook salmon bycatch caps among the AFA sectors and further allocate the inshore sector allocation to inshore cooperatives and the CDQ Program allocation among the six CDQ groups.

The catch of most target species is readily determined using observer and landings data because the target species must be retained, landed, and sold for the vessel owner to receive earnings from that catch. However, prohibited species catch generally is required to be discarded and its catch often limits the catch of economically valuable target species. The greater the potential to limit the target species catch, the greater the incentive created to avoid enumeration of prohibited species. If pollock catch is forgone as a result of the Chinook salmon bycatch caps, vessel owners or CDQ groups will not earn the income that could have been generated by the harvest and sale of that pollock. Each Chinook salmon properly accounted for contributes to the potential limit on the catch of pollock. Any Chinook salmon that is caught but does not get counted by an observer or reported by a vessel owner or processor does not accrue against a Chinook salmon cap and does not increase the potential limit on the catch of pollock. The addition of transferable Chinook salmon bycatch caps further increases the economic incentive to misreport Chinook salmon bycatch because an entity transferring Chinook salmon is likely receive monetary or other benefits in exchange for the transfer.

For these reasons, all of the alternatives to the status quo, but particularly Alternatives 2, 4, and 5, would significantly increase 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. As a result, current methods of estimating Chinook salmon bycatch in the Bering Sea pollock fishery may not be adequate to support monitoring and enforcement of the Chinook salmon caps under any of the alternatives.

To ensure effective monitoring and enforcement of transferable Chinook salmon bycatch caps, NMFS recommends a census, or a count, of all salmon bycatch by all sectors directed pollock fishing in the Bering Sea. An accurate census of Chinook salmon bycatch requires revisions to regulations for observer coverage and equipment and operational requirements for all participants in the Bering Sea pollock fishery. Currently, observer coverage is based on vessel length and 56 of the catcher vessels in this fleet are less than 125 feet length overall, so are required to carry an observer for 30 percent of their fishing trips. Under Alternatives 2, 3, 4, and 5, all catcher vessels, except those delivering unsorted catch to motherships, would be required to carry an observer all of the time that it is directed fishing for pollock in the Bering Sea. In addition, no salmon of any species could be discarded from the catcher vessel. Modifications would be required in the catch monitoring and control plans for the inshore processors to improve the observers' ability to accurately count salmon bycatch sorted from each pollock delivery.

For catcher/processors and motherships, no change in observer coverage would be required because these vessels already are required to carry two observers. Revisions would be made in equipment and operational requirements to ensure that no salmon are discarded before they are counted by an observer. The most significant additional requirement for the catcher/processors and motherships is the requirement to install a video system with a monitor in the observer sample station that provides views of all areas where salmon could be sorted from the catch and the secure location where salmon are stored. Catcher/processors would be required to report the count of salmon in each haul using an electronic logbook supplied by NMFS. No changes in reporting requirements would be needed for motherships, because they already are required to report the number of salmon in each delivery through an electronic landings report.

Alternatives 4 and 5 are more complicated to manage and enforce than the other alternatives, in part, because participants in any given year could be operating under different Chinook salmon cap levels, and under either transferable allocations or non-transferable caps. Prior to the start of each year's fishery, NMFS would be required to identify which cap each of the approximately 120 vessels participating in the pollock fishery is fishing under. During the fishing seasons, NMFS would attribute the catch from each vessel to the appropriate sector's, inshore cooperative's, or CDQ group's allocation, or the backstop cap, and monitor compliance with Chinook salmon bycatch caps for up to 36 different groups of vessels fishing under different Chinook salmon bycatch caps. Alternative 5 would require NMFS to determine whether a sector has failed to meet its performance standard. Also, each alternative includes a provision for an industry contractual agreement with incentives to reduce Chinook salmon bycatch below the high cap. NMFS would be required to review an industry contractual agreement submitted by the pollock industry and approve or disapprove this agreement prior to the start of the pollock fishery.

Consequences of the Alternatives

The specific components as prescribed in Alternative 1, Alternative 4, Alternative 5, the subset of combinations under Alternative 2, and triggered closures under Alternative 3 were analyzed quantitatively for impacts on Chinook salmon, pollock, chum salmon, and the related economic analyses. EIS 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 impact of alternative Chinook salmon bycatch management measures is evaluated by comparing the actual bycatch of Chinook salmon, by season and sector, for the years from 2003 to 2007 with the alternative cap levels and then determining when, if at all, the pollock fishery would have closed. When a cap level would have closed the pollock fishery earlier in a given season than actually occurred, an estimate is made of (1) the amount of pollock TAC that would have been left unharvested, “forgone pollock,” and (2) the reduction in the amount of Chinook salmon bycatch as a result of the closure, “salmon saved.” The estimates of forgone pollock and salmon saved under each alternative are then used as the basis for comparing the relative impacts of the alternatives.

Results presented in EIS Chapter 5 include both overall changes in Chinook salmon bycatch due to alternative management measures, as well as resulting estimates of the amount of Chinook salmon that would have returned to natal rivers as adult fish. Additional information is provided on the relative Chinook salmon and pollock catch inside and outside proposed closures in Alternative 3; however discussion of salmon saved is limited to the cap levels as analyzed in Alternatives 2, 4, and 5. Estimates of the amount of Chinook salmon that would return to natal rivers as adult fish as a result of continued fishing outside of the triggered closures of Alternative 3 could not be evaluated due to the difficulty in modeling the potential effect of displaced effort and the resulting bycatch of specific stocks.

The RIR examines the costs and benefits of the alternatives based on the analysis in EIS Chapters 4 and 5 that estimates the likely dates of pollock fisheries closures and thereby retrospectively projects likely forgone pollock harvest and the number of Chinook salmon that may have been saved. 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 Chinook 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 the changes in Chinook salmon bycatch predicted under the alternatives. The analysis instead relies on estimates of Chinook salmon saved as the measure of economic benefits of the alternatives.

Chinook Salmon

The Chinook salmon taken as bycatch in the pollock fishery originate from Alaska, the Pacific Northwest, Canada, and Asian countries along the Pacific Rim. Estimates vary, but more than half of the Chinook salmon caught as bycatch in the Bering Sea pollock fishery may be destined for western Alaska. Therefore, this document primarily focuses on Chinook salmon bound for western Alaska. Western

Alaska includes the Bristol Bay, Kuskokwim, Yukon, and Norton Sound areas: the Nushagak, Kuskokwim, Yukon, Unalakleet, Shaktoolik and Kwiniuk rivers make up the Chinook salmon index stocks for this region. A general overview of stock status is contained in Table ES-9. In general, these western Alaska Chinook salmon stocks declined sharply in 2007 and declined even further in 2008. In recent years of low Chinook salmon returns, the in-river harvest of western Alaska Chinook salmon has been severely restricted and, in some cases, river systems have not met escapement goals. Additionally, in 2007 and 2008 the United States did not meet the Yukon River Chinook salmon escapement goals established with Canada by the Yukon River Agreement to the Pacific Salmon Treaty of 2002. In 2009, the United States exceeded these escapement goals. EIS Chapter 5 provides an overview of Chinook salmon biology, distribution, and stock assessments by river system or region.

Table ES-9 Overview of western Alaska Chinook salmon stock status for 2008

Chinook Stock	Total run estimated?	2008 preliminary run estimate above or below projected/forecasted	Escapement estimates?	Escapement goals met?	Stock of concern?
Norton Sound	No	Below	Yes	No	Yield concern (since 2004)
Yukon	Yes	Below	Yes	Most in Alaska No-Canadian treaty goal	Yield concern (since 2000)
Kuskokwim	Yes	Below	Yes	Some [3]	No Yield concern discontinued 2007
Bristol Bay	Yes	Below	Yes	Some	No

Chinook salmon support subsistence, commercial, personal use, and sport fisheries in their regions of origin. RIR Chapter 3 provides information on the major Chinook salmon fisheries that occur in the Norton Sound region, Kuskokwim area, the Yukon River, and in the Nushagak and Togiak districts of the Bristol Bay region. The State of Alaska Department of Fish & Game manages the commercial, subsistence, sport, and personal use salmon fisheries. The Alaska Board of Fisheries 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. Highest priority use is for subsistence under both state and federal law. Subsistence fisheries management includes coordination with U.S. federal government agencies where federal rules apply under the Alaska National Interest Lands Conservation Act. Surplus fish beyond escapement needs and subsistence use are made available for other uses. Yukon River salmon fisheries management includes obligations under an international treaty with Canada.

Chinook salmon serve an integral cultural, spiritual, nutritional, and economic role in the lives of Alaska Natives and others who live in rural communities. Many people in western Alaska depend on Chinook salmon as a primary subsistence food. Subsistence salmon fisheries are important culturally and greatly contribute to local economies. In addition, commercial fishing for Chinook salmon may provide a

[3] For the Kuskokwim: 3 of 4 weir goals were below while 3 of 5 aerial goals were below.

significant source of income for many people who live in remote villages and often supports the subsistence lifestyle.

Chinook salmon savings

EIS Chapter 5 analyzes the impacts of the alternatives on Chinook salmon. The first step was to predict the number of Chinook salmon saved under each alternative compared to Alternative 1, status quo. Note that these estimates are based on actual numbers of Chinook salmon taken as bycatch per year and do not represent the numbers of adult Chinook salmon expected to return to their rivers of origin. The second step was to use a model to estimate and analyze the total numbers of adult Chinook salmon that were expected to return to their rivers of origin, called adult equivalents or AEQ. The third step was to analyze the amount of adult equivalent Chinook salmon that would return to specific rivers or regions of origin.

Table ES-10 shows the predicted changes in the amount of Chinook salmon bycatch under each alternative in the highest (2007) and lowest (2003) bycatch years analyzed. For each year, the table indicates the projected fleetwide bycatch, by season and annually, for the Alternative 5 caps and the highest and lowest bycatch combinations of sector and seasonal splits under Alternative 2. The table compares the projected bycatch totals for Alternatives 2 and 5 to the actual bycatch in that year under Alternative 1, and shows the percentage reduction under Alternatives 2 and 5 from the actual bycatch. Note that this analysis does not capture changes in fleet behavior since 2007 or estimate changes in behavior expected to occur in response to any alternative.

Table ES-10 Projected fleetwide salmon bycatch, by season and annually, under Alternative 5, and the lowest and highest bycatch sector and season combinations for Alternative 2, for the highest (2007) and lowest (2003) bycatch years[4].

Bycatch years[3]	Alternative	Bycatch cap	Projected salmon bycatch			Reduction from actual bycatch in that year (Alt 1)
			A season	B season	Annual Total	
2007	Alt 5	60,000	40,718	17,683	58,401	52%
	Alt 5	47,591	32,175	14,208	46,383	62%
Actual bycatch: 121,638	Alt 2, Option 2d sector split, 70/30 season split	29,300	2,801	6,557	9,358	92%
	Alt 2, Option 2a sector split, 50/50 season split	87,500	40,415	36,828	77,243	37%
2003	Alt 5	60,000	33,578	13,113	46,691	0%
	Alt 5	47,591	31,520	13,113	44,633	5%
Actual bycatch: 46,691	Alt 2, Option 1 sector split, 50/50 season split	29,300	11,550	11,084	22,634	52%
	Alt 2[5]	87,500	33,808	13,185	46,993	0

The highest bycatch year analyzed, and the year of highest historical bycatch of Chinook salmon, was 2007. For Alternative 5, in 2007, the 60,000 Chinook salmon cap would have resulted in a 52 percent reduction overall in Chinook bycatch, from the actual amount caught and the 47,591 Chinook salmon cap would have resulted in a 62 percent reduction from the actual bycatch. Under Alternative 2, a reduction of 92 percent was estimated under the most restrictive cap of 29,300 Chinook salmon (with seasonal split of 70/30 and a sector split as noted in option 2d), while the least restrictive cap of 87,500 Chinook salmon

[4] The analytical base years used were 2003-2007, and actual bycatch estimates retrieved from the CAS in 2008.

[5] The following sector and seasonal splits all produced similar results: Option 1 sector split [all seasonal splits equivalent]; Option 2a, [58/42]; Option 2d, [58/42, 70/30].

(with seasonal split of 50/50 and sector split of option 2a) would have resulted in a 37 percent reduction from actual bycatch in that year.

In low bycatch years, the majority of caps under consideration would have minimal impact on annual bycatch amounts. In 2003, the lowest bycatch year analyzed, none of the Alternative 5 cap results in large reductions from the actual bycatch in that year, while under the highest cap under consideration (87,500), no change is evident from Alternative 1. The lowest cap under consideration of 29,300 (split seasonally 50/50 with a sector split under option 1) provides a 52 percent reduction from the status quo. In years when the actual bycatch was well below all of the cap levels, like in 2008 and 2009, none of the cap levels analyzed would have result in salmon saved or pollock forgone.

Adult Equivalent Chinook salmon savings

The second step in the analysis uses a simulation model to compute adult equivalent impacts (AEQ bycatch) from the hypothetical bycatch numbers calculated in the first step. AEQ bycatch takes into account the fact that some of the Chinook salmon taken as bycatch in each year would not have returned to their river of origin in that year. Based on their age and maturity, they might have returned from one to four years later. Some proportion of the bycatch would not have returned in any year due to ocean mortality. AEQ bycatch estimates provide a means to evaluate the impacts to spawning stocks and future mature returning Chinook salmon.

The pattern of bycatch relative to AEQ is variable. In some years, the actual bycatch may be below the AEQ estimates, due to the lagged impact of catches in previous years. For example, in 2000, actual bycatch is below the predicted AEQ bycatch (Fig. ES-4). This is because from 1996 to 1998, the actual bycatch was high. The impacts from high bycatch years show up in the AEQ bycatch in subsequent years.

A similar situation is predicted for the AEQ model results for 2008 because of high bycatch in previous years, especially in 2007. Although 2008 Chinook salmon bycatch was very low, compared to previous years, the impacts from 2007 bycatch will continue to be experienced in river systems for several years to come. This impact analysis does not predict impacts past 2007; however, authors acknowledge that bycatch during the years 2003-2007 will continue to influence adult equivalent salmon returning to river systems for several years into the future.

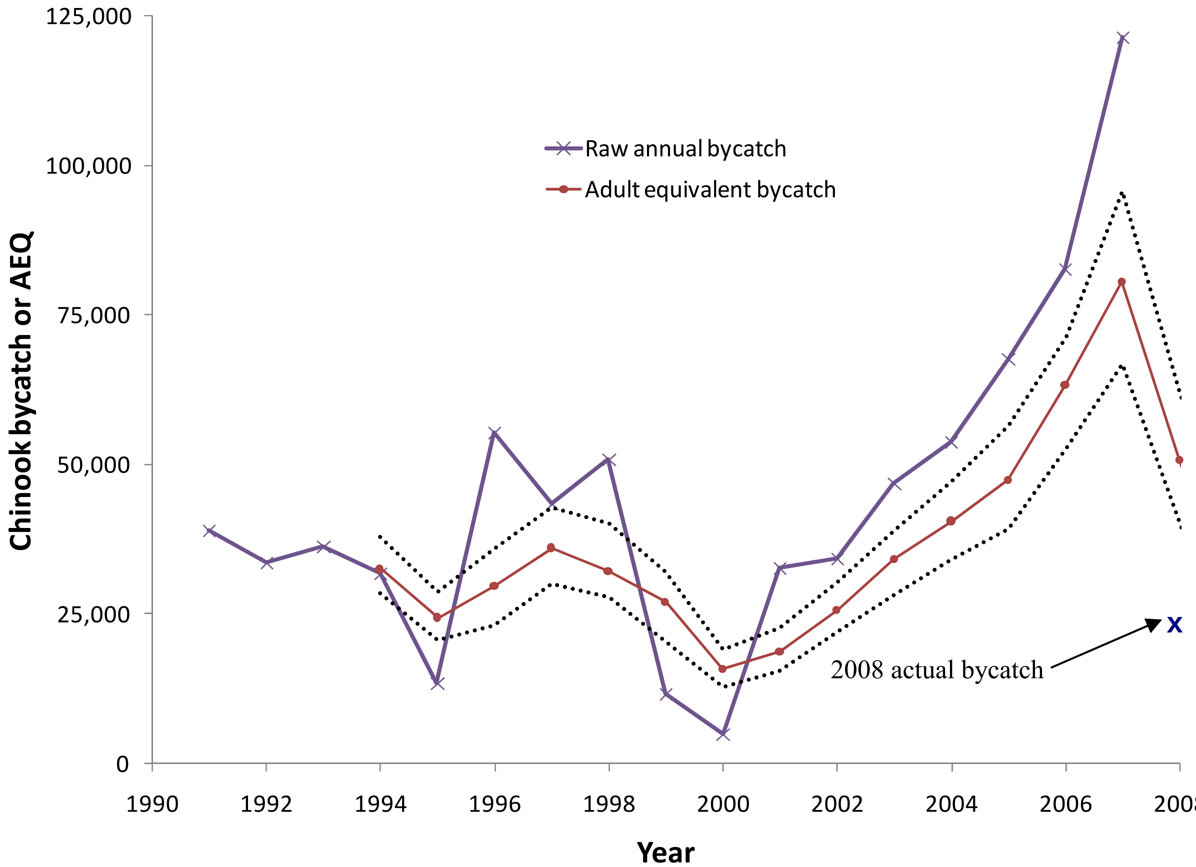

Fig. ES-4 Time series of Chinook actual and adult equivalent bycatch from the pollock fishery, 1991-2007 (2008 bycatch indicated by 'x'). The dotted lines represent the uncertainty of the AEQ estimate, due to the combined variability of ocean mortality, maturation rate, and age composition of bycatch estimates.

For the cap levels in Alternatives 4 and 5, as well as each of the subsets (36 alternatives) analyzed under Alternative 2, if these measures had been in place (and assuming that fleet behavior in the past approximates future behavior), the results indicate that fewer Chinook salmon would have been removed from the system, except in years where bycatch level was already low, like in 2003. Table ES-11 compares the number of Chinook salmon that would have been saved in 2007, if Alternative 5, Alternative 4, or the highest and lowest caps of comparable seasonal and sector combinations of Alternative 2 had been in place.

Table ES-11 Comparison of the total projected reduction in Chinook salmon bycatch and adult equivalent salmon bycatch using 2007 results under Alternative 5, Alternative 4, and the highest and lowest caps of comparable seasonal and sector combinations of Alternative 2.

	Alt 5 60,000 cap	Alt 4 and 5 47,591 cap	Alt 4 68,392 cap	Alt 2 cap 87,500 Opt 2d 70/30	Alt 2 cap 29,300 Opt 2d 70/30
Number of salmon bycatch saved	63,288	75,306	55,307	46,766	112,280
Adult equivalent salmon saved	27,119	40,843	26,928	22,417	65,476

AEQ Chinook salmon returns to rivers of origin

The third step in evaluating Chinook salmon bycatch impacts is to relate the total AEQ salmon saved to particular river systems and regions where the Chinook salmon would return to spawn. Applying available genetics and scale-pattern data showed that the clearest results were for western Alaska river systems. Since the genetics results are limited in the ability to distinguish among these stocks, this analysis uses the results from scale-pattern analyses to provide estimates for western Alaska rivers based on the proportional breakouts of western Alaska Chinook salmon derived from Myers et al. (2003). These values are based on medians from the simulation model and are applied to mean proportional assignments to regions within each stratum - A-season (all areas) and B-seasons (broken out geographically be east and west of 170°W long.). See EIS Chapter 3 for methodology and EIS Chapter 5 for detailed impacts by river system.

Table ES-12 provides a comparison of the distribution of AEQ salmon saved to selected river systems and the relative reduction of AEQ Chinook salmon bycatch by region of origin for a snapshot of one year (2007) under the alternatives. Alternative 5 is compared to results from Alternative 4 and Alternative 2, using the Option 2d sector split for the highest and lowest cap levels (87,500 and 29,300). The 70/30 seasonal split is used for all caps. EIS Chapter 5 contains an analysis of additional scenarios for different caps, seasonal and sector splits.

This table shows the increases in AEQ Chinook salmon saved by river systems from the estimated AEQ returns under Alternative 1. Results for aggregate groupings for the Pacific Northwest stocks, the North Alaska Peninsula stocks, Cook Inlet stocks, and Transboundary stocks are shown in the analysis for comparison of their relative trends by alternative. Absolute impacts of aggregate AEQ savings as noted to these rivers systems is not estimable at this time due to the genetic data limitations. However results are shown for inference of trends to various regions and areas.

Table ES-12 Comparison of the projected reduction of adult equivalent salmon bycatch, in number of salmon, by region of origin (based on genetic aggregations) under Alternative 5, Alternative 4, and the highest and lowest caps of comparable seasonal and sector combinations of Alternative 2, using 2007 results. Higher numbers indicate a greater salmon “savings” compared to Alternative 1.

Stocks of Origin[6]	Alt 5 60,000 cap	Alt 4 and 5 47,591 cap	Alt 4 68,392 cap	Alt 2 cap 87,500 Opt 2d 70/30	Alt 2 cap 29,300 Opt 2d 70/30
Yukon	5,396	8,840	5,228	3,299	14,938
Kuskokwim	3,507	5,746	3,398	2,144	9,710
Bristol Bay	4,586	7,514	4,443	2,804	12,697
Pacific Northwest aggregate stocks (PNW)	8,444	11,135	8,489	9,581	15,507
Cook Inlet stocks	912	1,202	1,042	1,010	1,284
Transboundary aggregate stocks (TBR)	617	821	699	670	909
North Alaska Peninsula stocks (N.AK)	2,882	4,389	2,318	2,264	8,594
Aggregate “other” stocks	592	865	534	549	1,495

Relative impacts to individual river systems are highly dependent upon where the fleet fished in a given year, as a river system’s proportional contribution to bycatch varies spatially. Thus, comparative results for the same caps and rivers of origin will be highly variable by year. See EIS Section 5.3.5 for additional results by year and stock of origin. For the highest cap level, results suggest that over 3,000 western Alaska AEQ Chinook salmon would have been saved had those measures been in place in 2006 and 2007. Under the lowest cap level, the number of AEQ Chinook salmon saved returning to western Alaska rivers would have been over 26,000 in 2006 and over 33,000 in 2007. Alternative 5 provides neither the highest nor lowest reduction in adult equivalents to individual river systems, based on the range of caps under consideration.

In a high bycatch year such as 2007, some management options also result in higher AEQ salmon mortalities for some systems (e.g., for a number of options for the middle and Upper Yukon River). Given that Chinook salmon from these rivers tend to be found most commonly in the northwest Bering Sea during the B season, and that the proportion attributed to that stratum increases from the estimated 8 percent to over 44 percent for some options, the relative stock composition of the AEQ bycatch as a whole can change. These complexities reveal the difficulty in predicting how any management action will affect specific stocks of salmon, particularly since the relative effects appear to vary in different years.

Benefits of Chinook salmon savings

RIR Chapter 5 analyzes the benefits of the estimated changes in Chinook salmon savings under the alternatives. The AEQ estimates represent the potential benefit in numbers of adult Chinook salmon that would have returned to individual river systems and aggregate river systems as applicable in the years

[6] For specific information on stocks included in each stock of origin grouping, see Table 3-7 in EIS Chapter 3.

2003 to 2007. 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. Exactly how those fish would be used is the fundamental, and exceedingly difficult, question to answer in order to provide a balanced treatment of costs and benefits.

Measuring the potential economic benefit of Chinook salmon saved, in terms of effects on specific subsistence, commercial, sport, and personal use fisheries is difficult. The proportion of AEQ estimated Chinook salmon that might be taken in each of the various fisheries is a function of many variables including overall run strength, subsistence management strategies, commercial management strategies, availability of commercial markets, the effect of weather on catch (e.g., high water), and potentially, on management of other salmon runs as well. Lacking estimates of the proportion of AEQ Chinook salmon that would be caught by each user group, it is not possible to estimate economic benefits in terms of gross revenues or other monetary values for those user groups due to changes in AEQ Chinook salmon under each alternative.

Without an estimate of changes in commercial catches, it is not possible to accurately estimate changes in gross revenue for the commercial Chinook salmon fishermen from changes in AEQ Chinook salmon under the alternatives. Estimating changes in commercial Chinook salmon gross revenues would require two unrealistic assumptions. First, the analysts would have to assume the portion of the AEQ Chinook salmon that would be caught by the commercial fisheries, such as the simple assumption that the commercial fishery would catch all of the returning AEQ Chinook salmon. This assumption would not be realistic because the subsistence use of Chinook salmon has priority over commercial use. Thus, in some river systems, increases in Chinook salmon returns might be caught wholly by subsistence fishermen.

Second, to estimate changes in gross revenues, one must also make an assumption of average weight per fish and determine an appropriate average price per pound by river system. In some rivers systems, directed commercial Chinook salmon fisheries have not occurred in recent years. Thus, average weight and average price proxy values from other areas would have to be used, which creates additional uncertainty in the estimates of potential commercial value.

Further, the total social and cultural value of subsistence Chinook salmon harvests cannot be evaluated in a way that is directly comparable to the monetary value of potential increases in commercial Chinook salmon catch or forgone gross revenues from the pollock fleet. Estimates of changes to the gross revenues to the commercial Chinook salmon fishery may mask the true subsistence value, tempting the reader to focus on the monetary estimates of commercial value when the non-monetary value of subsistence harvests is very important and not reflected in terms of gross revenues.

For these reasons, the analysis of potential economic benefits is in terms of AEQ estimated Chinook salmon saved and does not provide estimates of a monetary value of the salmon saved. The first step is to evaluate, by year, the overall AEQ salmon saved for Alternative 2, 4, and 5, and season and sector options, as compared to Alternative 1, status quo. Table ES-13 provides this summary comparison by indicating the percentage change in aggregate AEQ estimates of benefits under the alternatives analyzed compared to the estimated historical AEQ by year (2003-2007). This comparison shows that the AEQ benefits of the Alternative 5 range from a less than 1 percent change in AEQ Chinook salmon estimated in 2003, to a high of 52 percent more AEQ Chinook salmon in 2007.

Four cap options for Alternative 2, with the same 70/30 seasonal split and sector divisions (Option 2d), are compared against Alternatives 4 and 5. The Alternative 2 68,100 Chinook salmon cap is considered closest to (though higher than) the Alternative 5 60,000 Chinook salmon cap. Alternative 2 at this cap would have a similar minor benefit in 2003 but in higher bycatch years, like 2007, it would have an estimated 43 percent increase in benefit compared with a 34 percent increase for Alternative 5. For comparison, the highest cap of 87,500 Chinook salmon shows a 28 percent increase in benefits. As with Alternative 5, one can see the range of values that fall in between as bycatch levels generally increased from 2003 through 2007. The highest percentage change from status quo occurs with the lowest cap considered (29,300) in the highest bycatch year (2007) which results in an estimated 83 percent increase in the AEQ Chinook salmon savings in that year.

Table ES-13 Percentage change in adult equivalent Chinook salmon savings from Alternative 1, status quo, between Alternative 4 and 5 caps and closely comparable management options in Alternative 2, for the years 2003 to 2007.

	2003	2004	2005	2006	2007
Alt. 1 AEQ Chinook salmon	**33,215**	**41,047**	**47,268**	**61,737**	**78,814**
Alt 5 60,000 cap	<1%	7%	17%	24%	34%
Alt 4 68,392 cap	<1%	7%	16%	22%	34%
Alt 4 and 5 47,591 cap	2%	11%	24%	40%	52%
Alt 2 87,500 cap, opt 2d, 70/30	1%	7%	19%	21%	28%
Alt 2 68,100 cap, opt 2d, 70/30	0%	10%	23%	34%	43%
Alt 2 48,700 cap, opt 2d, 70/30	12%	18%	29%	51%	64%
Alt 2 29,300 cap, opt 2d, 70/30	42%	45%	51%	67%	83%

These results are for the total AEQ Chinook salmon saved by year to give an overall impression of the relative magnitude of effects for all river systems to compare against the constraints on the pollock fishery. Individual benefits of AEQ Chinook salmon returning to specific river systems is evaluated next, with a particular focus on river systems in western Alaska because proportional break-outs were only possible for western Alaskan-origin Chinook salmon. Our ability to provide results relating salmon saved to specific rivers of origin is limited by the aggregate genetic data employed in this analysis. Further discussion of this is included in EIS Chapter 3.

While it is very difficult to retrospectively assess the specific impacts or management implications of additional AEQ Chinook salmon to a given river system, it is reasonable to assume that any additional fish would benefit escapement and harvest according to the priorities outlined above. However, management decisions in the lower Yukon and Kuskokwim Rivers must be made long before adequate information on escapements is available and if additional AEQs of unknown stock origin were spread throughout the run, how management actions might specifically provide for greater stock-specific escapements is uncertain. Regardless, any additional fish in the run would presumably help to achieve escapement goals, and there is demonstrable benefit even from missing the escapement goal by a smaller amount of fish. Similarly, it is difficult to predict the impacts of additional fish to particular subsistence fishermen or even to the subsistence harvest as a whole. If escapement goals are projected to be met, it is logical that subsistence fishermen would directly benefit from increased run sizes of any magnitude.

Table ES-14 summarizes some management indices for the Yukon River, Kuskokwim River, and Bristol Bay, in conjunction with the restrictions that were imposed over the time period considered, and discusses what, if any, management changes could have been made given the projected changes in AEQ Chinook salmon returns indicated in this analysis. No subsistence fishery restriction occurred in the Kuskokwim, Yukon, or Bristol Bay from 2003 to 2007; however some fishermen reported that it took them longer to catch their needed number of Chinook salmon. There are direct cost increases associated with the need for increased time, effort, and resources (fuel, equipment wear and tear) necessary to approach individual subsistence needs. Where increases in run size contribute to achieving escapement goals and satisfying subsistence needs, one would expect some benefit to the commercial fishery as well. In the Yukon-Kuskokwim Delta, commercial fishing represents an important economic impact to local communities and in many respects, facilitates the pursuit of subsistence living with needed cash for supplies and equipment. The predicted benefits of additional AEQs to commercial fishermen may depend greatly on when the fish are available to the fishery in relation to managers' assessments of escapement and subsistence harvest.

Table ES-14 Summary of Chinook salmon escapement goals obtained, restrictions imposed, and potential management changes with additional AEQ Chinook salmon returns to rivers over the time period from 2003 to 2007.

<table>
<tr><th rowspan="2">River</th><th rowspan="2">Escapement met from 2003-2007</th><th colspan="3">Additional restrictions imposed from 2003-2007</th><th rowspan="2">Likely management changes if additional AEQ salmon had been available 2003-2007</th></tr>
<tr><th>Subsistence</th><th>Commercial</th><th>Sport</th></tr>
<tr><td rowspan="2">Yukon</td><td>2006 some key goals not met</td><td colspan="3">More conservative management plan imposed since 2001</td><td rowspan="2">2006-2007 additional fish would accrue towards meeting escapement; in all years increased potential for higher subsistence and commercial harvest</td></tr>
<tr><td>2007 Treaty goal not met</td><td>2007 Canada</td><td>Below average 2005-2007</td><td>2007 Canada</td></tr>
<tr><td rowspan="2">Kuskokwim</td><td>Most</td><td colspan="3">More conservative management plan imposed 2001-2006</td><td rowspan="2">Potential for increased commercial harvests within market constraints</td></tr>
<tr><td>2007 Most</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td>Bristol Bay (Nushagak)</td><td>2007 goals not met</td><td>No</td><td>No</td><td>2007</td><td>If sufficient additional to meet escapement then 2007 sport fish restriction would not have been imposed;
In all years additional fish towards escapement, increased potential for higher subsistence and commercial harvest</td></tr>
<tr><td>Norton Sound subdistricts 5 and 6</td><td>2003-2006 Unalakleet goal not met</td><td>2003-2004; 2006-2007</td><td>2003-2007</td><td>2003-2004; 2006-2007</td><td>Additional fish would accrue to escapement</td></tr>
</table>

Note that, according to the Alaska Department of Fish & Game, in general, the western Alaska Chinook salmon stocks declined sharply in 2007 and declined even further in 2008. In some of these areas, the 2008 Chinook salmon run was one of the poorest on record. The 2008 total run estimates from each of these river systems were below the projected or forecasted run sizes and despite conservative management, many of the escapement goals were not met. Limited directed Chinook salmon commercial fisheries occurred in the Yukon River or in Norton Sound, and only small commercial fisheries occurred in the Nushagak and Kuskokwim Rivers. Sport fisheries were restricted in the Yukon, Unalakleet, and Shaktoolik Rivers. More significantly, the subsistence fisheries in the Yukon River and in the Unalakleet and Shaktoolik subdistricts of Norton Sound were restricted. EIS Chapter 5 and RIR Chapter 3 provide more information about the 2008 run sizes and Chinook salmon fisheries.

Table ES-15 through Table ES-18 show the AEQ Chinook salmon savings results for the Yukon River, Kuskokwim River, Bristol Bay, and total western Alaska compared with commercial, subsistence, and sport catch over the analytical time period considered. Personal use catch is a very small component of the subsistence catch. Just as with estimating the total changes in catches in the commercial Chinook salmon fisheries from AEQ salmon saved discussed above, it is not possible, with presently available information, to determine the proportions of river specific AEQ estimates of returning adult Chinook salmon that would be caught in commercial, subsistence, and sport fisheries in these western Alaska river systems.

Kuskokwim River

In the Kuskokwim River, most escapement goals were met during the period from 2003 to 2007 and there were no restrictions to subsistence or sport fisheries beyond those provided for in state regulation. If additional fish had returned in these years, the commercial harvest may have been higher in some years, though poor chum salmon markets and lack of buyer capacity may have precluded more commercial fishing. Processor capacity increased with completion of a large facility in the area in 2009, so future additional AEQ Chinook salmon returns could directly benefit commercial fishermen.

Table ES-15 provides Kuskokwim area specific catch, by harvesting sector and by year, compared to AEQ Chinook salmon estimates for Alternatives 4 and 5, and for high and low caps under Alternative 2. The Kuskokwim AEQ estimates for the Alternative 4 range from -214[7] Chinook salmon under the 68,392 Chinook salmon cap in 2003 to 5,746 Chinook salmon under the 47,591 Chinook salmon cap in 2007. The Kuskokwim AEQ estimates for the Alternative 5 60,000 Chinook salmon cap range from -36 Chinook salmon in 2003 to 3,507 Chinook salmon in 2007. This simply indicates that the greatest benefit, in terms of numbers of returning adult Chinook salmon, would occur for the lower bycatch cap in years with the highest Chinook salmon bycatch. This also holds for the cap examples shown for Alternative 2, with the lowest benefit of 365 more Chinook salmon returning occurring under the highest cap of 87,500 in 2003. The greatest benefit, in the Kuskokwim areas, under Alternative 2 would be 9,710 more Chinook salmon returning, which occurs under the lowest cap of 29,300 and in the high bycatch years of 2006 and 2007.

Comparing these numbers to subsistence catches, which have priority over all other uses once escapements have been met, reveals that historic Kuskokwim area subsistence catches are much larger than the estimated increases in AEQ Chinook salmon returns under Alternatives 2, 4, and 5. However, commercial and sport catches are smaller than many of the AEQ estimates, indicating potential benefits to commercial and sport fishermen in the area.

[7] In years when the actual bycatch was below a given cap level, this could have resulted in negative AEQ salmon savings (i.e., more, not fewer, salmon were prevented from spawning than actually occurred). This can happen when the combined cumulative effect from prior years bycatch levels are low in some seasons and sectors and high in others.

Table ES-15 Kuskokwim area annual Chinook salmon catch, by fishery, compared to AEQ Chinook salmon savings estimates for Alternatives 2, 4, and 5 (2003-2007).

Kuskokwim Area					
Catch and AEQ Estimates	Year				
	2003[6]	2004	2005	2006	2007
Commercial Catch	158	2,300	4,784	2,777	179
Subsistence Catch	67,788	80,065	70,393	63,177	72,097
Sport Catch	401	857	1,092	572	2,543
Total Catch	68,347	83,222	76,269	66,526	74,819
Alt. 5 60,000 cap	-36	419	1,117	2,331	3,507
Alt. 4 68,392 cap	-214	384	1,269	2,217	3,398
Alt. 4 and 5 47,591 cap	-40	301	1,264	3,849	5,746
Alt. 2, 87,500 cap, opt 2d, 70/30	365	824	1,369	2,144	2,144
Alt. 2, 29,300, opt 2d, 70/30	2,399	3,243	6,361	9,710	9,710

Yukon River

In the Yukon River, for the period from 2003 to 2005, most escapement goals were met and there were no restrictions to subsistence or sport fisheries. Due to generally low run sizes, commercial fisheries were managed conservatively. Any additional fish would have likely increased escapements and contributed to subsistence and commercial harvests. Sport fish harvest is fairly stable and the harvest may be impacted more by water conditions than abundance, unless restricted to meet escapement goals. In 2006 and 2007, some key escapement goals were not met, but there were no restrictions to subsistence or sport fisheries. Additional fish in these years would most likely have accrued to escapement and some additional subsistence harvest. Yukon River Chinook salmon command a high price in commercial markets, but their value to escapement and subsistence fishermen is inestimable.

Table ES-16 provides Alaska Yukon River specific catch, by harvesting sector and by year, compared to AEQ Chinook salmon estimates for Alternatives 4 and 5, and the Alternative 2 high and low caps. The Yukon AEQ estimates for the Alternative 4 range from -329 Chinook salmon under the 68,392 Chinook salmon cap, in 2003, to 8,840 Chinook salmon under the 47,591 Chinook salmon cap in 2007. The Yukon AEQ estimates for the Alternative 5 cap of 60,000 Chinook salmon range from -54 Chinook salmon under, in 2003, to 5,396 Chinook salmon in 2007. This indicates that the greatest benefit, in terms of numbers of returning adult Chinook salmon, would occur under the lower bycatch cap in years with the highest Chinook salmon bycatch. This also holds for the cap examples shown for Alternative 2, with the low being -2 Chinook salmon in 2004, and under the highest cap of 87,500. The greatest benefit, in the Yukon area, under Alternative 2 would be 14,938 fish, which occurs under the lowest cap of 29,300 and in the high bycatch year of 2007.

Comparing Yukon AEQ numbers to subsistence catches, which have priority over all other uses once escapements have been met, reveals that historic Yukon area subsistence catches are much larger than the projected estimates of AEQ Chinook salmon returns under Alternatives 2, 4, and 5. The same is true of historic Yukon commercial catches. However, both Alternatives 4 and 5 would result in AEQ Chinook salmon estimates that are more than 10 percent of the commercial catch in 2007, and considerably larger than sport catch in that year. In 2006, a similar result is seen, although with a slightly smaller percentage. Thus, it is difficult to interpret just how much benefit the projected changes to AEQ Chinook salmon would imply.

Table ES-16 Alaska Yukon River area annual Chinook salmon catch, by fishery, compared to AEQ Chinook salmon savings estimates for Alternatives 2, 4, and 5 (2003-2007).

Yukon River (Alaska)					
Catch and AEQ Estimates	Year				
	2003	2004	2005	2006	2007
Commercial Catch	40,438	56,151	32,029	45,829	33,634
Subsistence Catch	55,109	53,675	52,561	47,710	59,242
Sport Catch	2,719	1,513	483	739	960
Total Catch	98,266	111,339	85,073	94278	92,876
Alt. 5 60,000 cap	-54	645	1,718	3,586	5,396
Alt. 4 68,392 cap	-329	591	1,952	3,409	5,228
Alt. 4 and 5 47,591 cap	-61	463	1,944	5,921	8,840
Alt. 2, 87,500 cap, opt 2d, 70/30	561	-2	1,267	2,107	3,299
Alt. 2, 29,300 cap, opt 2d, 70/30	3,690	3,469	4,989	9,786	14,938

Note: in years when the actual bycatch was below a given cap level, this could have resulted in negative AEQ salmon savings (i.e., more, not fewer, salmon were prevented from spawning than actually occurred). This can happen when the combined cumulative effect from prior years bycatch levels are low in some seasons and sectors and high in others.

Bristol Bay

During the period from 2003 to 2006, escapement goals were achieved and no restrictions were placed on any subsistence, sport, or commercial Chinook salmon fisheries in Bristol Bay. Though additional AEQ Chinook salmon returns would not have changed any management decisions made in those years, additional fish would have benefited all uses while providing additional escapement. In 2007, the sport fish bag limit was reduced to a single fish after July 7 for the Nushagak River. The in-river escapement goal was not achieved despite this restriction. Increased AEQ Chinook salmon returns to Bristol Bay would have mainly accrued towards achieving the in-river escapement goal, and probably would have made the Nushagak sport fish restriction unnecessary. These restrictions have immediate and lasting economic impacts due to continued perception of poor fishing and possible future restrictions. Additional fish might have provided benefits to commercial fishermen, though specific impacts are highly dependent upon the run timing of these fish.

Table ES-17 provides Bristol Bay area catch, by fishery and by year, compared to AEQ Chinook salmon estimates for Alternatives 4 and 5 as well as those for Alternative 2 high and low caps. The Bristol Bay AEQ estimates for the Alternative 4 range from -280 Chinook salmon under the 68,392 Chinook salmon cap in 2003 to 7,514 Chinook salmon under the 47,591 Chinook salmon cap in 2007. The Bristol Bay AEQ estimates for the Alternative 5 60,000 Chinook salmon cap range from -47 Chinook salmon in 2003 to 4,586 Chinook salmon in 2007. This indicates that the greatest benefit, in terms of numbers of returning adult Chinook salmon, would occur under the lower bycatch cap in years with the highest Chinook salmon bycatch. This also holds for the cap levels shown for Alternative 2, with the low being -1 Chinook salmon in 2004, and under the highest cap of 87,500. The greatest benefit, in the Bristol Bay area, under Alternative 2 would be 12,697 Chinook salmon, which occurs under the lowest cap of 29,300 and in the high bycatch year of 2007.

In the Bristol Bay area, in contrast to the Yukon and Kuskokwim areas, commercial fishing takes the largest proportion of harvestable surplus of Chinook salmon, possibly due to the presence of a large sockeye fishery. Comparing Bristol Bay AEQ numbers to catches reveals that historic Bristol Bay area subsistence and sport catches are larger than the Bristol Bay AEQ estimates across under Alternatives 2, 4, and 5, but not by as great a margin as evident in the Kuskokwim and Yukon areas. In addition, historic Bristol Bay area commercial catches are considerably larger than the estimates of AEQ Chinook salmon returns to Bristol Bay. As was the case for the Yukon, however, both Alternatives 4 and 5 would result in AEQ Chinook salmon estimates that approach or exceed 10 percent of the commercial catch in 2007, and that are considerably larger than sport catch in that year. Thus, it is difficult to interpret just how much benefit the estimated changes in AEQ Chinook salmon returns to Bristol Bay would imply and it is variable by year and option.

Table ES-17 Bristol Bay area annual Chinook salmon catch, by fishery, compared to AEQ Chinook salmon savings estimates for Alternatives 2, 4, and 5 (2003-2007).

Bristol Bay Area					
Catch and AEQ Estimates	**Year**				
	2003	**2004**	**2005**	**2006**	**2007**
Commercial Catch	46,953	114,280	76,590	106,962	62,670
Subsistence Catch	21,231	18,012	15,212	12,617	16,002
Sport Catch	9,941	13,195	13,036	10,749	15,200
Total Catch	78,125	145,487	104,838	119,579	78,672
Alt. 5 60,000 cap	-47	548	1,461	3,048	4,586
Alt. 4 68,392 cap	-280	503	1,659	2,898	4,443
Alt. 4 and 5 47,591 cap	-52	394	1,653	5,033	7,514
Alt. 2, 87,500 cap, opt2d, 70/30	477	-1	1,077	1,791	2,804
Alt. 2, 29,300 cap, opt2d, 70/30	3,137	2,948	4,241	8,318	12,697

Note: in years when the actual bycatch was below a given cap level, this could have resulted in negative AEQ salmon savings (i.e., more, not fewer, salmon were prevented from spawning than actually occurred). This can happen when the combined cumulative effect from prior years bycatch levels are low in some seasons and sectors and high in others.

Western Alaska combined

Table ES-18 combines the AEQ and catch estimates discussed above for each of the three major western Alaska river systems for which AEQ estimates are available in order to compare the aggregate effect of the alternatives on western Alaska Chinook salmon runs. Note, however, that genetic data necessary to provide separate AEQ estimates for the Norton Sound area rivers are not presently available. Thus, these estimates do not include Norton Sound.

The western Alaska total (excluding Norton Sound) AEQ estimates for Alternative 4 range from -823 Chinook salmon under the 68,392 Chinook salmon cap in 2003 to 22,100 Chinook salmon under the 47,591 Chinook salmon cap in 2007. The western Alaska total AEQ estimates for the Alternative 5 60,000 Chinook salmon cap range from -134 Chinook salmon in 2003 to 13,085 Chinook salmon in 2007. Under the Alternative 2 cap of 87,500, the smallest increase in returns would have been 821 Chinook salmon in 2004. The greatest benefit, in the western Alaska area, under Alternative 2, would be an estimated increase in returns of 37,345 Chinook salmon under the lowest cap of 29,300 and in the high bycatch year of 2007.

Comparing the combined total of Chinook salmon catches for western Alaska with combined total AEQ estimates reveals that total catches, which are dominated by subsistence catches, are more than ten times larger than the largest estimate of AEQ Chinook salmon returns under Alternatives 2, 4, and 5, in all years except 2007. However, these AEQ estimates, when compared to commercial harvests, can range between 10 percent and 40 percent of the total commercial catch in the highest bycatch year of 2007. Similarly, the AEQ estimates are, in some cases, comparable to sport catches. Thus, while these AEQ estimates appear small relative to the total catch, they may, nonetheless, represent measurable benefit to harvesters. The extent of that benefit is, of course dependent on which option is chosen and what level of bycatch occurred, as well as on the in-season management of the western Alaska salmon fisheries. Further, the aggregate AEQ estimates of all river systems combined produce numbers of AEQ Chinook salmon returns (Table ES-11) that are much larger than the western Alaska subset estimates.

Table ES-18 Total western Alaska (excluding Norton Sound) annual Chinook salmon catch, by fishery, compared to AEQ Chinook salmon estimates for Alternatives 2, 4, and 5 (2003-2007).

Total Kuskokwim, Alaska Yukon, and Bristol Bay					
Catch and AEQ Estimates	**Year**				
	2003	**2004**	**2005**	**2006**	**2007**
Commercial Catch	87,549	172,731	113,403	155,568	96,483
Subsistence Catch	144,128	151,752	138,166	123,504	147,341
Sport Catch	13,061	15,565	14,6	12,060	18,703
Total Catch	244,738	340,048	266,180	280,383	262,527
Alt. 5 60,000 cap	-134	1,545	3,948	8,818	13,085
Alt. 4 68,392 cap	-823	1,478	4,880	8,524	13,069
Alt. 4 and 5 47,591 cap	-153	1,158	4,861	14,803	22,100
Alt. 2, 87,500 cap, opt 2d, 70/30	1,403	821	3,713	6,042	8,247
Alt. 2, 29,300 cap, opt 2d, 70/30	9,226	9,660	15,591	27,814	37,345

Note: in years when the actual bycatch was below a given cap level, this could have resulted in negative AEQ salmon savings (i.e., more, not fewer, salmon were prevented from spawning than actually occurred). This can happen when the combined cumulative effect from prior years bycatch levels are low in some seasons and sectors and high in others.

Comparison of Chinook salmon saved and forgone pollock harvest

Selection of the preferred alternative involved explicit consideration of trade-offs between the potential salmon saved and the forgone pollock catch and of ways to maximize the amount of salmon saved and minimize the amount of forgone pollock. Table ES-19 compares Alternative 2 cap levels (with the sector split options from Table ES-5 and season split options from Table ES-4) with Alternative 4 and Alternative 5 for both their estimated Chinook salmon saved and the forgone pollock over the highest bycatch year analyzed (2007) and the lowest bycatch year analyzed (2003). Note that this analysis compares changes in actual Chinook salmon bycatch, not changes in AEQ bycatch.

In 2007, a 92 percent reduction in Chinook salmon bycatch would have occurred under the cap level of 29,300 Chinook salmon (with the sector and seasonal splits as noted). However, this would be achieved at a cost of 46 percent of the annual total pollock catch forgone. The highest cap under consideration (87,500) would have reduced overall salmon bycatch levels by an estimated 37 percent, but with a 22 percent reduction in pollock catch. Alternative 5 falls between these high and low levels, as indicated. The 60,000 Chinook salmon cap is estimated to result in a higher percentage of salmon saved than the 87,500 cap for an only slightly higher (3 percent increase) reduction in pollock catch. However, in a lower bycatch year (such as 2003), the 60,000 Chinook salmon cap is estimated to result in a limited reduction in salmon bycatch and corresponding limited reduction in pollock catch. In low bycatch years, only the lowest cap considered (29,300) is estimated to achieve substantial bycatch reduction.

Table ES-19 Estimated percentage of Chinook salmon saved from actual bycatch compared with the percentage of forgone pollock catch from actual catch for 2003 and 2007.

Year	Bycatch cap level (results for specific sector and seasonal allocations)	Reduction from actual bycatch in that year	Forgone pollock catch in that year
2007 (highest) **Actual bycatch= 121,638**	87,500[8]	37%	22%
	68,392 (Alt 4)	46%	23%
	60,000 (Alt 5)	52%	26%
	47,591 (Alt 5 and Alt 4)	62%	32%
	29,300[9]	92%	46%
2003 (lowest) **Actual bycatch= 46,691**	87,500[10]	0%	0%
	68,392 (Alt 4)	0%	0%
	60,000 (Alt 5)	0%	0%
	47,591 (Alt 5 and Alt 4)	5%	4%
	29,300[11]	52%	22%

As analyzed in EIS Chapters 4 and 5, the impacts of the alternatives on total bycatch numbers and forgone pollock would vary by year. This is due to the annual variability in the rate of Chinook salmon caught per ton of pollock and annual changes in Chinook salmon abundance and distribution in the Bering Sea.

Fig. ES-5 plots the forgone pollock and Chinook salmon saved estimates for the subset of Alternative 2 options and Alternative 4 and 5, over the years 2003 to 2007. The Alternative 2 caps are one of the four Alternative 2 hard cap suboptions in Table ES-3, with the option 2d sector split and the 70/30 season split, and assuming no transfers or rollovers. The Alternative 2 caps are not enclosed by symbols. The 68,392 Chinook salmon cap is illustrated by closed circles. The 47,591 Chinook salmon cap is illustrated by closed triangles. The 60,000 Chinook salmon cap is illustrated by stars. Each number represents the

[8] Option 2a sector split, 50/50 seasonal split
[9] Option 2d sector split, 70/30 seasonal split
[10] The following sector and seasonal splits all produced similar results: Option 1 sector split [all seasonal splits]; Option 2a [58/42]; Option 2d, [58/42, 70/30]
[11] Option 1 sector split, 50/50 seasonal split

year in which a particular cap would have resulted in that level of forgone pollock and Chinook salmon bycatch.

The bottom left-hand corner represents what would be an ideal situation with zero bycatch and zero pollock "forgone" (that is, no amount of the pollock TAC left unharvested) by the pollock fishery. The higher a number or shape is on the vertical axis, the more pollock that the option would require fishermen to forgo because of the restriction on bycatch imposed by that option; the farther to the right a number's or shape's position, the greater the amount of Chinook salmon bycatch. Therefore, the optimal options are represented by those shapes nearest the bottom (less pollock forgone) and farthest to the left (less bycatch). The figure also illustrates the inter-annual variability; the same option can have very different results in terms of forgone pollock and Chinook saved, on an annual basis.

In general, hard cap levels evaluated under Alternative 2 showed a large degree of variability in trade-offs between Chinook salmon bycatch and forgone pollock, with lower cap levels resulting in higher forgone pollock. For Alternative 2, due to other (e.g., sector allocation) constraints, the total annual bycatch caps are never reached.

The analysis shows that, overall, the 60,000 Chinook salmon cap (stars) resulted in lower levels of forgone pollock but higher levels of bycatch than the 47,591 Chinook salmon cap (triangles). The 60,000 Chinook salmon cap would have only been taken in years of higher bycatch, 2005-2007, and would have resulted in some forgone pollock in those years, although less than under the lower caps. In 2003 and 2004, the 60,000 Chinook salmon cap would not have been reached, and no pollock would have been forgone. In 2005, the inshore CV sector would have reached its allocation in the B season, and would have had forgone pollock. The 47,591 Chinook salmon cap resulted in bycatch levels at the hard cap in all years but had variable impact on industry's ability to catch the full pollock TAC. In years of low bycatch, 47,591 Chinook salmon cap would have resulted in little or no forgone pollock. For Alternatives 4 and 5, the retrospective examination shows that allowing for transferability among sectors and rollovers between seasons retains the feature of staying below the salmon bycatch cap while reducing the forgone pollock catch levels.

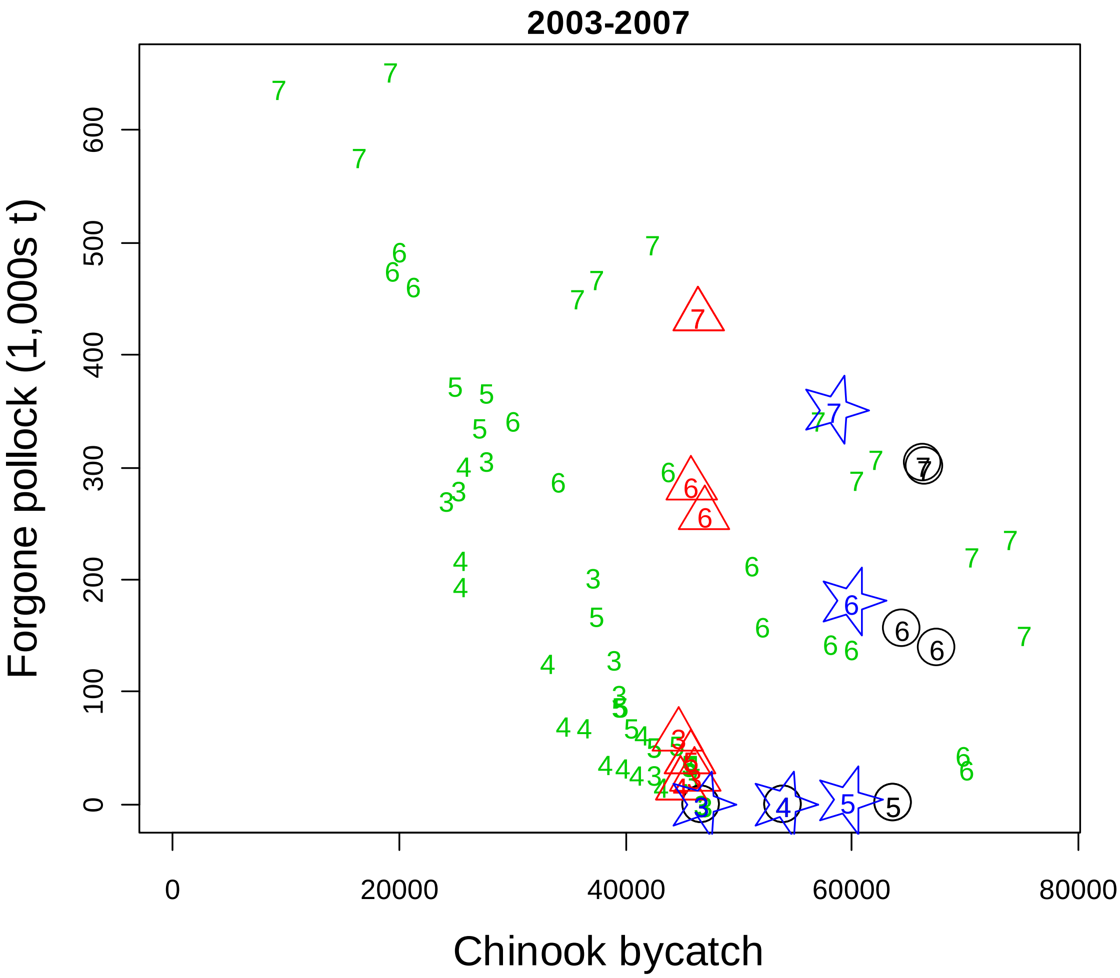

Fig. ES-5 Comparisons of hypothetical Chinook bycatch (numbers, horizontal axis) and forgone pollock (thousands of t, vertical axis). Numbers represent the year (e.g., 6=2006). The 68,392 cap is shown in circles, the 47,591 cap in triangles, and 60,000 cap in stars. The Alternative 2 caps are those not enclosed by a symbol and apply a 70/30 A-B season split and Option 2d sector split (CDQ=6.5%, inshore CV=57.5%, Motherships=7.5%, and at-sea processors= 28.5%).

Costs of forgone harvest in the pollock fishery

RIR Chapter 6 provides an analysis of the costs of the alternatives to the pollock industry in terms of forgone pollock gross revenue. This analysis assumes that past fleet behavior approximates operational behavior under the alternatives and does not estimate changes in behavior. While it is expected that the fleet would change its behavior to mitigate potential losses in pollock gross revenue, explicitly predicting changes in fleet behavior in a reasonable way would require data and analyses that are presently unavailable.

Impacts by hard cap alternative (Alternatives 2, 4, and 5) are summarized by the different components and options that define them (Table ES-20). The components and options projected to cause the greatest changes to the pollock fishery gross revenues are the overall cap level, the sector specific cap allocation, and the seasonal split. Rollovers and transfers are analyzed in conjunction with Alternatives 4 and 5 only, but comparative information is provided for evaluating rollover impacts under Alternative 2.

Table ES-20 Summary of main options under Alternatives 2, 4, and 5 and their relative scale of impact on pollock fishery gross revenues

Option	Relative economic impact on pollock industry
Cap level: 29,300-87,500	• Lowest cap leads to highest constraint on pollock fishery in all years. • In high bycatch years (e.g., 2007), even the highest cap (87,500) is constraining for the pollock fishery.
Sector allocation	• Sector impacts highly variable by season and by year. • See Table ES-21.
Seasonal allocation	• Higher forgone pollock revenue when seasonal allocations are lower in the A season (e.g. 50/50 and 58/42). • 70/30 seasonal split least constraining due to higher roe value in A season.
Rollover	• 80% rollover in Alternative 4 mitigates forgone revenue impacts in B season. • 100% rollover in Alternative 5 mitigates forgone revenue impacts in B season.
Transferability	• Full transferability mitigates forgone revenue impacts in the A season.

In order to summarize some of the differences between the impacts of the caps under Alternative 2, 4, and 5, the other aspects of Alternative 2 are assumed to be constant. For this analysis, Alternative 2 includes the Option 2d sector split, a 70/30 seasonal split, and, while transferability is an option under Alternative 2, for this comparison, it was assumed that transferability was not allowed. Full A season transferability is assumed for Alternatives 4 and 5.

Summarizing the relative impacts of sector allocations is difficult due to the complexity of the sector allocation options in Alternative 2. Table ES-21 compares the sector allocation option analyzed for the Alternative 2 caps with the sector allocations for Alternatives 4 and 5.

Table ES-21 Comparison of sector allocations under Alternative 2, option 2d, and Alternatives 4 and 5

Alternative	CDQ	Inshore CV	Mothership	Offshore CP
Alternative 2: option 2d (midpoint)	6.5%	57.5%	7.5%	28.5%
Alternatives 4 and 5: A season	9.3%	49.8%	8.0%	32.9%
B season	5.5%	69.3%	7.3%	17.9%

Table ES-22, Table ES-23, and Table ES-24 show the estimated impacts on forgone gross revenue (millions $) by sector for 2007.

Table ES-22 Comparison of the 2007 estimated forgone gross revenue, by sector, for the 68,100 Chinook salmon cap, the 68,392 Chinook salmon cap, and the 68,000 Chinook salmon cap (in millions of $).

Sector		**CDQ**	**Inshore CV**	**Mothership**	**Offshore CP**	**Total**
68,100 cap (Alt 2)						
	A season	$0	$135	$20	$118	$273
	B season	$3	$41	$2	$4	$49
	Total	**$2.5**	**$176**	**$22**	**$123**	**$322**
68,392 cap (Alt 4)						
	A season	$0	$123	$12	$115	$249
	B season	$4	$36	$2	$22	$64
	Total	**$4**	**$159**	**$14**	**$137**	**$313**
60,000 cap (Alt 5)						
	A season	$0	$145	$20	$128	$293
	B season	$5	$39	$3	$24	$70
	Total	**$5**	**$184**	**$23**	**$152**	**$363**

Table ES-22 provides a comparison of potentially forgone gross revenue impacts for Alternative 2 cap of 68,100 Chinook salmon the caps of 68,392 Chinook salmon under Alternative 4 and 60,000 Chinook salmon under Alternative 5. In this comparison, total potentially forgone gross revenue is less under Alternative 4 ($249 million); however, potentially forgone gross revenue for the pollock fleet varies by sector between the alternatives in terms of overall gains and losses. The CDQ sector has higher potentially forgone gross revenue under Alternative 5, due to the lower B season sector allocation. The inshore CV sector has a lower annual forgone gross revenue under Alternative 4 and lower seasonal forgone revenue in both A and B seasons as compared with Alternatives 2 and 5. The mothership sector also has a slightly lower annual forgone gross revenue total under Alternative 4 than under the other alternatives. This is driven by substantially lower A season forgone gross revenue under that scenario. The CP sector has higher forgone gross revenue under Alternative 4, driven primarily by the lower B season allocation.

Table ES-23 Comparison of the 2007 estimated forgone gross revenue, by sector, for the Alternative 2 48,700 Chinook salmon cap, the Alternative 4 and 5 47,591Chinook salmon cap (in millions of $).

Sector		**CDQ**	**Inshore CV**	**Mothership**	**Offshore CP**	**Total**
48,700 cap (Alt 2)						
	A season	$24	$201	$34	$156	$414
	B season	$5	$55	$4	$13	$76
	Total	**$29**	**$256**	**$38**	**$169**	**$490**
47,591 cap (Alt 4 and 5)						
	A season	$13	$154	$28	$172	$367
	B season	$5	$46	$4	$30	$86
	Total	**$18**	**$200**	**$32**	**$202**	**$453**

Table ES-23 provides a comparison of potentially forgone gross revenue impacts for Alternative 2 cap of 48,700 Chinook salmon with 47,591 Chinook salmon cap under Alternatives 4 and 5. At lower cap levels, the CDQ sector has a lower forgone gross revenue under the 47,591 Chinook salmon cap, due to the higher relative A season sector allocation. The inshore CV sector has a lower annual forgone gross revenue under the 47,591 Chinook salmon cap and lower seasonal forgone gross revenue in both A and B seasons as compared with Alternative 2. The mothership sector also has a lower annual forgone gross revenue under the 47,591 Chinook salmon cap, driven by the lower A season forgone gross revenue. The CP sector has a higher forgone gross revenue under the 47,591 Chinook salmon cap, driven primarily by the lower B season allocation.

Table ES-24 Comparison of the 2007 estimated potentially forgone gross revenue, by sector, for the Alternative 5 60,000 Chinook salmon cap the Alternative 4 and 5 47,591 Chinook salmon cap (in millions of $).

Sector		CDQ	Inshore CV	Mothership	Offshore CP	Total
60,000 cap (Alt 5)						
	A season	$0	$145	$20	$128	$293
	B season	$5	$39	$3	$24	$70
	Total	**$5**	**$184**	**$23**	**$152**	**$363**
47,591 cap (Alt 4, 5)						
	A season	$13	$154	$28	$172	$367
	B season	$5	$46	$4	$30	$86
	Total	**$18**	**$200**	**$32**	**$202**	**$453**

Table ES-24 provides a comparison, based on the 2007 high bycatch year, of the impacts of the 60,000 Chinook salmon cap with the 47,591 Chinook salmon cap that would be invoked if the performance standard of Alternative 5 is not met or if no IPA were formed. If all sectors had failed to meet the performance standard, and thus fished under the 47,591 Chinook salmon cap, the total potentially forgone pollock gross revenue would have increased approximately 25 percent from $363 million to $453 million. On a sector level, the greatest impacts of not meeting the performance standard would have occurred in the CDQ sector where impacts would have increased from $5 million to $18 million, which is more than 2.5 times larger than the impact of the 60,000 Chinook salmon cap. The inshore CV sector would have had an approximately 9 percent increase in forgone gross revenue from $184 to $200 million. Motherships would have had an approximately 39 percent increase from $23 million to $32 million. Finally, the offshore CP sector would have had an approximately 33 percent increase from $152 to $202 million.

Within Alternative 5, the Council established the 60,000 Chinook salmon hard cap with an IPA to encourage Chinook salmon avoidance in all years with the goal that actual salmon bycatch would be below the cap. Alternative 5 includes a performance standard as an additional tool to ensure sectors do not fully harvest the Chinook salmon bycatch allocations under the 60,000 Chinook salmon hard cap every year. This analysis shows that the penalty for violating the performance standard would be considerable in terms of the difference in potentially forgone gross revenue between the 60,000 Chinook salmon cap and the 47,591 Chinook salmon cap. This implies that the risk of bearing these impacts is likely to create the intended incentive for industry to avoid Chinook salmon bycatch by participating in an IPA with effective incentives to keep Chinook salmon bycatch below the 60,000 Chinook salmon cap.

Effects of Alternative 3 on Chinook salmon savings and pollock fishery gross revenue

Alternative 3 closes a large scale area rather than the whole fishery when specified cap levels are reached. The relative impacts of the cap levels themselves on salmon saved and AEQ by river of origin are equivalent to those described in Alternatives 2, 4, and 5. However, for Alternative 3, there is some potential for the levels of estimated bycatch to be higher than the cap given since once the cap is reached and the area closure is triggered, fishing may continue outside of the closure.

By design, the Alternative 3 trigger areas represent regions where on average (2000-2007) 90 percent or more of the bycatch by season was taken. In the A season, since 1991, the areas have comprised 72-100 percent of the bycatch. In the B season since 1991, with the exception of 2000 when there was an injunction on the pollock fishery, the areas have comprised between 68-98% of the Chinook salmon bycatch. In the most recent years evaluated (2006-2007), both A and B season areas have represented between 97-99 percent of the total Chinook salmon bycatch by season. Thus, while the fleet can continue to fish outside of the closed area and potentially continue to catch Chinook salmon as bycatch, based upon recent averages, it is not anticipated that there will be appreciable bycatch outside of the area following a closure.

To determine the effects of the triggered closure areas on Chinook salmon bycatch, the analysis in Chapter 5 estimates changes to pollock catch and Chinook salmon bycatch within and outside the trigger-closure area in each of the years 2003-2007. That methodology has estimated the numbers of Chinook salmon that are potentially saved by moving effort outside of the closure. These estimates are based on changed catch rates of Chinook salmon inside and outside the area closures. The AEQ analysis presented previously in the discussion of Alternatives 2, 4, and 5 has not been specifically re-created for the trigger-closure analysis at this time, thus it is not possible to relate these savings in Chinook salmon to total AEQ estimates or to specific western Alaska River systems.

Salmon Savings under Alternative 3

The maximum Chinook salmon bycatch reduction under Alterative 3, of 40,311 fish, would come from the lowest cap in the highest bycatch year (2007) and occurs for all but the 70/30 split, which had 36,899 Chinook saved. Thus, the 70/30 split reduces estimated Chinook savings overall in all years under the 29,300 trigger. In the low bycatch year of 2004, the maximum Chinook savings under the trigger-closure with the 29,300 cap is 5,224 fish and is greatest under the 50/50 split option. In general, in the more moderate bycatch years the 50/50 split results in the greatest Chinook savings under both the 29,300 and 48,700 triggers. Note, however, that the 48,700 trigger level is not estimated to save any Chinook salmon at 2004 bycatch levels. Further, the higher triggers are only expected to save salmon in the highest bycatch years of 2006 and 2007. Under the high trigger of 87,500, the maximum Chinook salmon saved would have come from the 50/50 split and would have been 12,098 and 15,088 in 2006 and 2007, respectively.

B season Chinook savings show a different pattern than in the A season. As expected, the maximum number of Chinook saved, 36,290 comes from the lowest trigger of 29,300 fish in the highest overall bycatch year (2007), and from the 70/30 split. However, even the 87,500 trigger with the 70/30 split is expected to save Chinook salmon with savings of 2,680, 11,300, and 20,322 expected for 2004, 2005, and 2007 bycatch levels, respectively. There are some instances when the trigger closure is shown to produce a negative savings of Chinook salmon. That finding implies that in some years, the catch rate of Chinook outside the B season triggered closure area is actually higher than inside of it. In the 2005 season this would have been the case under a 48,700 trigger with either the 58/42 or 55/45 season splits and with a 70/30 season split under the 68,100 trigger.

Revenue at Risk under Alternative 3

While the hard caps have the potential effect of fishery closure and resulting forgone pollock fishery gross revenues, the triggered closures 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. 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 data show that in the highest bycatch years (2007) and under the most restrictive trigger levels, gross revenue at risk for the pollock industry would be about 85 percent, or $520 million, in the A season for all vessels combined. As the trigger amount is increased, the impacts decrease; however, the least restrictive A season trigger (70/30 season split) of 87,500 Chinook salmon cap still results in $134.4 million in gross revenue at risk, or about 22 percent of the overall first wholesale gross revenue of all pollock vessels combined. In lower bycatch years (e.g. 2003, 2004, and 2005), the larger triggers of 87,500 and 68,100 do not cause triggers to be hit, and thus there is no revenue at risk. However, in the low bycatch year of 2004 even the lowest trigger of 29,300 would place $65.4 million (70/30) to $179.2 million (50/50) at risk. These values are 11 percent and 31 percent of total revenue respectively.

The revenue at risk in the B season is greatest under the 70/30 split and is as much as $117.38 million in the worst case (2006, 29,300, 70/30), or 19 percent of total B season revenue. At the 29,300 trigger, and 70/30 split, the B season revenue at risk remains above 15 percent in all years except 2003. Even under the 87,500 trigger with a 70/30 split, $57 million, or 98 percent of total first wholesale revenue, would have been placed at risk in 2007. Ignoring the 2007 year; however, only the 29,300 trigger generates revenue at risk in excess of 10 percent of total first wholesale value.

Pollock stocks

EIS Chapter 4 analyzes the impacts of the alternatives on pollock stocks. Analysis of Alternatives 2, 3, 4, and 5 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 Chinook salmon bycatch. Changes in where pollock fishing occurs may change the size or age of pollock caught which may, in turn, impact the pollock stocks.

Hard caps under Alternatives 2, 4, or 5 may result in the fishery focusing on younger ages of pollock than otherwise would have been taken. Changes in fishing patterns could result in lower acceptable biological catch and TAC levels overall, depending on how the age composition of the catch changed. Seasonal data of the size at age of pollock caught show that early in the season, the lengths-at-age and especially the weights-at-age are smaller. Should the fishery focus effort earlier in the B season then the yield per individual pollock will be lower. Spatially, a similar tendency towards smaller pollock occurs as the fleet ventures further from traditional fishing grounds. However, these changes would be monitored and incorporated in future stock assessments. Conservation goals of maintaining pollock spawning biomass would remain central to the stock assessments that will be used as a basis for setting future pollock TACs. Any changes in the size or age of pollock caught would be eventually accounted for in the stock assessment analysis since updated mean weights-at-age are computed. Smaller fish-at-age would likely result in a lower acceptable biological catch and TAC in future years but this would be accounted for in the present quota management system which is designed to prevent overfishing. Therefore, the risk to the pollock stock from changes in where pollock are caught as a result of any of the alternatives would be minor.

The impact of Alternative 3 (triggered closures) on pollock fishing was evaluated in a similar way. The assumption that the pollock TAC may be fully harvested depends on the difficulty in finding pollock after the area closures are triggered. 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, 4, and 5, 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. Both of these effects likely would result in catches of pollock that were considerably smaller in mean sizes-at-age. This impact would, based on future assessments, likely result in smaller TACs since pollock harvests would not benefit from the summer-season growth period.

Chum salmon

EIS Chapter 6 analyzes the impacts of the alternatives on chum salmon. As noted earlier, chum salmon is also caught incidentally by the pollock fishery, and while additional management measures will be evaluated at a later time by the Council specific to chum salmon management, alternatives which close the pollock fishery for reaching Chinook salmon caps also potentially impact the amount of chum salmon taken by the fleet. Historical temporal and spatial trends in chum bycatch are described in Chapter 6. Chum salmon are caught almost exclusively in the B season.

As with the pollock and Chinook salmon analysis, chum salmon bycatch levels were tabulated on a fleetwide basis given estimated closure dates for the years from 2003 to 2007. Impacts were evaluated three ways: hard caps alone; caps in combination with triggered area closures; and the possible effect of concentrating effort earlier in the B season so that Chinook salmon bycatch could be minimized.

Alternative 2, 4, and 5 caps resulted in some reduction in overall chum salmon catch by year. The overall estimated reduction ranged from 34 percent in some years under the lowest cap (29,300) to no impact (i.e. no reduction in chum salmon catch) under the highest cap (87,500). Often impacts of each alternative on actual chum bycatch levels by year and scenario are low due to the fact that the closure constraint on the fishery occurs after the time period in which most of the chum had already been caught. Results for Alternative 5 (preferred alternative) indicate that chum bycatch reduction would have been minimal in most years. Results from examinations of planned shortened season lengths were variable, but resulted in about the same overall amounts of bycatch than if the season had not been shortened. Information was not sufficient to carry the impact analysis of chum further than tabulating specific reduction in numbers, AEQ levels for chum were not estimated at this time.

Other groundfish

EIS Chapter 7 analyzes the impacts of the alternatives on other species caught as bycatch in the pollock fishery: groundfish, prohibited species, and forage fish. Other groundfish species include Pacific cod, flathead sole, rock sole, squid, arrowtooth flounder, Atka mackerel, Pacific ocean perch, yellowfin sole, and rockfish species.

None of the hard cap alternatives considered under Alternatives 2, 4, or 5, would be expected to measurably change the impact of the pollock fishery on other groundfish as compared to status quo. Groundfish fishery management, which maintains harvests at or below the TAC and prevents overfishing, would remain the same under any of the hard caps under consideration. The rate and type of incidentally caught groundfish are expected to vary largely in the same manner as the status quo. To the extent that the alternatives close the pollock fishery before the TAC is reached, the incidental catch of groundfish could diminish in relative amounts and perhaps in numbers of species. Under these alternatives, the fleet would not be expected to fish for extended periods in areas marginal for pollock, and thus is not expected to incur radically different incidental catch. If a hard cap closes the pollock fishery especially early in the fishery year, the fleet may increase focus on alternate fisheries to attempt to make up for lost catch.

Under Alternative 3, assuming that closures are driven by an association of a high concentration of pollock and Chinook salmon, displacing the fleet from that area and allowing the fishery to continue elsewhere may shift incidental groundfish catch from the current patterns. The degree to which incidental groundfish catch will vary in relation to status quo depends on the selected closed areas and the duration of the closures. To the extent that Alternative 3 displaces the pollock fleet away from the center of pollock concentration and into the other groundfish preferred habitat, change would occur in incidental groundfish species catch.

Other prohibited species and forage fish

EIS Chapter 7 also evaluates the impacts of the alternatives on other prohibited species and forage fish. The extent to which the alternatives would change the catch of steelhead trout, Pacific halibut, Pacific herring, red king crab, Tanner crab, and snow crab is unknown, but existing prohibited species catch limits and area closures constrain the catch of these species in the pollock fishery and limit the impacts on those species.

Forage fish (primarily capelin and eulachon) are not anticipated to be impacted adversely by these alternatives. If Alternatives 2, 3, 4, or 5 constrain the pollock fishery that would reduce fishing effort and the associated incidental catch of forage fish.

Other marine resources

EIS Chapter 8 analyzes the impacts of the alternatives on marine mammals, seabirds, essential fish habitat, and ecosystem relationships.

Potential impacts of the alternatives on marine mammals and seabirds are expected to be limited to incidental takes, effects on prey, and disturbance. The pollock fishery effects on prey could be direct effects by competing with seabirds and marine mammals that depend on pollock and salmon or indirect effects on the benthic habitat that may support benthic prey in areas where seabirds and marine mammals forage in the bottom habitat.

Potential impacts of the alternatives on seabirds and marine mammals are expected to be limited. The preferred alternative (Alternative 5) as well as other hard cap alternatives under consideration (Alternatives 2 and 4), would potentially lead to a decrease in disturbance and the incidental takes of marine mammals and seabirds due to relative constraints by season on the pollock fishery if seasonal caps close the pollock fishery earlier than would have occurred with no cap. Additionally, 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.

Under Alternative 3, the overall effect of shifting the pollock fishery and the resulting incidental takes of seabirds is unknown given the lack of precise information about potential seabird bycatch in these regions. Alternative 3 could impact some marine mammals if the fishery were shifted northward outside of the large scale area closure. However, the current protection measures and area closures for marine mammals remain in place and reduce the interaction with Steller sea lions, northern fur seals, and other marine mammals occurring in the closure areas. The overall effect of shifting the pollock fishery and the resulting incidental takes and disturbance of seabirds and marine mammal species such as ice seals, killer whales, Dall's porpoise, and whales is unknown given the lack of precise information in these regions. A northward shift in the pollock fishery outside of the triggered closure is not likely to affect the interaction with Steller sea lions as they are taken in both the southern and northern portion of the Bering Sea.

Under each alternative, the impact of the pollock fishery on essential fish habitat is not expected to change beyond those previously identified in the Final Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska (NMFS 2005).

The alternatives are not predicted to have additional impacts on ecosystem relationships beyond those identified in the Alaska Groundfish Harvest Specifications EIS (NMFS 2007a). The pollock fisheries, as prosecuted under Alternative 1, would have similar ecosystem impacts as analyzed in the Harvest Specifications EIS. Alternatives 2, 4, and 5, to the extent that they prevent the pollock fleet from harvesting the pollock TAC, and therefore reduce pollock fishing effort, would reduce the pollock fishery's impacts on ecosystem relationships from status quo. It is not possible to predict how much less fishing effort would occur under Alternatives 2, 4, and 5 because the fleet will have strong incentives to reduce bycatch through other means, such as gear modifications and avoiding areas with high salmon catch rates, to avoid reaching the hard cap and closing the fishery. And, 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. 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 relationships 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.

Environmental Justice

RIR Chapter 8 analyzes the Environmental Justice impacts of the alternatives. The key factor in an environmental justice analysis is the disproportionality of adverse impacts on identified minority or low-income populations in the United States, whereas adverse impacts that fall more generally on all populations are not considered for an environmental justice analysis. Significant proportions of the populations in the impacted area are low income and Alaska Native. Minority populations work aboard factory trawlers and in on-shore processing plants. Native American tribes in Northwest Washington, coastal Oregon, and along the Columbia River may be adversely affected by Chinook salmon bycatch. Changes in salmon bycatch and returns may affect populations in western Alaska and the Pacific Northwest; changes in pollock harvests may affect minority populations working in the pollock industry and populations in western Alaska who benefit from CDQ group activities. Populations in western Alaska may also be affected if alternatives induce changes in the way pollock vessels interact with other resources, including chum (and other) salmonid species, marine mammals, seabirds, essential fish habitat, other groundfish species, forage species, and other prohibited species.

As discussed in RIR Chapters 3 and 8, Chinook salmon is extremely important to subsistence and commercial fishermen. Alternatives 2, 4, and 5 (hard caps) which restrict the seasonal and annual total removals of Chinook salmon (and resulting AEQ by river system) would benefit subsistence and commercial users on these river systems by increasing the proportion of fish that would have returned in some years and thus potentially increasing the amount available for subsistence and commercial harvest. Some alternatives may actually increase the region-specific bycatch by river system in some years depending upon the spatial concentration of the fishing effort in that year.

Areas of controversy and issues yet to be resolved

Chinook salmon bycatch in the Alaska groundfish fisheries has long been and will remain a highly controversial subject. The EIS Scoping Report, and the Comment Analysis Report prepared for this EIS identify the issues with Chinook salmon bycatch in the pollock fishery raised by the public. The scoping report is summarized in Chapter 1, and the Comment Analysis Report is included in Chapter 10. Both reports are available on the NMFS Alaska Region website.[12]

Many of the issues highlight areas of on-going controversy which, though informed by analyses such as this one, are not totally resolved. Differences of opinion exist among various industry, Alaska Native, environmental, management, and scientific groups as to the appropriate levels of Chinook salmon bycatch. Areas of controversy primarily focus on the effects of Chinook salmon bycatch and the pollock fishery on the ten major resource components analyzed in this EIS. The most controversial of these are the effects of Chinook salmon bycatch on Chinook salmon stocks and the people, tribes, and communities that rely on Chinook salmon for their cultural and economic livelihoods.

The predominant area of controversy and issue yet to be resolved revolves around scientific uncertainty regarding the source of origin of Chinook salmon taken as bycatch in the Bering Sea pollock trawl fishery and the relationship of this bycatch to in-river salmon abundance. Chapter 3 describes the best available scientific information used to understand the impacts of the alternatives on Chinook salmon attributed to river or region of origin. Expanded data collection efforts are ongoing to improve the spatial and temporal extent of genetic information from Chinook salmon bycatch to understand how the bycatch composition changes over time and space. The ability to employ genetic methods rapidly to determine the river of origin is also improving. Chinook salmon bycatch data will continue be to collected and analyzed to improve understanding of the origins of this bycatch.

The declining returns of Chinook salmon to most regions of origin and the impacts of ocean survival on abundance are also issues yet to be resolved. The ocean environment is changing and the impacts of those changes on Chinook salmon abundance are unknown and the subject of on-going research and debate. The impacts of marine commercial fisheries on the abundance of Chinook salmon, both directed Chinook salmon fisheries and bycatch of Chinook salmon in other fisheries, are also under debate with some believing that marine fishery removals do not greatly impact Chinook salmon returns. Others believe that marine catches are the only human activity that we can directly control and, therefore, need to be controlled to mitigate the impacts of declining returns due to the changing environment.

Alaskan communities and communities throughout the Pacific coast of British Columbia, Washington, and Oregon depend on the marine resources for their livelihoods and lifestyles, whether as participants in commercial fisheries or tourism-related businesses or through subsistence or personal use fishing. Public comment expressed concern that the status quo levels of bycatch negatively impact the people and communities that rely on Chinook salmon. The RIR discusses the social and economic impacts of the alternatives, particularly on Alaskan communities where the majority of the bycatch losses are believed to accrue.

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