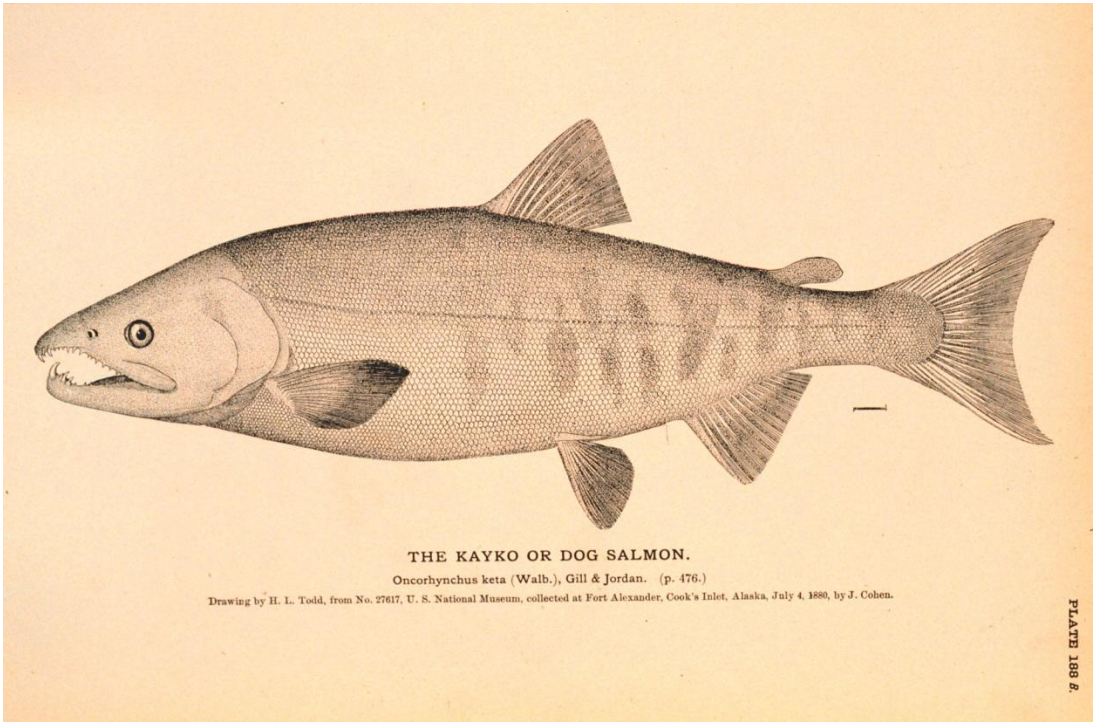
Bering Sea Non-Chinook Salmon Bycatch Management

Initial Review Draft Environmental Assessment



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Executive Summary

This executive summary summarizes the draft Bering Sea Chum Salmon Bycatch Management Environmental Assessment (EA) and Regulatory Impact Review (RIR). The EA and RIR provide decision-makers and the public with an evaluation of the predicted environmental, social, and economic effects of alternative measures to minimize chum salmon bycatch in the Bering Sea pollock fishery.

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

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

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

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

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

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

Bering Sea Pollock Fishery

The pollock fishery in waters off Alaska is the largest U.S. fishery by volume. The economic character of the fishery derives from the products produced from pollock: roe (eggs), surimi, and fillet products. In

2008, the total value of pollock was an estimated $1.331 billion. This dropped to $1.030 billion in 2009. 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 2010.

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

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

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

The CDQ Program was created to improve the social and economic conditions in coastal western Alaska communities by facilitating their economic participation in the BSAI fisheries, which had developed without significant participation from rural western Alaska communities. These fisheries, including the Bering Sea pollock fishery, are capital-intensive and require large investments in vessels, infrastructure, processing capacity, and specialized gear. The CDQ Program was developed to redistribute some of the BSAI fisheries' economic benefits to adjacent communities by allocating a portion of commercially important fisheries to six groups representing those communities as fixed shares of groundfish, halibut, crab, and prohibited species catch. These allocations, in turn, provide an opportunity for residents of these communities to both participate in and benefit from the BSAI fisheries through revenues derived from the fisheries, employment, capital projects, and fisheries infrastructure. Currently, NMFS allocates 10 percent of the pollock TAC and 7.5 percent of the Bering Sea Chinook salmon prohibited species catch limit to the CDQ Program.

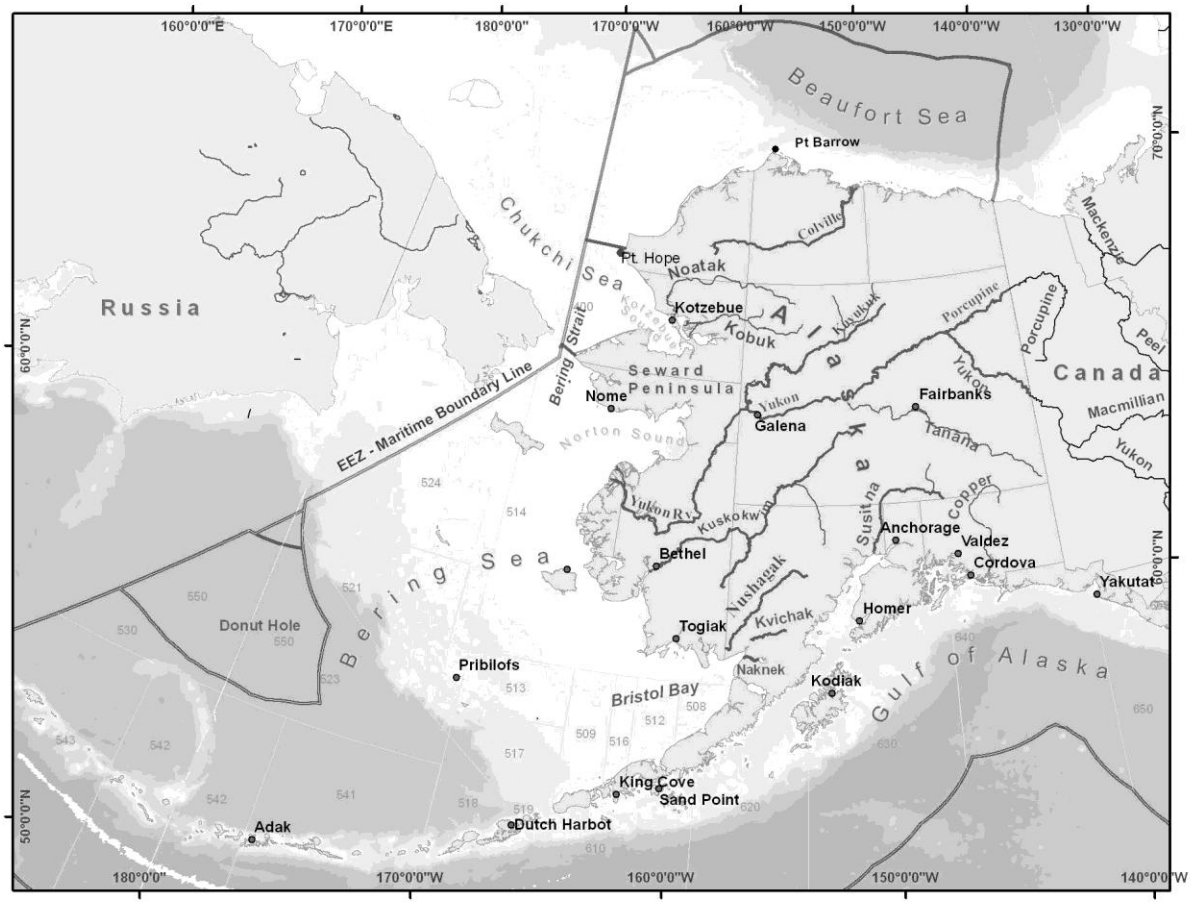

Figure ES-1 Map of the Bering Sea and major connected salmon producing rivers in Alaska and Northwest Canada

Salmon Bycatch in the Bering Sea Pollock Fishery

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

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

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

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

While chum salmon bycatch in the past few years has been declining, numbers reached an historical high in 2005 with approximately 705,000 fish taken as bycatch in the pollock fishery. Table ES-1 shows the number of chum salmon taken as bycatch from 2003 to 2010.

Table ES-1 The number of participating vessels in the Bering Sea pollock fishery, the pollock total allowable catch (TAC) in metric tons (t), and the number of non-Chinook (chum) salmon taken as bycatch from 2003 to 2010.[2]

Year	Number of pollock fishing vessels	Pollock TAC (t)	Non-Chinook (chum) salmon bycatch (numbers of fish)
2003	110	1,491,760	189,185
2004	113	1,492,000	440,459
2005	109	1,478,000	704,586
2006	105	1,487,756	309,644
2007	108	1,394,000	93,786
2008	108	1,000,000	15,142
2009	106	815,000	46,129
2010	104	813,000	13,306

The Council started considering revisions to existing chum salmon bycatch management measures in 2004 when information from the fishing fleet indicated that it was experiencing increases in chum salmon

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

[2] Non-Chinook (Chum) 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/chum_salmon_mortality.pdf. Chapter 3 provides more detailed information on the CAS.

bycatch following the regulatory closure of the Chum Salmon Savings Area. Contrary to the original intent of the area closure, chum 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 chum salmon bycatch that were more flexible and adaptive.

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

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

Description of Alternatives

Chapter 2 describes and compares four alternatives for minimizing chum 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: Triggered closure with intercooperative exemption

The alternatives analyzed in the EA and RIR generally involve limits or "caps" on the number of non-Chinook (elsewhere in document referred to simply as chum salmon as they comprise over 99% of the composition of the bycatch) that may be caught in the Bering Sea pollock fishery and closures of all or a part of the Bering Sea to pollock fishing once the cap is reached. These closures would occur when a non-Chinook salmon bycatch cap was reached even if a portion of the pollock TAC has not yet been harvested. Alternatives 2 and 3 represent a change in management of the pollock fishery because if the non-Chinook salmon bycatch allocations are reached before the full harvest of the pollock allocation, then directed fishing for pollock must stop either BS-wide or in a specified area. Under Alternative 3, like Alternative 1, reaching the cap closes specific areas important to pollock fishing. Under Alternative 4, a closure is proposed to which the fleet would be exempt for participating in an RHS program similar to status quo.

Alternative 1: Status Quo (No Action)

Alternative 1 retains the current program of Chum Salmon Savings Area (SSA) closures in the BS triggered by separate non-CDQ and CDQ non-Chinook salmon prohibited species catch (PSC) limits, along with the exemption to these closures by pollock vessels participating in the Rolling Hot Spot

intercooperative agreement (RHS ICA). This area is closed to all trawling from August 1 through August 31. Additionally, if 42,000 'other" salmon are caught in the Catcher Vessel Operational Area (CVOA) during the period August 15-October 14, the area remains closed remainder of the period September 1 through October 14. As catcher processors are prohibited from fishing in the CVOA during the "B" season, unless they are participating in a CDQ fishery, only catcher vessels and CDQ fisheries are affected by the PSC limit. Under this system, the pollock fishery can continue to harvest pollock outside of the closed areas. Pollock vessels participating in the RHS ICA, under regulations implemented for BSAI FMP Amendment 84, are exempt from these closures altogether.

Alternative 2: Hard cap

Alternative 2 would establish separate chum salmon bycatch caps for the pollock fishery (in the B season). When the hard cap is reached all directed fishing for pollock must cease. Only those non-Chinook salmon caught by vessels participating in the directed pollock fishery would accrue towards the cap. When the cap is reached, directed fishing for pollock would be prohibited. .

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

Setting the Hard Cap

Table 2-4 lists the range of numbers considered for the overall non-Chinook salmon hard caps, in numerical order, lowest to highest. As listed here, the CDQ Program of the fishery level cap would be allocated 10.7%, with the remainder allocated to the combined non-CDQ fishery.

Table ES-2 Range of suboptions for hard cap for non-Chinook with allocations for CDQ Program (10.7%) and remainder for non-CDQ fishery (89.3 %)

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

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

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 2-6. Non-CDQ sector level caps would be managed by NMFS with inseason actions to close the fishery once the cap was reached.

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

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

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

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

Transfers and Rollovers

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

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

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

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

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

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

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

Setting the hard cap (Component 1)	Option 1: Select from a range of numbers	**Non-Chinook**		**CDQ**	**Non-CDQ**
		50,000		5,350	44,650
		200,000		21,400	178,600
		353,000		37,771	315,229
Allocating the hard cap to sectors (Component 2)*		CDQ	Inshore CV	Mothership	Offshore CP
	No allocation	10.0%	45.0%	9.0%	36.0%
	1: Option 2ii	10%	45%	9%	36%
	2: Option 4ii	3%	70%	6%	21%
	3: Suboption	10.7%	44.77%	8.77%	35.76%
Sector transfers (Component 3)	No transfers				
	Option 1	Caps are transferable among sectors and CDQ groups within a fishing season			
		Suboption: Maximum amount of transfer limited to:		a	50%
				b	70%
				c	90%
	Option 2	NMFS rolls over unused salmon PSC to sectors still fishing in a season, based on proportion of pollock remaining to be harvested.			
Allocating the hard cap to cooperatives (Component 4)	No allocation	Allocation managed at the inshore CV sector level.			
	Allocation	Allocate cap to each cooperative based on that cooperative's proportion of pollock allocation.			
	Cooperative Transfers	Option 1	Lease pollock among cooperatives in a season or a year		
		Option 2	Transfer salmon PSC (industry initiated)		
		Suboption Maximum amount of transfer limited to the following percentage of salmon remaining:		a	50%
				b	70%
				c	90%

Alternative 3: Triggered Closures

Alternative 3 would establish monthly time and area closure systems that are triggered when specified cap levels are reached. As with Alternative 2, components and options for each component are specified and described below.

Trigger cap levels:

Table ES-6 lists the range of numbers considered for the overall non-Chinook salmon hard caps, in numerical order, lowest to highest. As listed here, the CDQ sector allocation of the fishery level cap would be 10.7%, with the remainder apportioned to the combined non-CDQ fishery.

Table ES-6. Range of suboptions for trigger cap levels for non-Chinook with allocations for CDQ (10.7%) and remainder for non-CDQ fishery.

	Non-Chinook	CDQ	Non-CDQ
i)	**25,000**	2,675	22,325
ii)	50,000	5,350	44,650
iii)	**75,000**	8,025	66,975
iv)	125,000	13,375	111,625
v)	**200,000**	21,400	178,600

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

Component 1B: Trigger limit application:

Three options are considered to apply trigger caps (Component 1B) to the area closure options. Option 1 would apply the trigger to all chum salmon bycatch, and use the calculated cumulative monthly proportion of the cap to establish monthly threshold limits. Here the cumulative monthly proportion (as noted in Table 2-10 below) is used to establish threshold limits by month for the overall cap as selected under Component 1A. The cumulative monthly proportion is calculated by estimating the average bycatch per month over the years 2003-2010.

Table ES-7. Monthly proportion of non-Chinook salmon limit that specifies option 1 of Alternative 3.

Month	**Option 1** : monthly threshold cumulative proportion
June	11.1%
July	35.4%
August	66.5%
September	92.8%
October	100.0%

Option 2 specifies a within-monthly limit defined as the minimum of the monthly cumulative and 150% of monthly historical proportion[3]. A suboption (referred to as Option 2a in the analysis) specifies a monthly trigger limit application that redistributes the monthly percentage such that trigger limits are lower in months where the western Alaska chum salmon bycatch component[4] is proportionately higher. This suboption is intended to provide similar protection levels for western Alaskan chum salmon stocks throughout the B-season. Note that in all months, results to date indicate that Asian stocks make up the

[3] Note monthly limit should evaluate +/- 25% of monthly limit distribution

[4] The category of western Alaska stocks includes coastal western Alaska and fall run Yukon chum salmon.

highest proportion of the bycatch. Similarly, the results from genetic studies indicate that the proportion of chum salmon bycatch that is western Alaska stock is higher during the early (June-July) part of the B-season compared to later in the season (August-October).

Under Option 3, a single (overall or sector-split) cap would be specified and bycatch would accrue toward it cumulatively over the season. When that cap was reached, the closure system specified in Component 4 would be enacted. There would be no additional monthly cap limit constraints as specified under Components 1A and 1B. The areas to be closed would depend upon the timing of when the overall cap (or sector-specific proportion) was reached and would continue monthly as specified under the closure system selected under Component 4.

Options 1-3 describe the mechanism by which the specific trigger limit (as selected under Component 1) is applied, which if reached enacts a series of closures, as described under Component 4. Under all three options, the closure system would be enacted for the remainder of the season should the cumulative total trigger by sector be reached. The distinction between the options is the progressively more restrictive within monthly limits imposed on either option 1 or 2 in addition to the cumulative cap. Component 4 describes the range of area closures under consideration based upon average historical bycatch percentages. Here Component 4B (50% historical bycatch) is selected for this example. The areas corresponding to these closures are shown in Figure 2-3.

Under option 1, the listed area will close for the month in which the sectors cap is reached. Those areas would then reopen at the end of the month. The next areas would remain open unless the cumulative bycatch by sector reaches the monthly limit. If bycatch reaches the monthly limit then the areas listed for that month will close for the remainder of the month. If in any month the cumulative total amount (listed in bold) is reached, then the CSSAs listed for each month would close according to their monthly schedule for the remainder of the season. In all cases there may be additional bycatch by sector outside of the CSSAs, however the sector whose limit has been reached will be prohibited from fishing in the CSSAs in each month in which the closure applies.

Under option 2, there are more restrictive within monthly limits in addition to the monthly cumulative limits shown in Table 2-10. For all sectors the monthly and cumulative amounts for June are equivalent (and for this sector allocation example they are equivalent in July as well). Should the within-monthly limit by sector be reached, regardless of the cumulative monthly limit not being reached, the CSSA would close for the remainder of the month. The following month, the CSSA would only close if the limit for that month was reached or if the cumulative bycatch reached the cumulative limits. As with option 1, if at any time the annual cumulative total (in bold) were reached, then the CSSAs would be enacted monthly for the remainder of the season and the sector or sectors reaching their limits would be prohibited from directed fishing for pollock within those areas in each month. As with option 1, bycatch by sector may continue to accrue outside of the CSSAs.

Under option 3, when the cumulative amount by sector is reached, the CSSA in the month in which the cap was reached will close for the remainder of the month and the CSSAs for all subsequent months through the end of the season will close as scheduled. No within monthly limit is applied in addition to the cumulative bycatch limit under this option. As with option 1 and 2, bycatch by sector may continue to accrue outside of the CSSAs.

Component 3: Cooperative Provisions

As with Alternative 2, the trigger cap may be further apportioned within the shoreside CV sector to the cooperative level if this component is selected.

Component 4: Area and Timing Options

Component 4 includes three options for a system of closure areas which change by month. Options represent the overall estimated bycatch percentage represented historically within these regions, on a monthly basis, over the years 2003-2010.

a) Area closure groupings by month that represent 40% of historical bycatch.
b) Area closure groupings by month that represent 50%[5] of historical bycatch.
c) Area closure groupings by month that represent 60% of historical bycatch.

Under the closure systems represented by Component 4, options a-c, the specified closures vary each month depending upon the selected historical bycatch percentage. Once a cap level and allocation as selected under components 1-3 are reached (by fishery, sector or cooperative depending upon the allocation level), the specified areas by month would close for the remainder of the month. At the end of the month, the areas would then reopen and if triggered (already based upon exceeding a cumulatively specified cap or within the subsequent month by triggering a within-month cap) new areas would close to those entities which exceeded their proportion of the cap the following month. In each month the areas to be closed are pre-specified but are not exactly the same from one month to the next. Under a cumulative cap scenario, once the cap is reached the closure system goes into place in every month for the remainder of the season. Further information on how the cap application corresponds to the closure system is contained in Chapter 2.

[5] The Council noted that the analysis should include quantitative analysis of the 50% closure options and qualitative analysis of the 40% and 60% closure options.

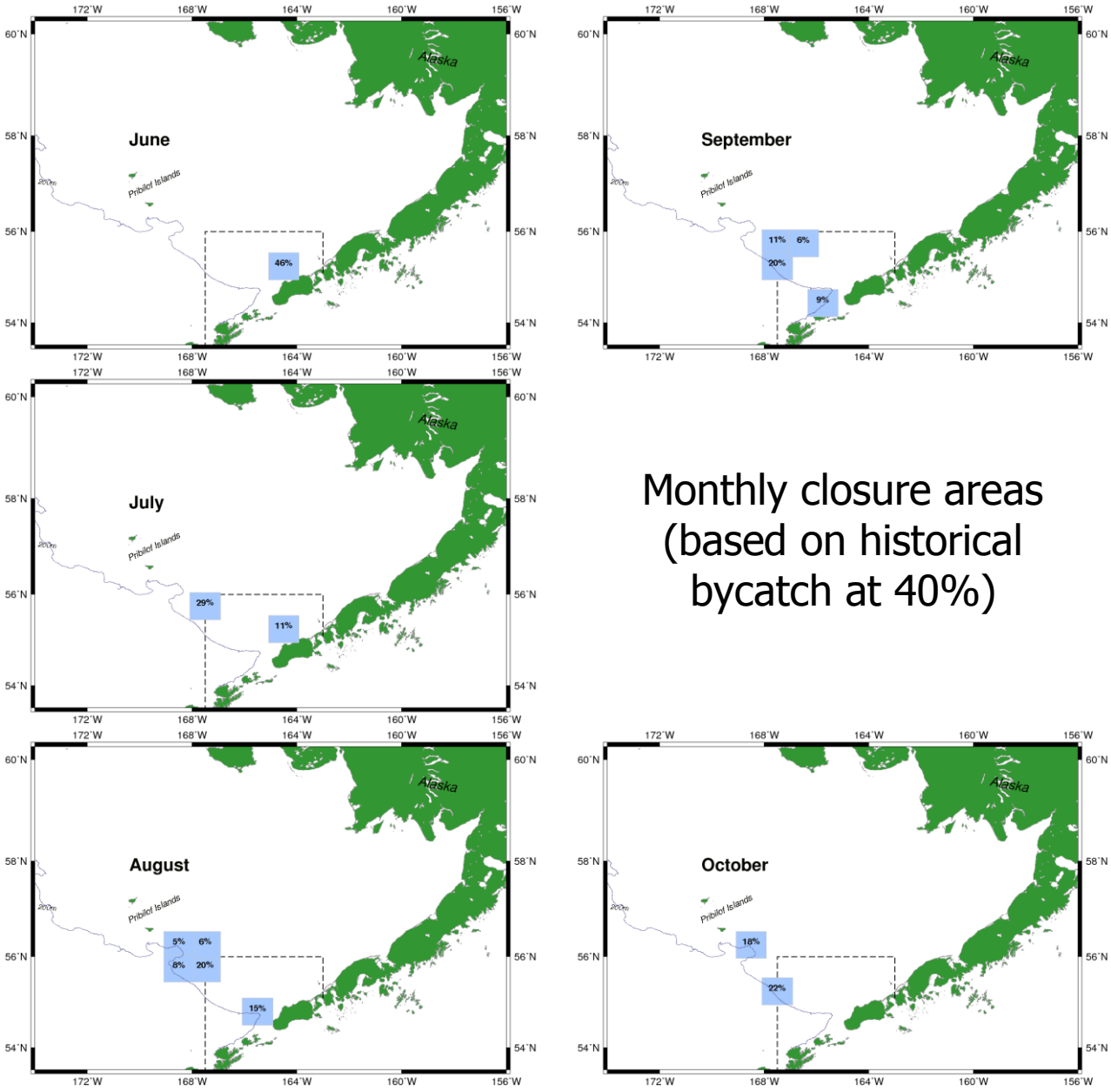

Figure ES-2. Monthly area closures based on ADFG areas that represented 40% of the historical chum salmon bycatch (within each month)

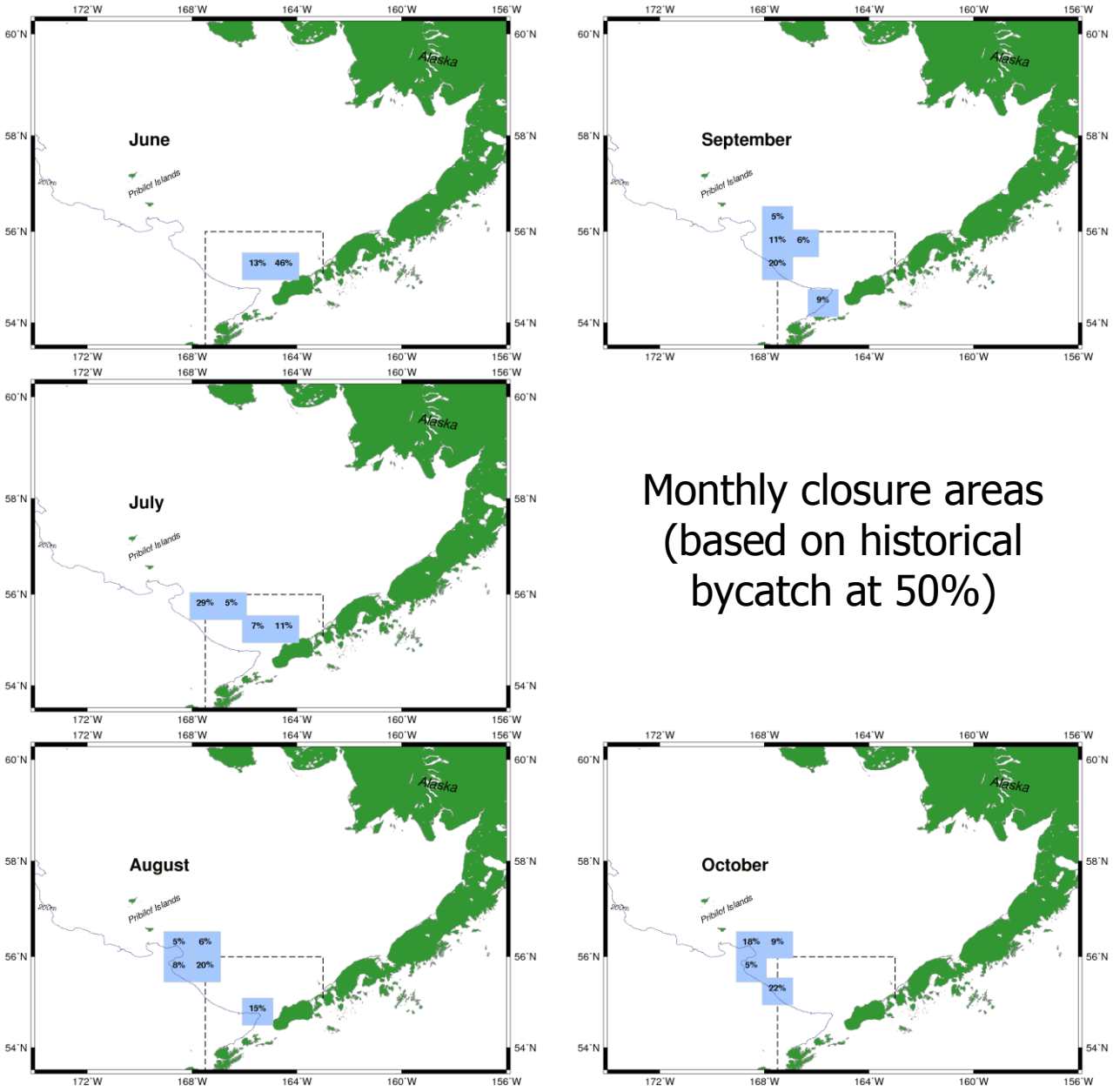

Figure ES-3. Monthly area closures based on ADFG areas that represented 50% of the historical chum salmon bycatch (within each month).

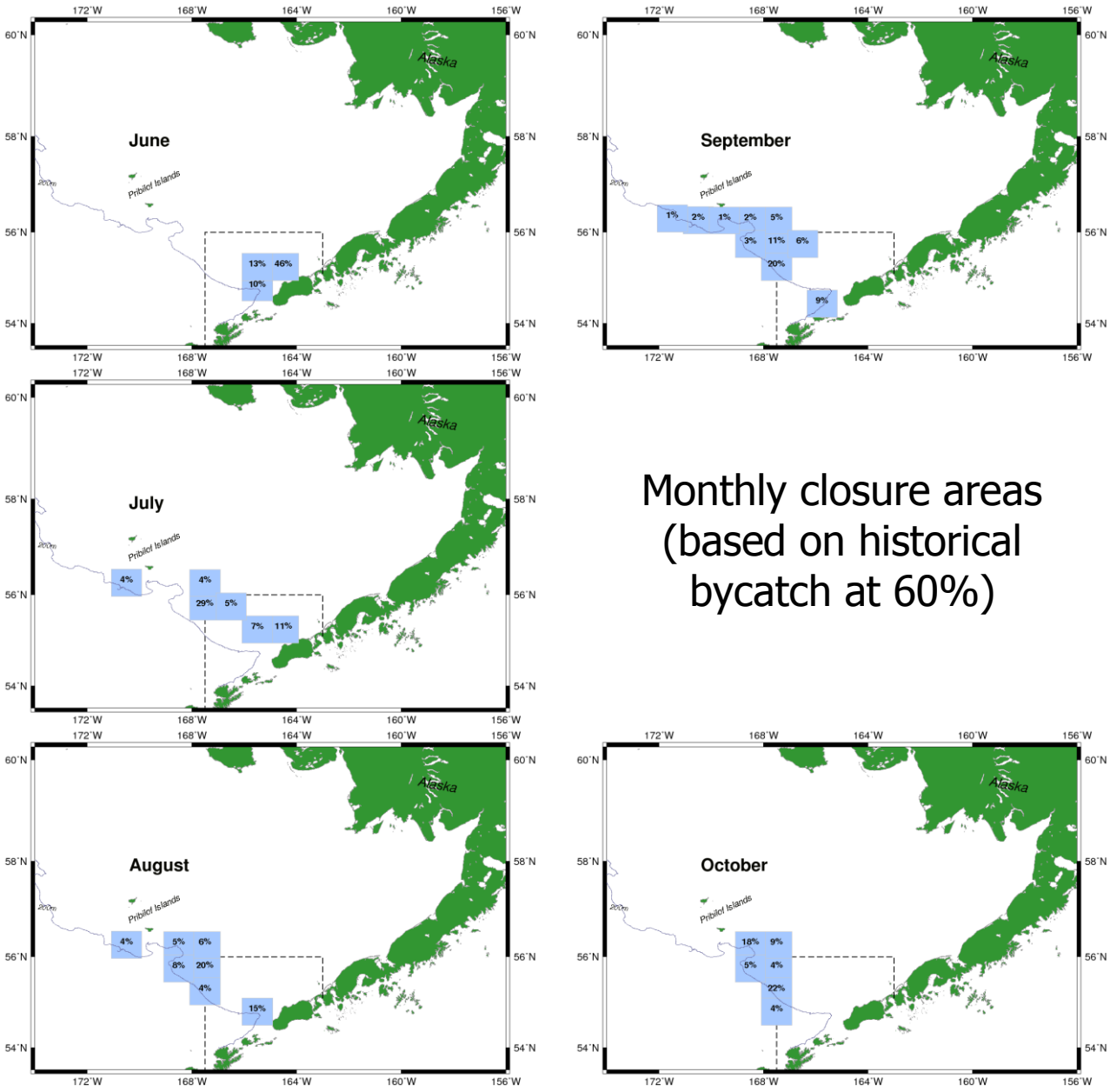

Figure ES-4. Monthly area closures based on ADFG areas that represented 60% of the historical chum salmon bycatch (within each month)

A summary of the Alternative 3 components and options for analysis are show in Table ES-8.

Table ES-8. Alternative 3 Components and options.

Setting the cap (Component 1)	1A: How to formulate the cap	Select a cap from a range of numbers, 25,000 –200,000 (same range as Alternative 2)			
	1B: How to apportion cap by season	Option 1: monthly apportionment of cap			
		Option 2: monthly threshold and within monthly limit			
Allocating the hard cap to sectors (Component 2)		CDQ	Inshore CV	Mothership	Offshore CP
	No allocation	3.4%	81.5%	4.0%	11.1%
	1: Option 2ii	6.7%	63.3%	6.5%	23.6%
	2: Option 4ii	10.7%	44.77%	8.77%	35.76%
	3: Option 6	3.4%	81.5%	4.0%	11.1%
Cooperative Provisions (Component 3)	Voluntary transfers among sectors are allowed				
	NMFS can reapportion unused salmon to other sectors based on their proportion of remaining pollock (except not from CDQ groups)				
Area and Timing Options (Component 4)	a	Area closure groupings by month that represent 40% of historical PSC			
	b	Area closure groupings by month that represent 50% of historical PSC			
	c	Area closure groupings by month that represent 60% of historical PSC			

Alternative 4-Closure with RHS exemption

Alternative 4 would establish a large area closure, with an option to select a cap to trigger the closure. If the triggered closure option is not selected, the area would be closed during the entire B-season. Similar to status quo (rolling hot-spot (RHS) system in regulation), participants in a vessel-level (platform level for the mothership sector) RHS would be exempt from the regulatory closure system under Alternative 4. The area proposed to be closed under Alternative 4 represents an area encompassing 80% of historical bycatch (Figure ES-5). A summary of the Components and options under Alternative 4 are provided in Table ES-9.

Table ES-9. Alternative 4 components

Fleet PSC management with non-participant fixed closure	B Season	Fixed closure encompassing 80% of historical PSC	
	RHS Exemption	Participants in RHS would be exempt from the regulatory closure	
Trigger Closure Option 1	All B Season	Fixed closure encompassing 80% of historical PSC for all RHS non-participants	
	Trigger Caps	1a	50,000
		1b	200,000
Sector Allocation Suboption	Trigger cap options under 1a and 1b would be apportioned to the sector level. This would result in separate sector level caps for the CDQ sector, the inshore catcher vessel (CV) sector, the mothership sector, and the offshore catcher processor (CP) sector.		

Allocating the hard cap to sectors (functionally same as under Alternative 2) see table 2-20 and Chapter 2 for cap numbers.		CDQ	Inshore CV	Mothership	Offshore CP
	No allocation	3.4%	81.5%	4.0%	11.1%
	1: Option 2ii	6.7%	63.3%	6.5%	23.6%
	2: Option 4ii	10.7%	44.77%	8.77%	35.76%
	3: Option 6	3.4%	81.5%	4.0%	11.1%

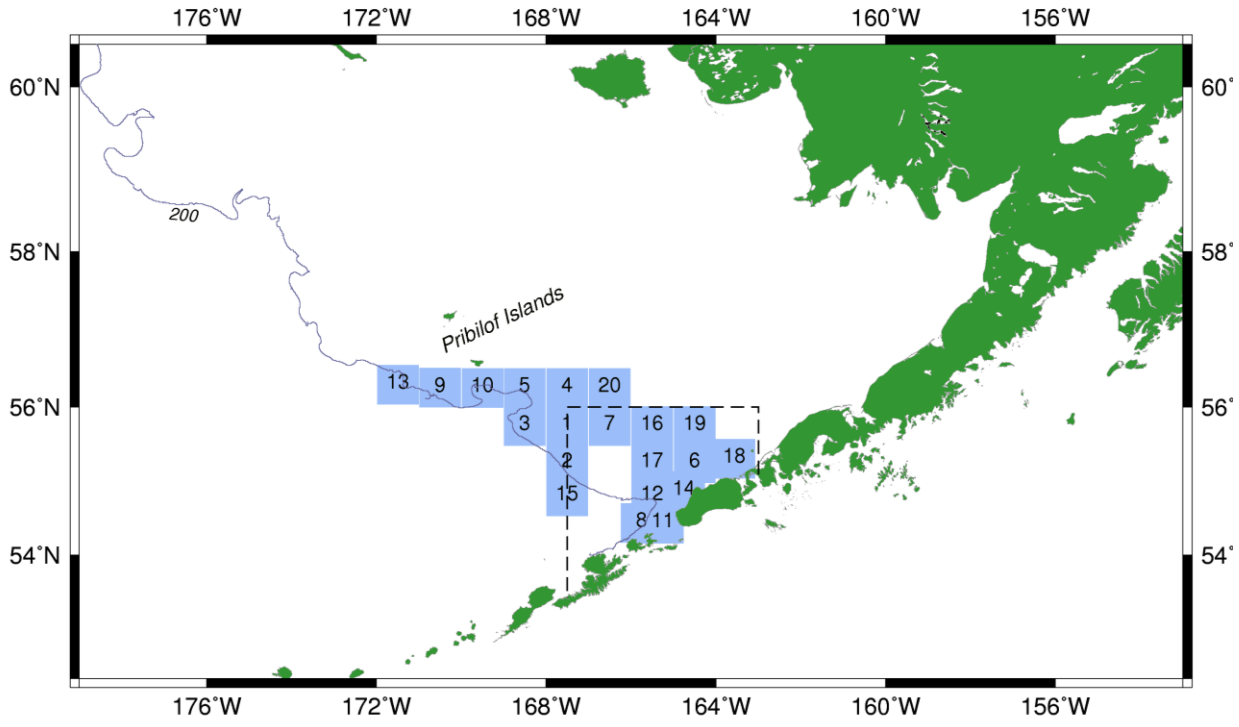

Figure ES-5. Large area closure based on ADFG areas that represented about 80% of the historical chum salmon bycatch

Effects of the Alternatives

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

The estimated impacts of alternative chum salmon bycatch management measures were evaluated by examining when cap options would have resulted in fishery closures and then estimating the numbers of salmon that would have been 'saved' by virtue of the fishery (or sector) closing earlier. The salmon saved is then compared to the amount of pollock that would have been forgone or diverted to open areas (for Alternative 3). The analyses were based on 2003-2010 NMFS observer data combined with NMFS regional office catch-accounting. For Alternative 3 triggered closures, data were augmented by using the same spatial and temporal patterns of PSC observed but with different absolute levels. This was done to provide resolution needed to distinguish characteristics between triggered closure options. For this reason proportional change between scenarios are reported and application to a "prototypical year" is presented to evaluate the expected consequences. Alternative 4 was analyzed two ways: 1) as a fixed B season closure should all vessels fail to participate in a voluntary rolling hotspot program, and 2) with 100% vessel participation in a rolling hotspot program. This allows for evaluation of two bookends of the potential impacts under this alternative.

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

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

Chum Salmon

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

Summaries on the status of wild chum salmon stocks in Alaska are presented to provide context of where issues and concerns are highest. These sections include tables of catch, the types of fisheries that the stocks support, whether escapement goals have been met, and whether there are stock concerns which are further summarized here (Table ES-10).

Table ES-10. Overview of Alaskan chum salmon stock performance, 2010.

Chum salmon stock	Total run size?	Escapement goals met?[1]	Subsistence fishery?	Commercial fishery?	Sport fishery?	Stock of concern?
Bristol Bay	Above average	1 of 1	Yes	Yes	Yes	No
Kuskokwim Bay	Above average	2 of 2	Yes	Yes	Yes	No
Kuskokwim River	Average	2 of 2	Yes	Yes	Yes	Yield concern discontinued 2007
Yukon River summer run	Average	2 of 2	Yes	Yes, but limited by low Chinook	Yes	Management concern discontinued 2007
Yukon River fall run	Below average	6 of 8	Restrictions	Limited late season (Tanana River)	No	Yield concern discontinued 2007
Eastern Norton Sound	Above average	1 of 1	Yes	Yes	Yes	No
Northern Norton Sound	Above average	7 of 7	Yes	Yes	Yes, except for Nome Subdistrict	Yield concern (since 2000)
Kotzebue	Above average	6 of 6	Yes	Yes	Yes	No
North Peninsula	Average	2 of 2	Yes	Yes	Yes	No
South Peninsula	Below average	2 of 4	Yes	Yes	Yes	No
Aleutian Islands	n/a	n/a	Yes	Yes	Yes	No
Kodiak	Below average	2 of 2	Yes	Yes	Yes	No
Chignik	Average	1 of 1	Yes	Yes	Yes	No
Upper Cook Inlet	Above average	1 of 1	Yes	Yes	Yes	No
Lower Cook Inlet	Average	9 of 12	Yes	Yes	Yes	No
Prince William Sound	Average	5 of 5	Yes	Yes	Yes	No
Southeast	Below average	6 of 8	Yes	Yes	Yes	No

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

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

Chum salmon serve an integral cultural, spiritual, nutritional, and economic role in the lives of Alaska Native peoples and others who live in rural communities. For Alaska Natives and others throughout western and interior Alaska, harvesting and eating wild subsistence foods are essential to personal, social, and cultural identity, and salmon comprise the majority of subsistence foods harvested and used. In addition, commercial fishing for chum salmon provides a significant source of income for many people who live in remote villages, which often supports the ability to engage in subsistence harvests. For

purposes of the RIR and this action, subsistence harvest by rural Alaskan communities is limited to the regions of western Alaska and includes: Norton Sound/Kotzebue (the Arctic Area); the Yukon River; the Kuskokwim Area; Bristol Bay; and the Alaska Peninsula.

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

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

Chum salmon savings

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

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

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

- From 2003-2010, chum bycatch rates in the 1-3 days following RHS closures are approximately 8 percent lower than rates prior to the closure
- Annual average chum bycatch rates by sector in the 5-days before closures (imposed on 2003-2010 data) ranged from 11-33 percent for CVs and from 2 percent to 30 percent for other sectors, most years in the upper end of this range.

- The average percentage of pollock catch that was moved due to closures ranged from 7 percent to 21 percent for CVs and was less than 5 percent for other sectors.
- Evaluating the pre-RHS data from 1993-2000, an RHS-like system would likely have reduced chum bycatch by 9 percent to 22 percent on average with about 4-10% percent of pollock fishing have been relocated to other areas.
- The pre-RHS analysis suggests that closures in place for chum have likewise been effective for Chinook with the range of Chinook savings as 6 percent to 14 percent per year.

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

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

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

Adult Equivalent chum salmon savings

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

Results show that the extent that bycatch is adjusted depending on the ages (to obtain the AEQ estimate) for chum salmon is variable (Figure ES-6). In some years, the actual bycatch may be below the AEQ estimates, due to the lagged impact of higher bycatch in previous years. Overall, the range of uncertainty

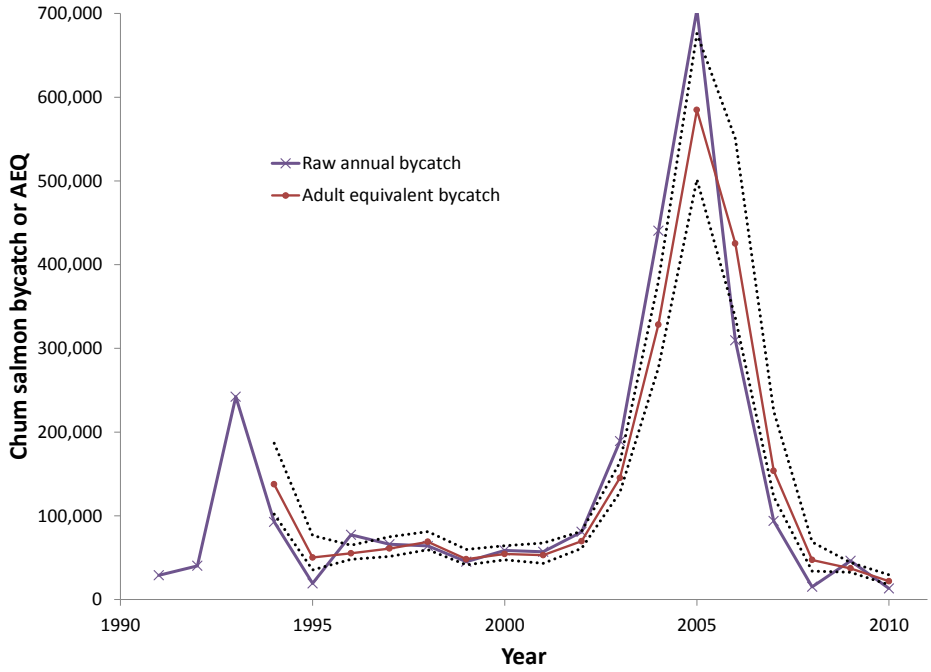

Figure ES-6. Time series of non-Chinook (chum) annual bycatch estimates compared to the adult equivalent estimates from the pollock fishery, 1991-2010. The dotted lines represent the uncertainty of the AEQ estimate, due to the combined variability of ocean mortality, maturation rate, and age composition of bycatch estimates.

AEQ chum salmon returns to rivers of origin

Combining the AEQ results with genetic analysis from 2005-2009 and estimates of run sizes (for coastal west Alaska and the Upper Yukon) provides the means to evaluate the historical impact of chum salmon bycatch. In particular, it provides estimates on how many salmon would have returned to specific river systems and regions had there been no pollock fishing. The stock composition mixtures of the chum salmon bycatch were based on samples collected from the Bering Sea pollock fishery. Results from a number of these analyses have been completed and presented to the Council (i.e., Guyon et al. 2010, Marvin et al. 2010, Gray et al. 2010, and McCraney et al. 2010). This analysis used the same approach and genetic breakouts to 6 individual regions to characterize region of origin for chum bycatch but with a slightly different sample stratification scheme. The regions that could be clearly resolved using genetics were: East Asia (referred in analysis as 'Asia'), north Asia (referred in analysis as 'Russia'), coastal western Alaska (including all WAK systems with the exception of the upper/middle Yukon), upper/middle Yukon, Southwest Alaska (including river systems in Kodiak as well as North and South Peninsula stocks) and Pacific Northwest (which includes river systems from Prince William Sound to WA/OR in the lower 48; Figure 3-9).

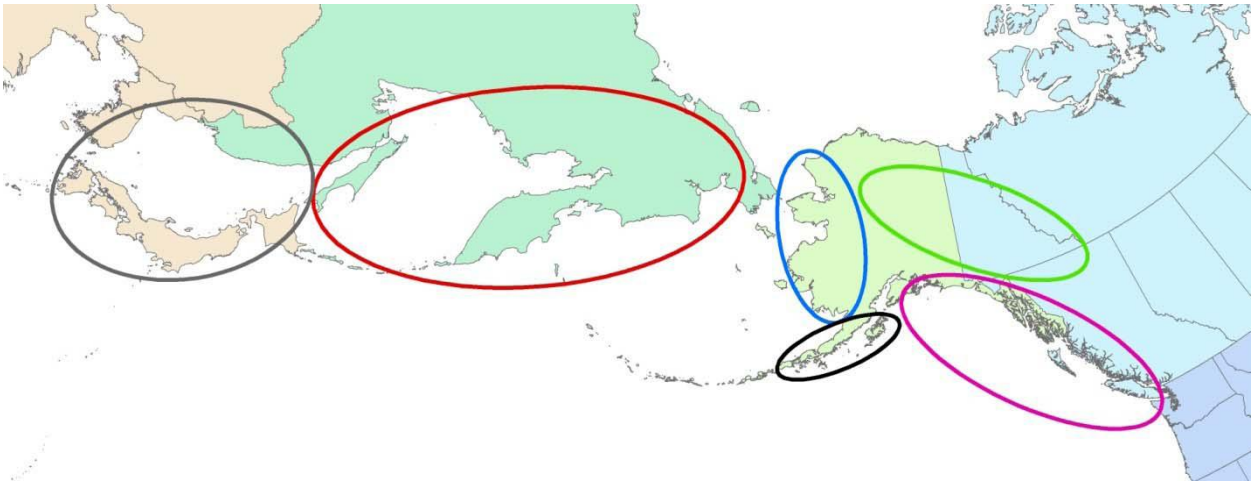

Figure ES-7. Six regional groupings of chum salmon populations used in the analysis including east Asia (grey), north Asia (red), coastal western Alaska (blue), upper/middle Yukon (green), southwest Alaska (black), and the Pacific Northwest (magenta). From Gray et al. 2010.

For this analysis, the genetic analysis was re-done (on the same sets of samples presented in the other studies—e.g., Guyon et al. 2010) but with the samples stratified temporally as from June-July or from August-October. The earlier genetic analyses presented to the Council, there appears to be a consistent pattern showing that Alaskan stocks are proportionately less common in bycatch later in the season compared to earlier. This re-stratification, along with careful accounting on the relative proportions of bycatch that occurred within years, confirms this pattern with Alaskan stocks being proportionately more common in the June-July period compared to later (Figure 3-16). The proportions of bycatch from the SE Alaska-BC-Washington region also decreased later in the season while proportions from Russia and Japan increased.

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

These proportions by year are applied to conservative run size estimates, where available, for Alaskan regional groupings to estimate an overall average impact rate of bycatch by region (Figure 5-92). Results indicate that the highest impact rate (chum salmon mortality due to the pollock fishery divided by run-size estimates) was less than 1.7% for the combined western Alaska stocks. For the Upper Yukon stock, the estimate of the impact was higher with a peak rate of 2.7% estimated on the run that returned in 2006 (Figure 5-92). For the SW Alaska region (taken to be from Area M) the estimate of impact rate was the lowest for any of the Alaska sub-regions. The average impact rate (2005-2009) by region (with ranges) was:

Coastal west Alaska	0.6%	(0.1% - 1.5%)
Upper Yukon	1.2%	(0.2% - 2.7%)
Combined WAK	0.7%	(0.1% - 1.5%)
Southwest Alaska	0.4%	(0.1% - 1.0%)

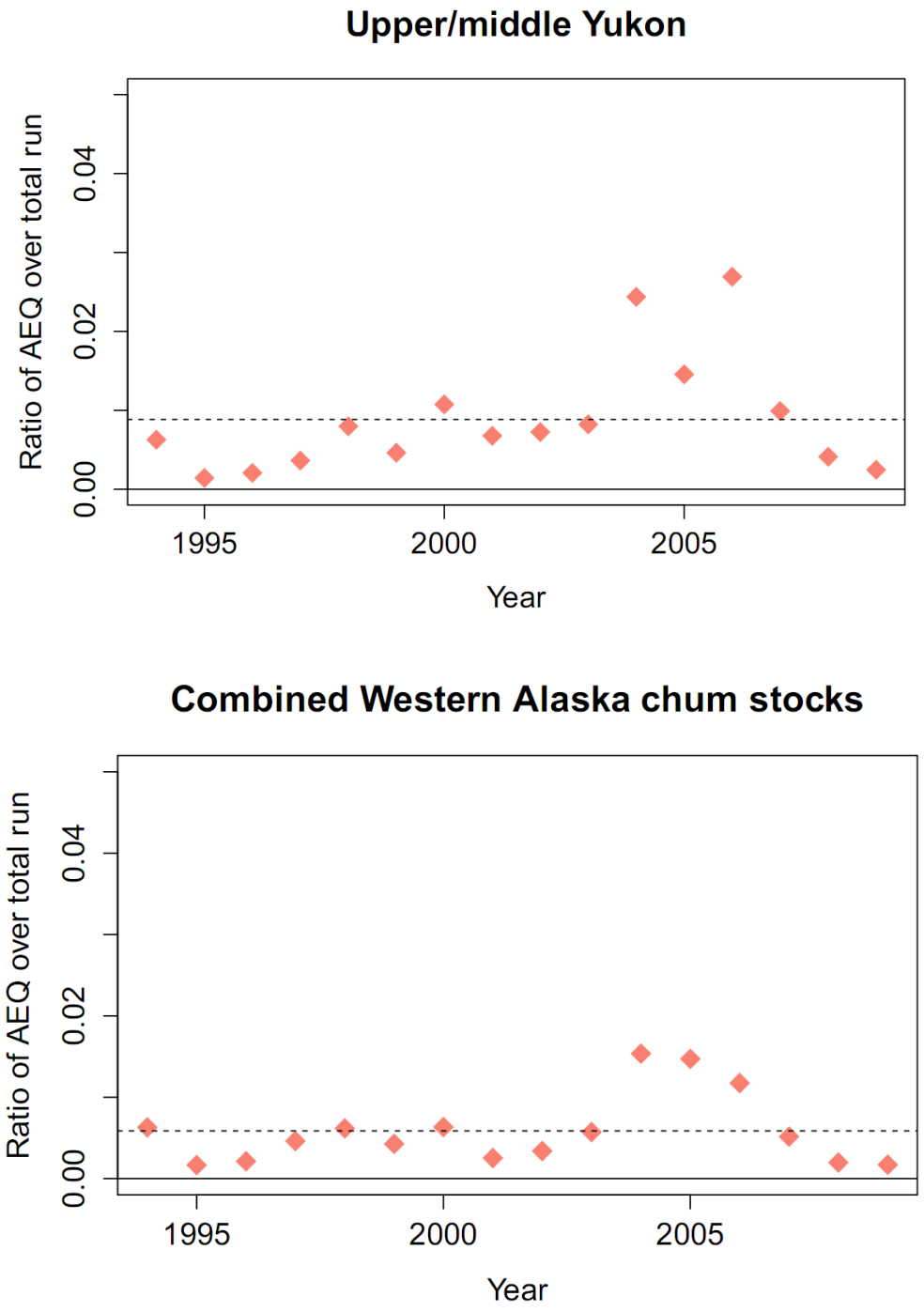

Figure ES-8. Estimated impact rates due to pollock fishery bycatch of chum salmon run sizes for Upper/middle Yukon (top) and for western Alaska stocks (coastal west Alaska stocks plus Upper/middle Yukon combined; bottom). Dashed horizontal line represents the mean value.

Under Alternative 2, the hard cap options, estimates are made by year of the number of salmon saved (in numbers as well as AEQ estimates) and compared to the actual amounts estimated under status quo under each cap and sector allocation scenario. The amount of salmon saved under each options varies considerably from year to year as well as by cap and sector allocation. The greatest number of salmon saved under Alternative 2 is 93% in the highest year (2005) for the most restrictive cap level considered (50,000). This contrasts with other years where no salmon would have been saved (given the assumptions) under the higher cap scenarios in years of both high and low bycatch. In years of low bycatch there is limited salmon savings under any cap and allocation scenario. Expected chum salmon saved for selected options under alternative 2 are presented in Table 5-80.

Table ES-11. Estimated proportion of Alaska chum salmon saved relative to AEQ mortality year for different **hard caps** and sector allocations by year for Alternative 2.

Sector allocation option	Hard Cap		
	50,000	200,000	353,000
2ii	80%	45%	21%
4ii	80%	50%	29%
6	81%	56%	43%

As previously noted, results for Alternative 3 the trigger cap and closure options are presented for scenarios over a range of hypothetical high and low bycatch years to provide contrast among the specified options rather than on actual historical bycatch levels. Results for the trigger cap levels and options themselves indicate that the resulting salmon savings are relatively insensitive to the cap levels and among the four different trigger application options. This insensitivity reflects the highly variable nature of chum salmon bycatch between years, and by seasons and areas rather than shortcomings of the closure design. Of the trigger application options, option 3 results in the highest percentage of salmon saved. However, this option results in lower amounts of salmon saved earlier in the B season when more of the bycatch is estimated to be of WAK origin. Overall savings of salmon under Alternative 3 ranged from 6-14% over all cap configurations and high and low bycatch years with sub-option 2a generally performing the best compared to the other options (i.e., greater levels of chum salmon PSC reductions; Table 5-86).

Table ES-12. Estimated relative reduction in chum salmon bycatch and diverted pollock catch by sector allocation (panels) and trigger cap levels for different trigger closure options.

2ii (sector allocation 1)						
	25,000		75,000		200,000	
	Chum	Pollock	Chum	Pollock	Chum	Pollock
Option 1	13.6%	11.3%	12.5%	8.1%	8.6%	3.7%
Option 2	13.6%	11.4%	12.6%	8.5%	9.0%	4.3%
Option 2a	13.8%	12.0%	13.1%	9.1%	10.7%	5.0%
Option 3	13.2%	9.7%	10.9%	6.4%	5.9%	2.5%
4ii (sector allocation 2)						
	25,000		75,000		200,000	
	Chum	Pollock	Chum	Pollock	Chum	Pollock
Option 1	13.1%	9.6%	12.8%	8.5%	9.9%	4.7%
Option 2	13.1%	10.1%	12.8%	8.9%	10.3%	5.3%
Option 2a	13.5%	10.8%	13.3%	9.6%	11.2%	5.8%
Option 3	11.9%	7.8%	11.6%	6.8%	6.6%	3.2%
6 (sector allocation 3)						
	25,000		75,000		200,000	
	Chum	Pollock	Chum	Pollock	Chum	Pollock
Option 1	13.7%	11.9%	13.2%	9.3%	10.9%	6.1%
Option 2	13.7%	12.0%	13.2%	9.7%	11.1%	6.5%
Option 2a	13.7%	12.7%	13.4%	10.3%	11.7%	7.0%
Option 3	13.5%	10.3%	12.2%	7.7%	8.3%	4.5%

Under Alternative 4, with a fixed large-scale area closure imposed over the entire B season, the overall reduction in salmon bycatch is estimated to be approximately 36%, given the assumption that pollock fishing outside of the closure area remains viable (estimated with data from 2003-2010) and no fishing occurs in the closed area. However, as with status quo, participation under the RHS program is anticipated to remain at 100%, particularly with the greater incentive to participate under Alternative 4, , thus estimated impacts are likely best approximated by status quo.

Additional information on the relative salmon savings, AEQ and region of origin impacts under all of the alternatives is contained in Chapter 5.

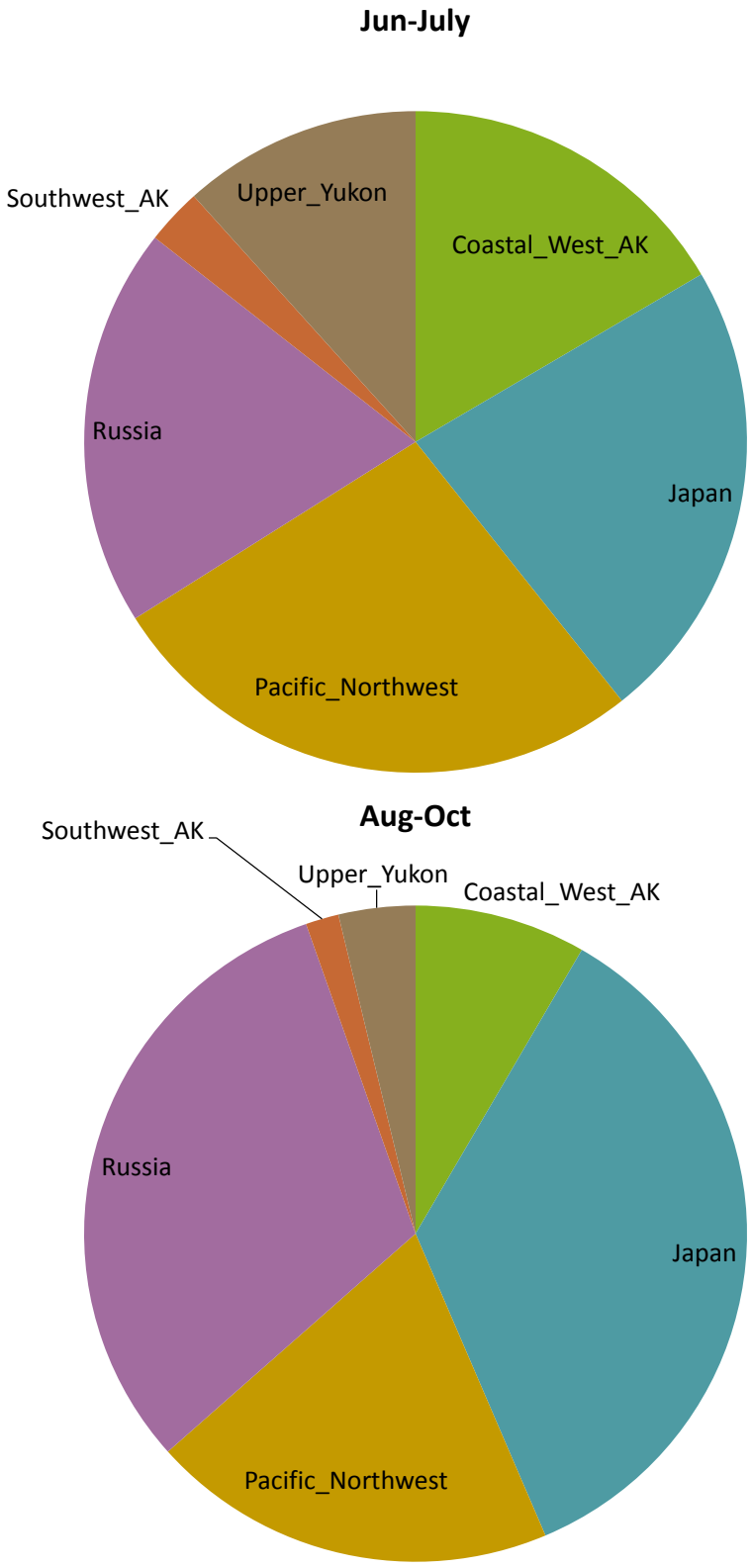

Figure ES-9. Average breakout of bycatch based on genetic analysis by early and late B-season strata, 2005-2009.

Chinook salmon

The pollock fishery catches both chum and Chinook salmon PSC in the B-season. The timing of this catch is dissimilar amongst the two species, with Chinook salmon caught in the latter part of the B season and chum salmon caught throughout the B season (Figure ES-10).

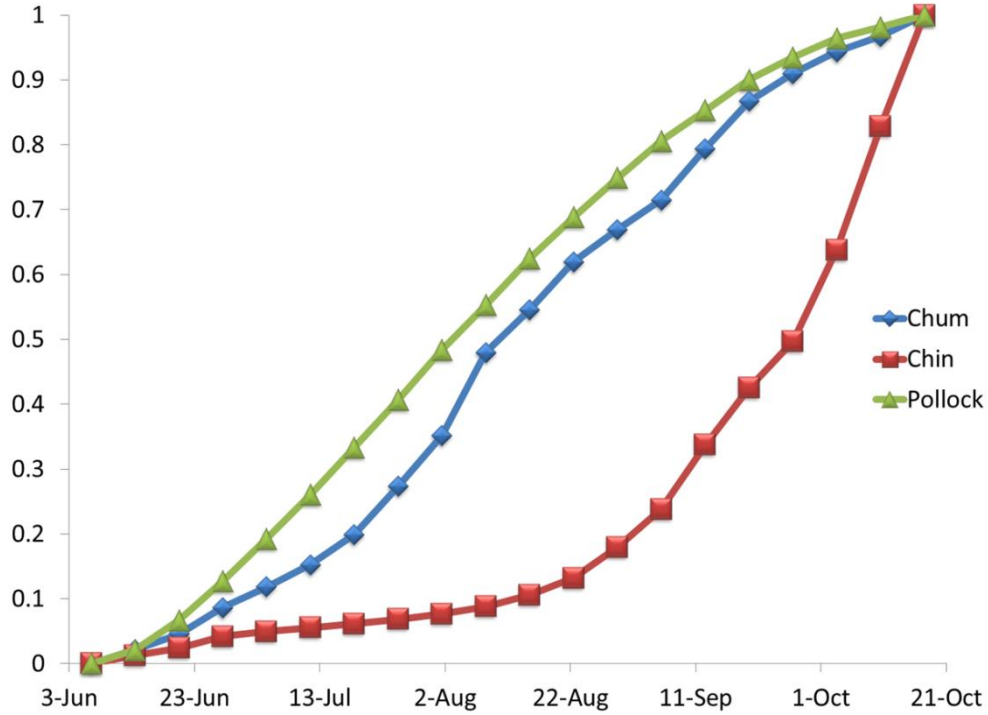

Figure ES-10. Mean relative values of pollock catch (triangles) compared with catch of chum (diamonds) and Chinook (squares) salmon species in the pollock fishery during the B-season.

Policy decisions for alternative management measures for chum must also consider the potential impact on the catch of Chinook salmon as a result of imposing additional management measures on the same pollock fishery. The 2011 A-season was the first season of management under the new bycatch management program implemented by Amendment 91. Incidental catch of Chinook salmon by the pollock fishery participants in the 2011 A-season indicated that pollock fishery participants remained well below their limits with a total A-season bycatch of 6,706 fish. This compares to Chinook salmon bycatch ranging from 7,661 fish in the A season of 2010 to 69,408 fish in the A season of 2007, thus Chinook bycatch in 2011 so far is much lower than in the recent 5 years.

For Alternative 2, hard caps for chum salmon, the impact on Chinook will likely result in lower levels of bycatch since for many years, the fishery is closed relatively early and Chinook bycatch tends to increase later in the B-season. Analysis of closure configurations under Alternative 3 indicates that many of the area closures benefit both chum and Chinook salmon savings. The early part of the season (June-July) on average tends to save a higher percentage of Chinook salmon compared to later for the different cap, sector splits, and trigger closure options. However, since the total Chinook bycatch is relatively low in the early period, the impact of the chum salmon trigger closures would tend to reduce Chinook bycatch by about 3% on average. Note that the variability about this result indicates that in some years, in particular years when high Chinook bycatch, the chum measures will make Chinook bycatch levels worse. Compared to the non-Chinook measures, the impact of lower cap levels on relative salmon savings was similar in direction (lower cap meaning more Chinook salmon saved) but not as beneficial. Additional

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

Economic Impacts of the Alternatives

The RIR provides an overview of the economic impacts of the alternatives in terms of **salmon saved** by imposing the proposed management measures as a reflection of the costs and benefits to salmon dependent subsistence, recreational, and commercial fisheries and communities. The RIR also summarizes the estimated cost of the alternatives on the directed pollock fishery and pollock fishery dependent communities. Detailed tables of salmon saved, forgone revenue, and revenue at risk are contained in the RIR and not repeated here.

The RIR analyzes the benefits of the estimated changes in chum salmon savings under the alternatives. The AEQ estimates represent the potential benefit in numbers of adult chum salmon that would have returned to aggregate regions as applicable in the years 2003 to 2010. 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 question to answer in order to provide a balanced treatment of costs and benefits.

Measuring the potential economic benefit of chum salmon saved, in terms of effects on specific subsistence, commercial, sport, and personal use fisheries is difficult. The proportion of AEQ estimated chum 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. Lacking estimates of the proportion of AEQ chum 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 chum salmon estimated for each alternative

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

While the hard caps (Alternative 2) have the potential effect of fishery closure and resulting forgone pollock fishery gross revenues, the triggered closures (Alternatives 3 and 4) 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 greatest adverse economic impact on the pollock fishery would have occurred in the highest PSC year (2005) and under the most restrictive PSC cap of 50,000 non-Chinook salmon where scenario 1 estimates are approximately $489 million would potentially have been forgone. That gross value is

composed of $214 million from the CV sector, $206 million from the CP sector, $51million from the Mothership sector, and $19 million from CDQ pollock fisheries.

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

Comparing the alternatives on the relative impact on chum salmon savings (in terms of AEQ) together with the relative change in pollock that would be diverted to areas outside of the closed areas suggests that relatively little benefit (in terms of bycatch reduction) is estimated by using low trigger cap levels. For example, computing averages over the different sector allocations and trigger options shows that the benefit for greater salmon savings at lower cap levels was much lower than the relative costs of redistributing pollock fishing effort.

There are several options for triggered area closures under Alternative 3. Summarizing years (2003-2010) and sectors suggests that a trigger closure under Alternative 3, option 3 results in the lowest reduction in bycatch for all sector splits and cap levels. Trigger closure option 2a, which was designed to improve early-season salmon savings in order to target a higher salmon savings during the portion of the season in which a higher relative percentage of the bycatch is of western Alaska stock, performed better than the other options in June-July, particularly for the high cap level. At the low trigger cap level and third sector allocation scheme, option 2a is estimated to perform similar to options 1 and 2. Option 3 performed poorly during the early period, since under this option, closures would generally occur later in the season since cap limits are based on season rather than monthly limits.

Under the alternatives to the status quo, fishermen would be expected to attempt to minimize losses associated with potentially forgone gross revenue and/or revenue placed at risk by altering their current operations. These reactions could include the following: (1) mitigating a triggered area closure by re-deploying fishing effort, using the same fishing gear and methods, to known adjacent fishing grounds that may be equally or only somewhat less productive (similar CPUE) than the fishing grounds lost to the salmon PSC minimization measure; (2) avoiding non-Chinook salmon PSC by re-deploying fishing effort to an area of unknown productivity and operational potential, using the identical fishing gear, in an exploratory mode; (3) switching to a different target fishery if possible; and (4) mitigating the risk of a hard cap induced closure by speeding up harvesting and processing activities (race for fish). Each of these strategies may have operational cost implications. While empirical data on operating cost structure at the vessel or plant level are not available, cost trends for key inputs may shed some light on the probable impacts of the fishing impact minimization alternatives on the pollock industry in the aggregate and on average.

Any regulatory action that requires an operator to alter his or her fishing pattern, whether in time or space, is likely to impose additional costs on that operator. The alternative non-Chinook salmon PSC management actions may affect the operating costs of the pollock fleet, compared to the status quo condition, with the degree of those effects necessarily dictated by the extent to which hard cap and/or triggered closures constrain harvests. The RIR addresses this issue in terms of both fixed and variable costs. Fixed costs tend to arise from investment decisions and variable costs arise from short-run production decisions. As the terms imply, fixed costs are those that do not change in the short run, no

matter what the level of activity. Variable costs, on the other hand, are those costs that do change directly with the level of activity, recognizing that variable inputs must be used if production exceeds zero.

Clearly, upon attainment of a hard cap, some portion of TAC would remain unharvested, representing forgone gross revenue; however, triggered closures may increase the cost of fishing per unit of the pollock that continue to be caught. Based on information provided by the industry at public meetings and through individual contacts, as well as the professional judgment of the preparers of this RIR, seven categories of costs were defined for consideration, as follows:

- Increased travel costs
- Costs of learning new grounds or using new or modified gear (e.g. excluder devices)
- Costs of PSC avoidance measures, or (if these efforts are unsuccessful) premature closure due to excessive PSC
- Reduced pollock CPUE due to less concentrated target stocks;
- Potential gear conflicts
- Effects on processors (floating or shoreside) built for higher throughput
- Safety impacts

The RIR discusses specific safety-related issues that have been considered with respect to the alternatives. These include the following:

1. Fishing farther offshore,
2. Reduced profitability, and
3. Changes in risk.

Additional information on all of the categories of cost and safety-related issues are discussed in detail in the RIR.

Alternative 4 is essentially a rolling hotspot system, similar to the current approach under status quo, with a large area closure for those who do not participate. While impacts in terms of revenue at risk have been provided for Alternative 4 in the RIR, they are intended to identify the considerable incentive for participation in the rolling hotspot system. As such, it appears likely that most, if not all, vessel operators would be motivated to participate in a rolling hotspot system, thereby eliminating any potential revenue at risk under this alternative. As a result, it is not possible to predict whether any vessel may choose not to participate, and thereby have vessel specific revenue at risk, which would potentially generate shoreside value added "at risk" as well. Thus, the analysis does not provide that breakout as it would be inappropriate to imply that such a likelihood exists.

Other resources categories analyzed

The EA also evaluated the impact of alternative management measures for chum salmon on several different resources categories: pollock stocks, other marine resources (comprised of marine mammals, seabirds, habitat, ecosystem) and cumulative effects. Impacts of the alternatives for these categories are summarized below.

Pollock stocks

Chapter 4 analyzes the impacts of the alternatives on pollock stocks. Analysis of Alternatives 2, 3, and 4 indicate that these alternatives would make it more difficult to catch the full TAC for Bering Sea pollock compared to Alternative 1. Catching less pollock than authorized under the TAC would reduce the total

catch of pollock and reduce the impact of fishing on the pollock stock. However, these alternatives are likely to result in fishermen shifting where they fish for pollock to avoid chum salmon bycatch. Changes in where pollock fishing occurs were shown to likely change the size—and by extension—age to younger smaller pollock which would potentially impact future ABC limits established for the pollock stocks.

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

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

Other marine resources

The impacts of the alternative management measures on marine mammals, seabirds, habitat and the ecosystem are evaluated qualitatively based upon results of the quantitative analysis for chum, Chinook, pollock and economic considerations. Alternative 2, hard caps, is not likely to increase fishery interactions with any of these resources categories, and may result in fewer interactions compared to status quo since the pollock fishery is likely to be closed earlier in the B-season. Under area closures proposed under Alternatives 3 and 4, any closure of an area where marine mammals and seabirds are likely to interact with pollock fishing vessels would likely reduce the potential for incidental takes. The potential reduction would depend on the location and marine mammal species. Closures under Alternatives 3 and 4 would also minimize fishery interactions with the seafloor and benthic habitat.

Cumulative effects

The discussion of cumulative effects includes future actions that may affect the Bering Sea pollock fishery, the salmon caught as bycatch in that fishery, and the impacts of salmon bycatch on the resource components analyzed in this analysis. The future actions considered have been grouped in the following four categories: ecosystem-sensitive management, traditional management tools, actions by other Federal, State, and international agencies and private actions. Details on the actions contained in these categories and the activities considered are contained in Chapter 8.

This section considers the direct and indirect impacts of the proposed action when added to the impacts of past and present actions previously analyzed in other documents (incorporated by reference) and the impacts of the reasonably foreseeable future actions listed.

Policy considerations

In considering a preferred management approach, the Council will evaluate the range of alternatives and the estimated impacts biologically and economically (including impacts to subsistence, commercial, and recreational salmon fishing and commercial pollock fishing) of each alternative. Some comparative information is provided below to compare alternatives in terms of relative chum salmon saved, forgone pollock harvest, pollock revenue at risk (i.e., potentially unrealized economic gain due to closure areas), trade-offs in bycatch reductions for chum salmon compared with Chinook salmon, and relative benefits accrued from reductions in both species. At this time, it is difficult to predict pollock fleet behavior in the 2011 B-season under the first year of operation under Amendment 91, thus it is not possible to estimate how the Chinook salmon bycatch management measures will be affected by any new management measures imposed for chum salmon bycatch.

Comparison of chum salmon saved and forgone pollock harvest

Selection of a preferred alternative involves 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.

As analyzed 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 chum salmon caught per ton of pollock and annual changes in chum salmon abundance and distribution in the Bering Sea. The RIR examines the relative cost of forgone pollock fishing under Alternative 2 and the revenue at risk under Alternative 3 as well as the potential benefits to subsistence, commercial, and recreational salmon fisheries.

In terms of cap and sector allocation options under Alternative 2, the lowest forgone pollock catches result in expected reductions of chum salmon bycatch by about 20 percent to 45 percent, depending on the sector allocation options (Figure ES-11). For hard cap scenarios that have the highest impact on forgone pollock catch levels, the sector allocation are estimated to have negligible additional improvements on chum salmon saved (Figure ES-11).

Under Alternative 3, options that require a greater proportion of pollock to be diverted elsewhere have diminishing benefits in terms of increased salmon savings (Figure ES-12). Option 2a generally outperforms the other options (i.e., greater reductions in chum salmon) given the same cap and allocation configurations. Option 3 has the lowest estimated levels of pollock diverted relative to the other options and allocation scenarios but also has a relatively low estimated level of salmon saved (Figure ES-12).

The implications of imposing Alternatives 2 or 3 and the associated options indicate that reducing bycatch levels and impacts to Alaskan chum salmon runs can be achieved, but improvements would be relative to the current estimated impacts which are already low (typically less than 1%). The extent that these measures, if enacted without a system like the current RHS program (analyzed under Alternative 1) are less well understood. It is clear that bycatch totals generally increase as run sizes increase. It is also clear that the effectiveness of triggered closure areas will vary from year to year due to the inherent variability and complexity of pollock and chum salmon seasonal and spatial distribution.

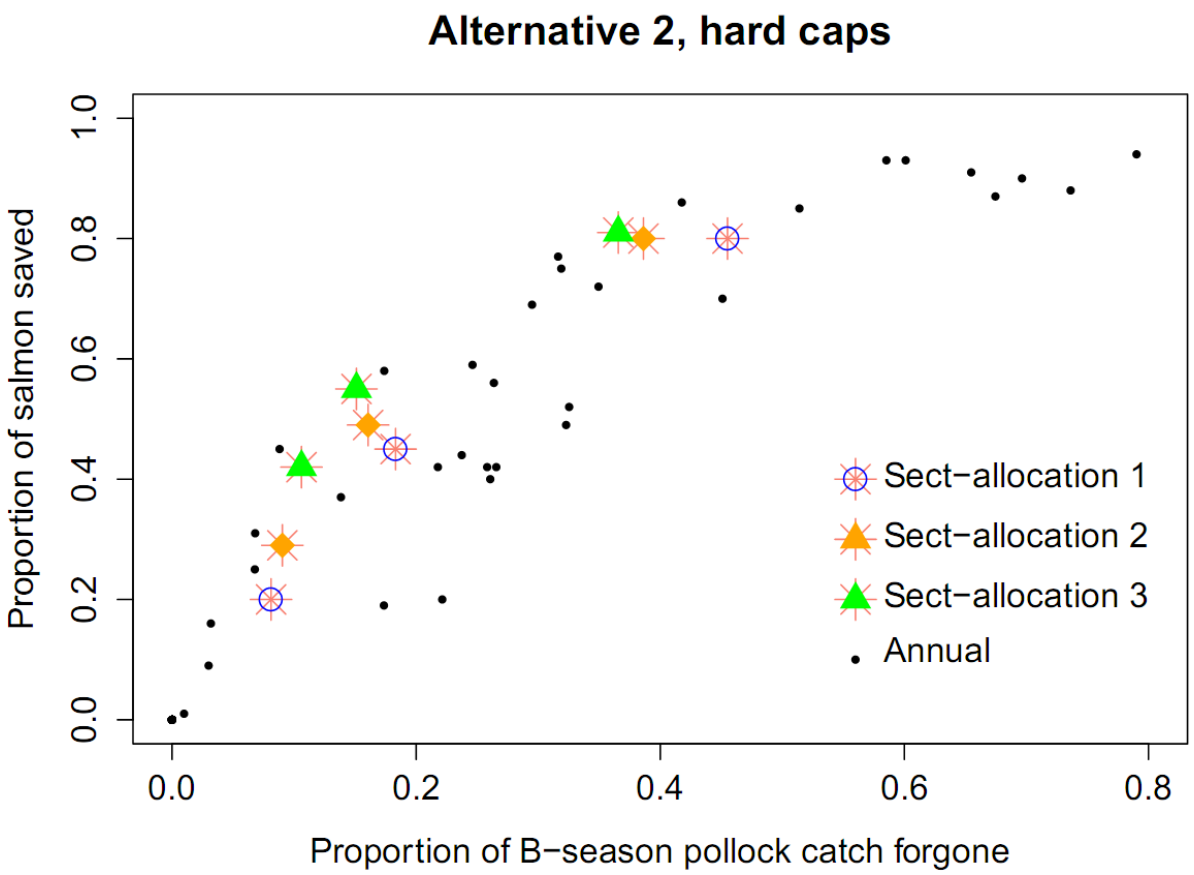

Figure ES-11. Expected (mean) trade-offs between B-season pollock forgone (horizontal axis) and relative salmon saved for **Alternative 2, hard caps** by sector allocation splits and three cap levels (50k chum, 200k chum, and 353k chum)**.** Bullet points represent estimates from annual data (2003-2010).

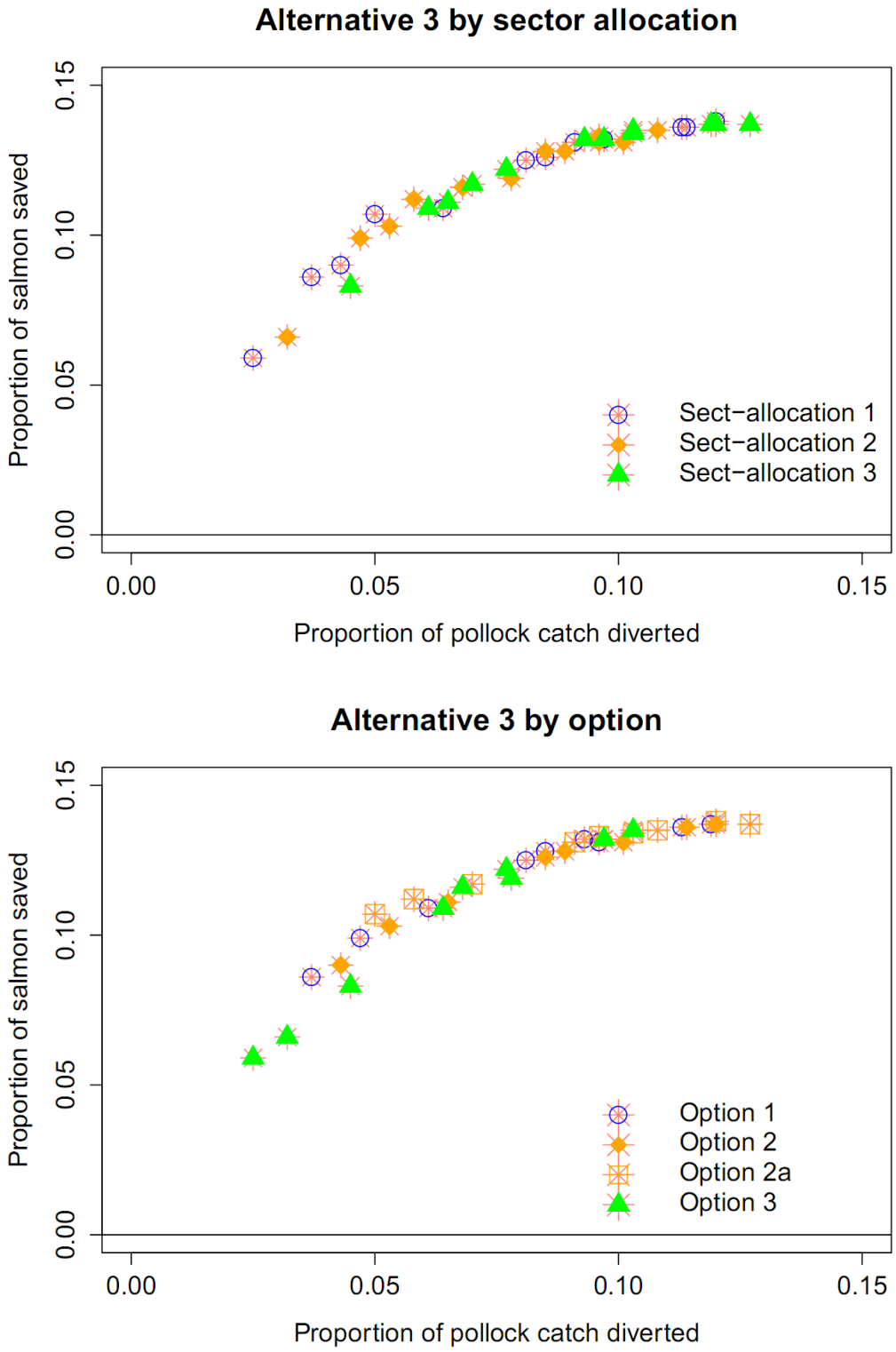

Figure ES-12. Expected (mean) trade-offs between B-season pollock forgone (horizontal axis) and relative salmon saved for **Alternative 3, triggered closures** by sector allocation splits (top) and by options (bottom) with three cap levels (25k chum, 75k chum, and 200k chum)**.**

Rural community outreach

One of the Council's policy priorities is to improve outreach and communication with Alaska Native entities, communities, and rural stakeholders in the development of fishery management actions.[6] The Council's Rural Community Outreach Committee met in August 2009 and recommended that the non-Chinook salmon bycatch issue be a priority for rural outreach, as did the Council's Salmon Bycatch Workgroup, and the Council agreed to undertake an outreach effort with affected community and Native stakeholders prior to and during the development of the draft analysis, well prior to final Council action.

The outreach plan for non-Chinook salmon bycatch management measures was developed by Council staff with input from NMFS, the Council, the Rural Community Outreach Committee, and affected stakeholders. It is intended to improve the Council's decision-making processes on the proposed action, as well as enable ongoing, two-way communication with Alaska Native and rural communities. The outreach plan for the proposed action is maintained and updated on the Council website.[7] The general components of the outreach plan include: several direct mailings to stakeholders prior to important steps in the process and/or Council meetings; rural community outreach meetings; additional outreach (statewide teleconference, radio/newspaper, press releases); and documentation of rural outreach meeting results. In addition, the draft analyses, associated documents, outreach materials, and powerpoint presentations, have been posted on the Council website as the process occurs.

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

Council staff consulted with the coordinators of five of the Federal Subsistence Regional Advisory Councils (RACs), the Association of Village Council Presidents (AVCP), the Tanana Chiefs Conference (TCC), the Yukon River Drainage Fisheries Association (YRDFA), Kawerak, Inc., and the Yukon River Panel, in order to evaluate the potential for time on the agendas of their annual regional meetings.[8] In sum, two Council members and one to two staff analysts attended and presented the preliminary analysis of the alternatives for the proposed action at seven regional meetings, in addition to two meetings with the Yukon River Panel in Anchorage. The meetings were as follows:

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

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

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

outreach meetings are provided in the form of an outreach report, included as a supplement to this EA/RIR/IRFA. Please reference the outreach report for details of the meetings, a summary of the input provided, and any formal resolutions resulting from the meetings attended.