AGENDA C-2
MARCH 2012

MEMORANDUM

TO: SSC, AP and Council Members

FROM: Chris Oliver
Executive Director

DATE: March 21, 2012

SUBJECT: BSAI Chum salmon bycatch

ESTIMATED TIME
12 HOURS

Jeff Guyon
Martin Loefflad
Diana Stram
[illegible]
Scott Miller

ACTION REQUIRED

(a) Update on salmon genetics
(b) Initial review of chum salmon bycatch measures

BACKGROUND

(a) Update on salmon genetics

Genetic analyses of samples from the BSAI groundfish trawl fisheries bycatch of Chinook and chum salmon are now being done annually. Two NOAA technical memorandums have been recently published with results from the 2010 genetic stock composition analysis of the Chinook salmon bycatch samples and the 2010 chum bycatch samples. The Chinook salmon bycatch technical memorandum was mailed to you on February 22nd and is attached here as **Item C-2(a)**. The chum salmon bycatch technical memorandum was mailed to you on March 12th. Dr. Jeff Guyon of the NOAA Auke Bay Laboratory will provide an overview of the 2010 genetic results of bycatch samples for both species and be available to answer additional questions on these results and plans for future analyses.

(b) Initial review of chum salmon bycatch measures

At this meeting the Council will take initial review of the draft EA/RIR/IRFA for the BSAI non-Chinook (chum) Salmon PSC Management analysis. The draft analysis was mailed to you on March 11th. The analysis examines three alternatives to reduce chum salmon bycatch in the Bering Sea pollock fishery. The executive summary of the EA/RIR, which includes the full suite of alternatives and options, is attached as **Item C-2(b)(1)**. This executive summary has been revised since the version mailed to you. A list of corrections made to the draft document (reflected in the Executive Summary attached here) is attached as **Item C-2(b)(2)**. The Council last reviewed this analysis in June 2011. At that time the Council made revisions to the alternatives and requested additional analyses. The Council's motion from June 2011 is attached as **Item C-2(b)(3)**.

Some additional sections for the EA are attached. These materials provide additional information to be presented in conjunction with the draft analysis at this meeting and will subsequently be folded into the final public review draft analysis, scheduled for review later in 2012. **Item C-2(b)(4)** is a supplemental section for the EA section 5.3.1.1 providing additional information on the 2011 B season salmon PSC closures for both Chinook and chum. This builds upon the information contained in the EA on the 2003-

2010 Rolling Hotspot results. **Item C-2(b)(5)** includes additional sections to be included in Chapter 7 Other Marine Resources under section 7.2.2 ESA Consultations for Marine Mammals and 7.6 Prey Availability Effects. These new sections (7.2.2.5 and revisions to 7.2.6) address information related to the ESA consultation on Cook Inlet Beluga whales.

Two additional reports related to Council outreach and NMFS tribal consultation are included. **Item C-2(b)(6)** provides a summary of a statewide teleconference on the chum salmon PSC analysis held on February 24, 2012. This is the second such teleconference held by Council staff on this issue, the first was held in May 2010. The purpose of the second call last month was to again inform the public of the alternatives under consideration to reduce chum salmon PSC in the Bering Sea pollock fishery, to help the public understand the Council process and ways to provide formal input to the Council, and to provide opportunity for the public to express concerns and ask questions of the Council analysts.

Finally, a letter to the Council chairman and documents related to two tribal consultation meetings held in 20111 between the NMFS and Alaska Native tribes from the Norton Sound region about chum salmon bycatch is attached as **Item C-2(b)(7).** NMFS staff will provide an overview of the tribal consultation meetings and these documents.

At this meeting the Council will take initial review of the analysis. In doing so, the Council may wish to revise the suite of alternative management measures under consideration, request further data and/or analysis, and/or select a preliminary preferred alternative (PPA). The Council is not required to select a PPA and may wait until final action to indicate their preferred alternative. Any modifications recommended by the Council at this meeting will be analyzed in the next draft analysis, prior to it being released for public review. The Council has tentatively scheduled this action for final action in October 2012, but may modify that schedule at this meeting.

AGENDA C-2(a)
MARCH/APRIL 2012

NOAA Technical Memorandum NMFS-AFSC-232

Genetic Stock Composition Analysis of Chinook Salmon Bycatch Samples from the 2010 Bering Sea Trawl Fisheries

by
C. M. Guthrie, III, H. T. Nguyen, and J. R. Guyon

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Fisheries Science Center

January 2012

NOAA Technical Memorandum NMFS

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This document should be cited as follows:

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U.S. DEPARTMENT OF COMMERCE
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National Oceanic and Atmospheric Administration
Jane Lubchenco, Under Secretary and Administrator
National Marine Fisheries Service
Eric C. Schwaab, Assistant Administrator for Fisheries

January 2012

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ABSTRACT

A genetic analysis of samples from the Chinook salmon (*Oncorhynchus tshawytscha*) bycatch of the 2010 Bering Sea groundfish trawl fishery was undertaken to determine the overall stock composition of the sample set. Samples were genotyped for 43 single nucleotide polymorphism DNA markers and results were estimated using the Alaska Department of Fish and Game (ADF&G) SNP baseline. In 2010, genetic samples were collected as part of the observer's species-composition analysis. This sampling change for 2010 was an interim measure implemented until recommended systematic sampling protocols could be finalized. Consequently, stock composition estimates apply to the sample set and may not represent the entire Chinook salmon bycatch. Based on the analysis of 826 Chinook salmon bycatch samples collected throughout the 2010 Bering Sea trawl fishery, Coastal Western Alaska stocks dominated the sample set (42%), with smaller contributions from Upper Yukon River (20%), North Alaska Peninsula (14%) and Middle Yukon River (11%) stocks. The annual estimates for the 2010 Chinook salmon bycatch sample set were generally similar to the 2005–2009 Chinook salmon bycatch estimates, although there were higher proportions of Yukon River stocks and lower proportions of Coastal Western Alaska stocks in 2010. Analysis of temporal groupings within the groundfish "A" and "B" seasons revealed changes in stock composition during the course of the year with lower contribution of North Alaska Peninsula and Yukon River stocks and higher concentrations of Pacific Northwest and British Columbia stocks during the "B" season, but leaves unanswered whether these changes are due to temporal or spatial differences in the sample set.

CONTENTS

INTRODUCTION

The Bering Sea is a known feeding habitat for multiple brood years of Chinook salmon (*Oncorhynchus tshawytscha*) from many different localities in North America and Asia. Determining the geographic origin and stock composition of salmon caught in federally managed fisheries is essential to understanding whether fisheries management could address conservation concerns. This report provides genetic stock identification results for a set of Chinook salmon bycatch samples collected from the U.S. Bering Sea groundfish trawl fisheries. National Marine Fisheries Service (NMFS) geographical statistical areas associated with the groundfish fishery are shown in Figure 1 and are used later in the report to describe the spatial distribution of the Chinook salmon bycatch and genetic samples.

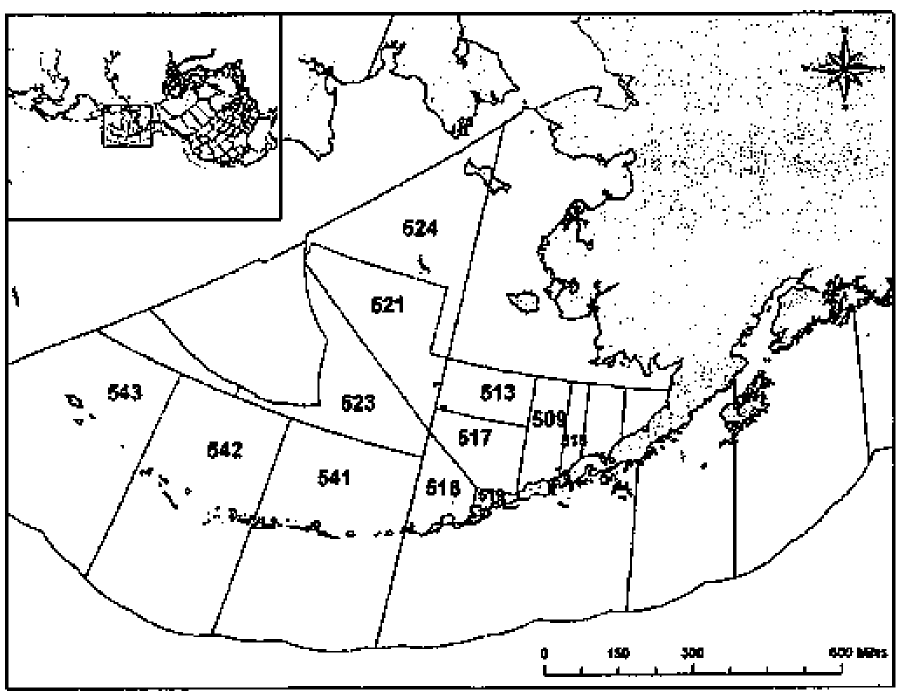

Figure 1. -- NMFS statistical areas associated with the Bering Sea Aleutian Island (BSAI) trawl fishery.

The goal of this report is to present stock composition estimates for samples collected from the bycatch of the Bering Sea trawl fishery, but it is important to understand the limitations for making accurate estimates of the entire bycatch imposed by the sampling distribution and the genetic baseline. This report is divided into the following five sections: Introduction, Sample Distribution, Genetic Stock Composition, Comparison with Previous Estimates, and a Summary. The analysis uses a single nucleotide polymorphism (SNP) baseline provided by the Alaska Department of Fish and Game (ADF&G) (Templin et al. 2011) and was used previously to estimate stock composition of samples from the 2005, 2006, 2007, 2008, and 2009 Chinook salmon bycatch (Guyon et al. 2010a and b; NMFS 2009). For additional information regarding background and methodology, this report is intended to be supplemented with the Chinook salmon bycatch report prepared previously for the 2008 Bering Sea trawl fishery (Guyon et al. 2010a).

SAMPLE DISTRIBUTION

Samples were collected by the Alaska Fisheries Science Center's (AFSC) North Pacific Observer Program as a Special Project (designated "Salmon Genetic Project") for the Auke Bay Laboratories (ABL). Samples of axillary process tissue for genetic analysis were collected as part of the species composition analysis throughout the 2010 groundfish "A" and "B" seasons. Axillary process tissue was stored in coin envelopes which were labeled, frozen, and shipped to ABL. While the majority of the Chinook salmon bycatch genetic samples were derived from the bottom and mid-water pollock trawl fishery (78% pollock, 7% cod, and 15% unknown), the actual target was only determined after the season was completed as the most common catch in the haul or offload. In addition, a vessel can theoretically participate in various fisheries on a particular cruise before an offload. For these reasons, stock composition estimates are provided for the entire data set and presented as the stock composition of the BSAI groundfish trawl fishery for 2010.

In 2010, an estimated 12,532 Chinook salmon were taken in the bycatch of the Bering Sea groundfish trawl fisheries (NMFS 2011), of which 9,513 were estimated from the trawl "A" season and 3,019 were estimated for the "B" season. The majority of Chinook salmon were taken as bycatch of the Bering Sea pollock fishery (9,737 in 2010). The year with the highest overall Chinook bycatch in the Bering Sea was 2007 (Fig. 2) when an estimated 129,567 were taken. The genetic sample set for the 2010 "A" season Chinook salmon bycatch was 702 fish, corresponding to a sampling rate of 7.4%. The genetic sample set for the 2010 "B" season Chinook bycatch was 124 fish, corresponding to a sampling rate of 4.1%. The annual sampling rate for the entire year was 6.6%.

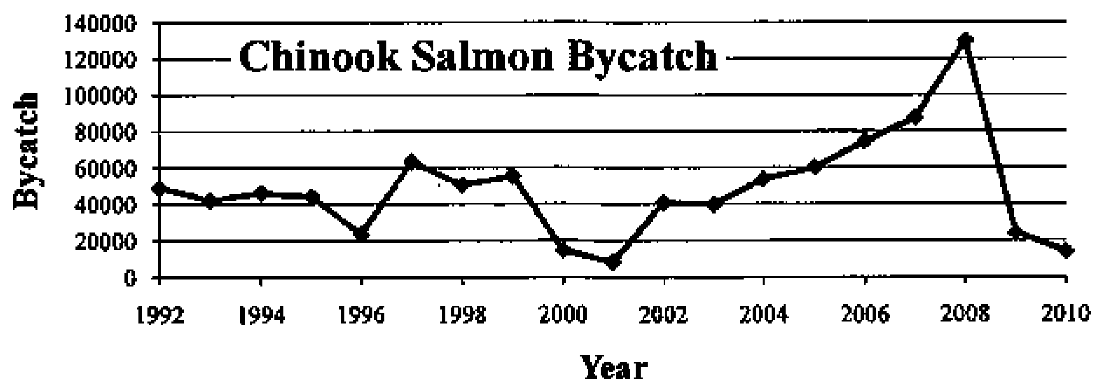

Figure 2. -- Yearly estimates for the Chinook salmon bycatch from the Bering Sea trawl fishery (NMFS 2011).

Potential biases associated with the collection of genetic samples from the bycatch are well documented, and have the potential to affect resulting stock composition estimates (Pella and Geiger 2009). Potential spatial and temporal biases associated with the 2010 Chinook salmon bycatch sample sets were evaluated by comparing the genetic sample distribution with the overall bycatch estimate distribution (Fig. 3). During 2010, the overall bycatch and genetic samples were generally comparable in their temporal distribution.

To evaluate the sample spatial distribution, the Chinook salmon bycatch was compared with the bycatch samples by statistical area over time (Fig. 4). Spatial and temporal sample biases can become more apparent at these higher resolution scales. For samples collected from offloads in which the vessel fished in multiple areas, the sample location of the entire catch of a fishing trip was identified as the location of the first haul, although generally those areas were in close proximity to each other. Overall, the sampling of the Chinook salmon bycatch in the 2010 Bering Sea trawl fishery was in proportion to the catch, although the "B" season sample size was slightly underrepresented (Fig. 4). The sample spatial and temporal distribution was improved in 2010 compared to previous years when samples were collected more opportunistically (Guyon et al. 2010a, 2010b). In 2010, genetic samples were collected as part of the observer's species composition analysis. This sampling change for 2010 was an interim measure implemented until systematic sampling protocols recommended by Pella and Geiger (2009) could be finalized.

GENETIC STOCK COMPOSITION

DNA was extracted from axillary process tissue and matrix-assisted laser desorption/ionization - time of flight (MALDI-TOF) genotyping was performed as described previously (Guyon et al. 2010a) using a Sequenom MassARRAY iPLEX platform (Gabriel et al. 2009) to genotype 43 SNP DNA markers represented in the Chinook salmon baseline (Templin et al. 2011). The SNP baseline contains genetic information for 172 populations of Chinook salmon grouped into 11 geographic regions. This baseline was used previously for the genetic analysis of the 2005, 2006, 2007, 2008, and 2009 Bering Sea Chinook bycatch (NMFS 2009; Guyon et al. 2010a, b). In addition to internal MALDI-TOF chip controls, 10 previously

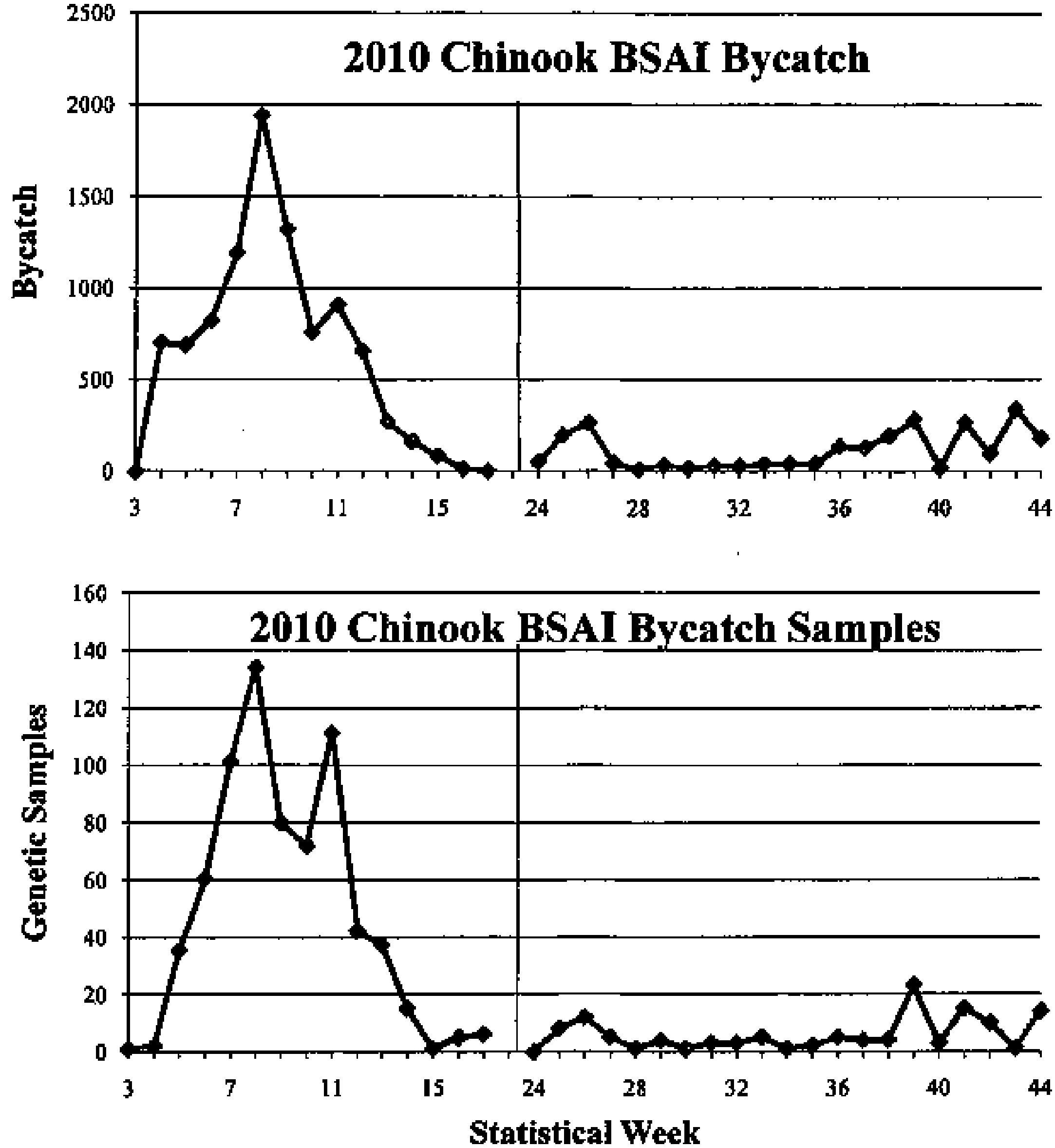

Figure 3.– Number of Chinook salmon bycatch and genetic samples graphed by statistical week.Top panel: Distribution of all Chinook salmon caught in the 2010 Bering Sea groundfish trawl fishery. Bottom panel: Distribution of the available 826 genetic samples from the 2010 bycatch. Weeks 3-17 correspond to the groundfish "A" season, whereas weeks 24-44 correspond to the "B" season, the demarcation of which is a vertical line.

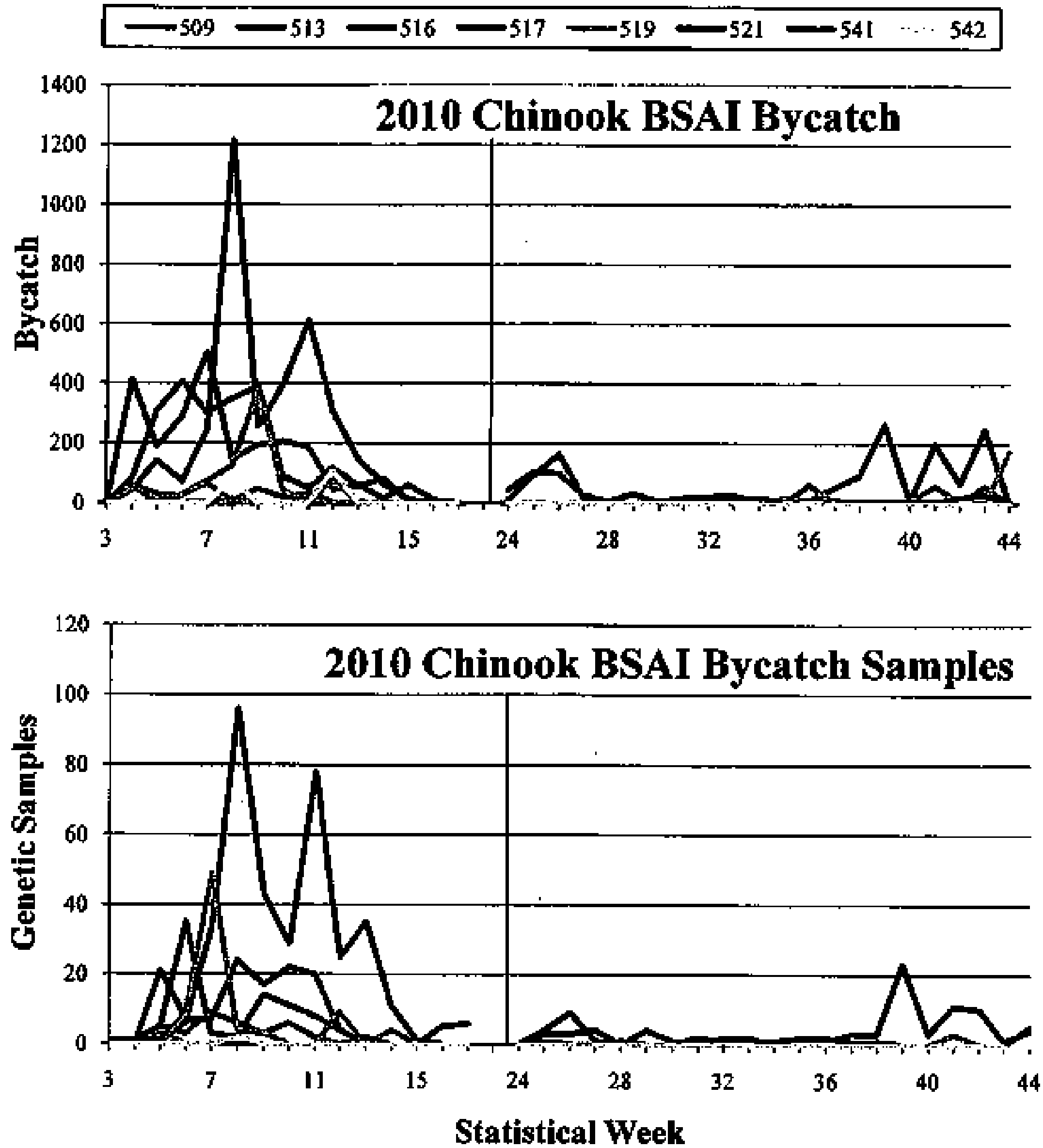

Figure 4. – Comparison of the Chinook salmon bycatch by time and area with the distribution of available genetic samples. Top panel: Distribution of the estimated Chinook salmon caught in the 2010 BSAI groundfish trawl fishery. Not graphed were an estimated 33 fish from area 523, 5 from area 524, and 5 from area 543. Bottom panel: Distribution of the available 826 genetic samples from the 2010 bycatch. Not graphed were 1 fish from areas 516, and 524 each; 3 from area 523, and 4 from area 543. Weeks 3-17 correspond to the groundfish "A" season, whereas weeks 24-44 correspond to the "B" season, the demarcation of which is a vertical line.

genotyped samples were included on each chip during the analyses and resulting genotypes were compared to those from ADF&G, which used TaqMan chemistries (Applied Biosystems). Concordance rates of 99.9% between the two chemistries for the 2010 controls confirmed the utility and compatibility of both genotyping methods.

From the 2010 Chinook salmon bycatch, a total of 1,028 samples were analyzed of which 994 samples were successfully genotyped for 35 or more of the 43 SNP loci, a success rate of 96.7%. These genotypes were analyzed in GenAlEx (Peakall and Smouse 2006) for data integrity, resulting in the removal of 7 fish: 4 with duplicate genotypes and 3 fish without date information. Of the remaining 987, there were 826 which were determined to be from the Bering Sea (160 were from the Gulf of Alaska and because of the small sample set were not analyzed in this report). The remaining 826 Bering Sea samples had genetic information for an average of 42.75 of 43 markers. Stock composition estimates were derived using both SPAM (maximum likelihood analysis) and BAYES (Bayesian analysis) software and both methods yielded almost identical stock composition estimates (Tables 1-3).

BAYES software uses a Bayesian algorithm to produce stock composition estimates and can account for missing alleles in the baseline (Pella and Masuda 2001). In contrast, SPAM uses a conditional maximum likelihood approach in which the mixture genotypes are compared directly with the baseline (ADF&G 2003). Although Version 3.7b of the SPAM software allows Bayesian modeling of baseline allele frequencies, these options were not utilized for the stock composition analyses. Convergence of the SPAM estimates was monitored with the "Percent of Maximum" value which was determined to be 91.1 ("A" estimate), 90.2 ("B" estimate), and 90.8 (overall estimate), exceeding the 90% guaranteed percent achievement of the maximal likelihood. For each BAYES analysis, 11 Monte Carlo chains starting at disparate values of stock proportions were configured such that 95% of the stocks came from one designated region with weights equally distributed among the stocks of that region. The remaining 5% was equally distributed among remaining stocks from all other regions. For all estimates, a flat prior of 0.005814 (calculated as 1/172) was used for all 172 baseline populations. The analyses were completed for a chain length of 10,000 with the first 5,000 deleted during the burn-in phase when determining overall stock compositions. Convergence of the chains to posterior distributions of stock proportions was determined with Gelman and Rubin shrink statistics, which were all 1.05 or less for all the estimates, conveying strong convergence to a single posterior distribution (Pella and Masuda 2001).

Results (BAYES) suggest that 94% of the 702 samples from the "A" season originated from Alaskan river systems flowing into the Bering Sea with the Coastal Western Alaska stock contributing the most (41%), followed by the Upper Yukon (24%), North Alaska Peninsula (16%), and Middle Yukon (12%) (Table 1). For the "B" season, over 47% of the 124 samples originated from Alaskan river systems flowing into the Bering Sea with the Coastal Western Alaska region contributing the most (42%). This was followed by British Columbia (22%) and the Western U.S. coast (19%) (Table 2).

For the entire year, an estimated 87% of the bycatch samples were estimated to be from Alaskan river systems flowing into the Bering Sea with the Coastal Western Alaska stock contributing the most (42%), trailed by the Upper Yukon (20%), North Alaska Peninsula (14%), and the Middle Yukon (11%) (Table 3). The "overall" and "A" season stock compositions were similar, which was anticipated given that 85% of the samples were from the "A" season. In 2010, 76% of the Bering Sea groundfish Chinook salmon bycatch was from the "A" season.

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Table 1. -- Regional SPAM and BAYES stock composition estimates for the 702 Chinook salmon samples from the bycatch of the 2010 "A" season Bering Sea groundfish trawl fishery. Standard deviations for the SPAM estimates were determined by the analysis of 1,000 bootstrapping resamplings of the mixture. The BAYES mean estimates are provided with standard deviations (SD), 95% credible intervals, and the median estimate.

Region	SPAM	SD	BAYES	SD	0.025	Median	97.5%
Russia	**0.021**	0.004	**0.022**	0.006	0.012	0.021	0.034
Coast W AK	**0.437**	0.017	**0.414**	0.024	0.369	0.414	0.463
Mid Yukon	**0.106**	0.006	**0.121**	0.020	0.080	0.121	0.159
Up Yukon	**0.241**	0.013	**0.239**	0.020	0.201	0.239	0.279
N AK Pen	**0.143**	0.008	**0.162**	0.017	0.130	0.162	0.197
NW GOA	**0.014**	0.001	**0.006**	0.006	0.000	0.003	0.022
Copper	**0.002**	0.001	**0.000**	0.001	0.000	0.000	0.003
NE GOA	**0.000**	0.000	**0.000**	0.002	0.000	0.000	0.005
Coast SE AK	**0.003**	0.000	**0.003**	0.003	0.000	0.002	0.009
BC	**0.027**	0.002	**0.029**	0.007	0.017	0.028	0.043
WA/OR/CA	**0.006**	0.000	**0.005**	0.003	0.001	0.004	0.011

Table 2. -- Regional SPAM and BAYES stock composition estimates for the 124 Chinook salmon samples from the bycatch of the 2010 "B" season Bering Sea groundfish trawl fishery. Standard deviations for the SPAM estimates were determined by the analysis of 1,000 bootstrapping resamplings of the mixture. The BAYES mean estimates are also provided with standard deviations (SD), 95% credible intervals, and the median estimate.

Region	SPAM	SD	BAYES	SD	0.025	Median	97.5%
Russia	**0.024**	0.011	**0.024**	0.014	0.005	0.022	0.058
Coast W AK	**0.384**	0.037	**0.422**	0.051	0.323	0.422	0.520
Mid Yukon	**0.025**	0.009	**0.022**	0.022	0.000	0.017	0.078
Up Yukon	**0.005**	0.000	**0.001**	0.004	0.000	0.000	0.011
N AK Pen	**0.034**	0.013	**0.034**	0.019	0.005	0.031	0.079
NW GOA	**0.043**	0.009	**0.023**	0.020	0.000	0.018	0.075
Copper	**0.000**	0.000	**0.001**	0.003	0.000	0.000	0.007
NE GOA	**0.026**	0.004	**0.007**	0.012	0.000	0.000	0.043
Coast SE AK	**0.045**	0.004	**0.064**	0.025	0.023	0.061	0.120
BC	**0.228**	0.025	**0.216**	0.038	0.148	0.215	0.294
WA/OR/CA	**0.186**	0.022	**0.185**	0.035	0.122	0.184	0.260

Table 3. -- Regional SPAM and BAYES stock composition estimates for the 826 Chinook salmon samples from the bycatch of the 2010 Bering Sea groundfish trawl fishery. Standard deviations for the SPAM estimates were determined by the analysis of 1,000 bootstrapping resamplings of the mixture. The BAYES mean estimates are also provided with standard deviations (SD), 95% credible intervals, and the median estimate.

Region	SPAM	SD	BAYES	SD	0.025	Median	97.5%
Russia	**0.022**	0.003	**0.022**	0.005	0.013	0.022	0.034
Coast W AK	**0.433**	0.016	**0.416**	0.022	0.374	0.415	0.460
Mid Yukon	**0.096**	0.005	**0.112**	0.018	0.077	0.112	0.146
Up Yukon	**0.205**	0.010	**0.204**	0.017	0.171	0.203	0.238
N AK Pen	**0.126**	0.007	**0.141**	0.015	0.113	0.141	0.171
NW GOA	**0.017**	0.001	**0.006**	0.006	0.000	0.004	0.021
Copper	**0.001**	0.000	**0.000**	0.001	0.000	0.000	0.003
NE GOA	**0.002**	0.000	**0.000**	0.002	0.000	0.000	0.005
Coast SE AK	**0.009**	0.000	**0.009**	0.004	0.003	0.008	0.018
BC	**0.056**	0.003	**0.056**	0.008	0.041	0.056	0.073
WA/OR/CA	**0.034**	0.003	**0.035**	0.007	0.023	0.034	0.048

COMPARISON WITH PREVIOUS ESTIMATES

Stock compositions from the analysis of the 2010 "A" season Chinook salmon bycatch samples were in general agreement with the 2008 "A" season estimates. For example, most samples were from stocks originating from river systems directly flowing into the Bering Sea, although differences were noted for the Upper and Middle Yukon group (increased in 2010) and the Western Alaska and the Northern Alaska Peninsula groupings (decreased in 2010) (Fig. 5). With regard to the 2010 "B" season stock composition estimates, substantial differences were apparent when compared to previous years (Fig. 6). The largest differences were the decrease for Coastal Western Alaska stocks and the increase in British Columbia, West Coast U.S. and Coastal Southeast Alaska stocks in 2010. Since most of the Chinook salmon bycatch occurs during the spring "A" season, the sample sets available for the "B" season were smaller and

Figure 5. -- Comparison of "A" season genetic stock composition estimates for 2008 and 2010 based on available genetic samples from the Bering Sea Chinook salmon bycatch. The same genetic baseline and general regional groupings were used in all analyses. Other group consists of combined values from NWGOA, Copper, NE GOA, and Coast SE AK groupings.

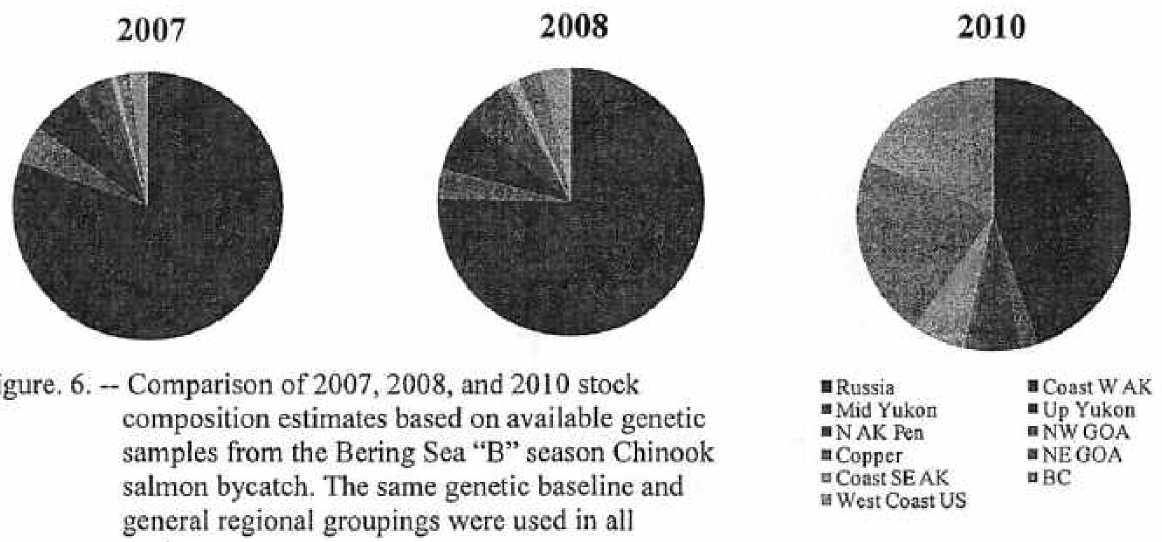

Figure. 6. -- Comparison of 2007, 2008, and 2010 stock composition estimates based on available genetic samples from the Bering Sea "B" season Chinook salmon bycatch. The same genetic baseline and general regional groupings were used in all analyses.

therefore potentially subject to more stock variability implying that caution must be exercised in interpreting these results. When the stock compositions were analyzed for the entire year, Coastal Western Alaska and Northern Alaska Peninsula stock compositions trended downward between 2008 and 2010, while the Yukon, British Columbia, and West Coast U.S. stock compositions slightly increased (Fig. 7). These changes may be the result of more representative sampling of the bycatch in 2010 or reflect true changes in the overall stock compositions.

SUMMARY

Communities in western Alaska and elsewhere are dependent on Chinook salmon for subsistence and commercial purposes. Decreasing Chinook salmon returns to western Alaska rivers have caused hardships in these communities and led to the recent declaration of a fisheries disaster for Yukon River Chinook salmon by the U. S. Secretary of Commerce (Locke 2010). Salmon-dependent communities have expressed concern regarding the numbers of salmon caught as bycatch in the Bering Sea trawl fishery. The incidental harvest of Chinook salmon in the Bering Sea groundfish fishery averaged 46,453 salmon per year during 1992-2010, but

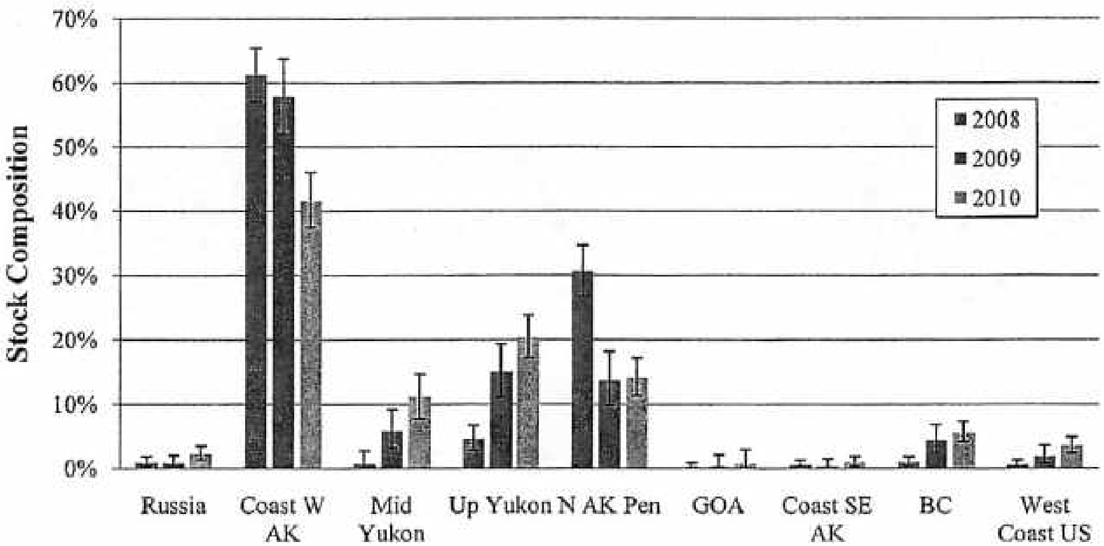

Figure 7. -- Comparison of yearly stock composition estimates (2008-2010) based on available genetic samples from the Bering Sea Chinook salmon bycatch. The same genetic baseline and general regional groupings were used in all analyses. GOA group consists of combined values for NWGOA, Copper, and NE GOA. BAYES 95% credible intervals are plotted for yearly estimates.

steadily increased to a peak of 129,567 in 2007. The Chinook salmon bycatch has abated in more recent years dropping to a total of 12,532 Chinook salmon in 2010 and a Chinook salmon bycatch management program was implemented in 2011 by the North Pacific Fishery Management Council to limit the amount of Chinook salmon taken in the pollock fishery and provide incentives to avoid Chinook salmon bycatch. Stock composition estimates of the Chinook salmon bycatch are needed for pollock and salmon fishery managers to understand whether the trawl fisheries may be impacting salmon returns. This report provides a stock composition analysis of genetic sample sets from the 2010 BSAI Chinook salmon bycatch. The results and limitations of this analysis are summarized below.

Sampling Issues

The inherent spatial and temporal biases in the sample sets from previous years have been reduced in 2010 (Figs. 3-4). These past biases limited the application of the genetic sample stock composition estimates to the entire Chinook salmon bycatch, although the small sample size from the "B" season still causes concern. With regard to future improved sampling protocols, NMFS recently instituted a rule and notice of availability for Amendment 91 to the Fishery Management Plan for Groundfish of the BSAI Management Area (75 FR 14016, March 23, 2010). This rule will require that all salmon bycatch taken in the Bering Sea pollock fishery be sorted by species and counted to ensure compliance with the salmon bycatch caps for the pollock fishery. This may provide additional opportunity for observers to provide representative sampling of the salmon bycatch for genetic analysis, and improve the capability to characterize the origin of salmon taken as bycatch in the Bering Sea trawl fishery.

Stock Composition Estimates

Overall, the majority (> 85%) of the genetic samples were collected from the 2010 "A" season, a time which accounted for over 75% of the total 2010 Chinook bycatch of the Bering Sea trawl fishery. Genetic stock composition analysis showed the majority of bycatch samples were from Alaskan stocks predominantly originating from river systems directly flowing into the Bering Sea. The Chinook salmon bycatch stock composition estimates for the 2010 "B" season differed from those of the 2010 "A" season, suggesting temporal differences in the available Chinook salmon stocks. This was especially apparent for Middle/Upper Yukon stocks (35.9% vs. 2.3%), and the British Columbia/West Coast U.S. stocks (3.4% vs. 40.2%).

Application of These Estimates

The extent to which any salmon stock is impacted by the bycatch of the Bering Sea trawl fishery is dependent on many factors including (1) the overall size of the bycatch, (2) the age of the salmon caught in the bycatch, (3) the age of the returning salmon, and (4) the total escapement of the affected stocks taking into account lag time for maturity and returning to the river. As such, a higher contribution of a particular stock one year does not necessarily infer greater impact than a smaller estimate the next. Efforts to better understand these relationships and their impacts are the subject of additional work.

ACKNOWLEDGMENTS

Genotyping for this analysis was funded by the Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA. We are grateful to Bill Templin of the ADF&G Gene Conservation Laboratory for providing suggestions and advice regarding the analysis, and reviewing this report. We are also grateful for the help from the AFSC's North Pacific Groundfish Observer Program including Martin Loefflad, Lisa Thompson, Craig Faunce, Jennifer Cahalan, Paul Wilkins, and the many participating observers who helped fulfill our request for genetic samples. MALDI-TOF genotyping and assay design was performed in collaboration with the genotyping core facility at the University of Arizona (Libby Serbi and Ryan Sprissler). Phil Mundy, Andrew Gray, Chris Kondzela, Tyler McCraney, and Colby Marvin helped review the report.

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APPENDIX

Appendix 1. -- Chinook salmon populations in the ADF&G SNP baseline with the regional designations used in the analyses of this report.

ADF&G number	Population name	Region number	Region
1	Bistraya River	1	Russia
2	Bolshaya River	1	Russia
3	Kamchatka River late	1	Russia
4	Pakhatcha River	1	Russia
8	Andreafsky River	2	Coast W AK
40	Aniak River	2	Coast W AK
9	Anvik River	2	Coast W AK
34	Arolik River	2	Coast W AK
54	Big Creek	2	Coast W AK
44	Cheeneetnuk River	2	Coast W AK
36	Eek River	2	Coast W AK
45	Gagaryah River	2	Coast W AK
41	George River	2	Coast W AK
10	Gisasa River	2	Coast W AK
7	Golsovia River	2	Coast W AK
33	Goodnews River	2	Coast W AK
35	Kanektok River	2	Coast W AK
38	Kisaralik River	2	Coast W AK
42	Kogrukluk River	2	Coast W AK
37	Kwethluk River	2	Coast W AK
51	Mulchatna River	2	Coast W AK
53	Naknek River	2	Coast W AK
50	Nushagak River	2	Coast W AK
5	Pilgrim River	2	Coast W AK
48	Salmon River - Pitka Fork	2	Coast W AK
43	Stony River	2	Coast W AK
52	Stuyahok River	2	Coast W AK
46	Takotna River	2	Coast W AK
47	Tatlawiksuk River	2	Coast W AK
49	Togiak River	2	Coast W AK
11	Tozitna River	2	Coast W AK
39	Tuluksak River	2	Coast W AK
6	Unalakleet River	2	Coast W AK
17	Beaver Creek	3	Mid Yukon
18	Chandalar River	3	Mid Yukon
15	Chena River	3	Mid Yukon
12	Henshaw Creek	3	Mid Yukon
14	Kantishna River	3	Mid Yukon
16	Salcha River	3	Mid Yukon
19	Sheenjek River	3	Mid Yukon
13	South Fork Koyukuk River	3	Mid Yukon
27	Big Salmon River	4	Up Yukon
24	Blind River	4	Up Yukon
20	Chandindu River	4	Up Yukon
21	Klondike River	4	Up Yukon

ADF&G number	Population name	Region number	Region
26	Little Salmon River	4	Up Yukon
23	Mayo River	4	Up Yukon
30	Nisutlin River	4	Up Yukon
29	Nordenskiold River	4	Up Yukon
25	Pelly River	4	Up Yukon
22	Stewart River	4	Up Yukon
31	Takhini River	4	Up Yukon
28	Tatchun Creek	4	Up Yukon
32	Whitehorse Hatchery	4	Up Yukon
59	Black Hills Creek	5	N AK Pen
55	King Salmon River	5	N AK Pen
56	Meshik River	5	N AK Pen
57	Milky River	5	N AK Pen
58	Nelson River	5	N AK Pen
60	Steelhead Creek	5	N AK Pen
78	Anchor River	6	NW GOA
62	Ayakulik River	6	NW GOA
72	Benjamin Creek	6	NW GOA
61	Chignik River	6	NW GOA
69	Crescent Creek	6	NW GOA
76	Crooked Creek	6	NW GOA
65	Deception Creek	6	NW GOA
64	Deshka River	6	NW GOA
73	Funny River	6	NW GOA
70	Juneau Creek	6	NW GOA
63	Karluk River	6	NW GOA
77	Kasilof River mainstem	6	NW GOA
75	Kenai River mainstem	6	NW GOA
71	Killey Creek	6	NW GOA
79	Ninilchik River	6	NW GOA
67	Prairie Creek	6	NW GOA
74	Slikok Creek	6	NW GOA
68	Talachulitna River	6	NW GOA
66	Willow Creek	6	NW GOA
81	Bone Creek	7	Copper
82	E. Fork Chistochina River	7	Copper
85	Gulkana River	7	Copper
80	Indian River	7	Copper
87	Kiana Creek	7	Copper
88	Manker Creek	7	Copper
86	Mendeltna Creek	7	Copper
83	Otter Creek	7	Copper
84	Sinona Creek	7	Copper
90	Tebay River	7	Copper
89	Tonsina River	7	Copper
92	Big Boulder Creek	8	NE GOA
95	Kelsall River	8	NE GOA
96	King Salmon River	8	NE GOA
116	Klukshu River	8	NE GOA
91	Situk River	8	NE GOA
93	Tahini River	8	NE GOA

ADF&G number	Population name	Region number	Region
94	Tahini River - Pullen Creek Hatchery	8	NE GOA
111	Andrews Creek	9	Coast SE AK
110	Blossom River	9	Coast SE AK
102	Butler Creek	9	Coast SE AK
98	Chickamin River	9	Coast SE AK
99	Chickamin River - Little Port Walter	9	Coast SE AK
100	Chickamin River - Whitman Lake Hatchery	9	Coast SE AK
103	Clear Creek	9	Coast SE AK
104	Cripple Creek	9	Coast SE AK
112	Crystal Lake Hatchery	9	Coast SE AK
121	Dudidontu River	9	Coast SE AK
105	Genes Creek	9	Coast SE AK
114	Hidden Falls Hatchery	9	Coast SE AK
101	Humpy Creek	9	Coast SE AK
106	Kerr Creek	9	Coast SE AK
109	Keta River	9	Coast SE AK
97	King Creek	9	Coast SE AK
117	Kowatua River	9	Coast SE AK
118	Little Tatsemenie River	9	Coast SE AK
115	Macaulay Hatchery	9	Coast SE AK
113	Medvejie Hatchery	9	Coast SE AK
120	Nakina River	9	Coast SE AK
122	Tahltan River	9	Coast SE AK
108	Unuk River - Deer Mountain Hatchery	9	Coast SE AK
107	Unuk River - Little Port Walter	9	Coast SE AK
119	Upper Nahlin River	9	Coast SE AK
143	Big Qualicum River	10	BC
157	Birkenhead River spring	10	BC
128	Bulkley River	10	BC
148	Chilko River summer	10	BC
152	Clearwater River summer	10	BC
138	Conuma River	10	BC
124	Damdochax Creek	10	BC
130	Ecstall River	10	BC
158	Harrison River	10	BC
123	Kateen River	10	BC
125	Kincolith Creek	10	BC
133	Kitimat River	10	BC
135	Klinaklini River	10	BC
126	Kwinageese Creek	10	BC
153	Louis River spring	10	BC
154	Lower Adams River fall	10	BC
132	Lower Atnarko River	10	BC
131	Lower Kalum River	10	BC
155	Lower Thompson River fall	10	BC
139	Marble Creek	10	BC
156	Middle Shuswap River summer	10	BC
145	Morkill River summer	10	BC
136	Nanaimo River	10	BC
149	Nechako River summer	10	BC
140	Nitinat River	10	BC

ADF&G number	Population name	Region number	Region
127	Oweegee Creek	10	BC
137	Porteau Cove	10	BC
150	Quesnel River summer	10	BC
144	Quinsam River	10	BC
141	Robertson Creek	10	BC
146	Salmon River summer	10	BC
142	Sarita River	10	BC
151	Stuart River summer	10	BC
129	Sustut River	10	BC
147	Torpy River summer	10	BC
134	Wannock River	10	BC
168	Alsea River fall	11	West Coast US
166	Carson Hatchery spring	11	West Coast US
171	Eel River fall	11	West Coast US
160	Forks Creek fall	11	West Coast US
164	Hanford Reach	11	West Coast US
170	Klamath River	11	West Coast US
165	Lower Deschutes River fall	11	West Coast US
163	Lyons Ferry Hatchery summer/fall	11	West Coast US
159	Makah National Fish Hatchery fall	11	West Coast US
167	McKenzie River spring	11	West Coast US
172	Sacramento River winter	11	West Coast US
169	Siuslaw River fall	11	West Coast US
162	Soos Creek Hatchery fall	11	West Coast US
161	Upper Skagit River summer	11	West Coast US

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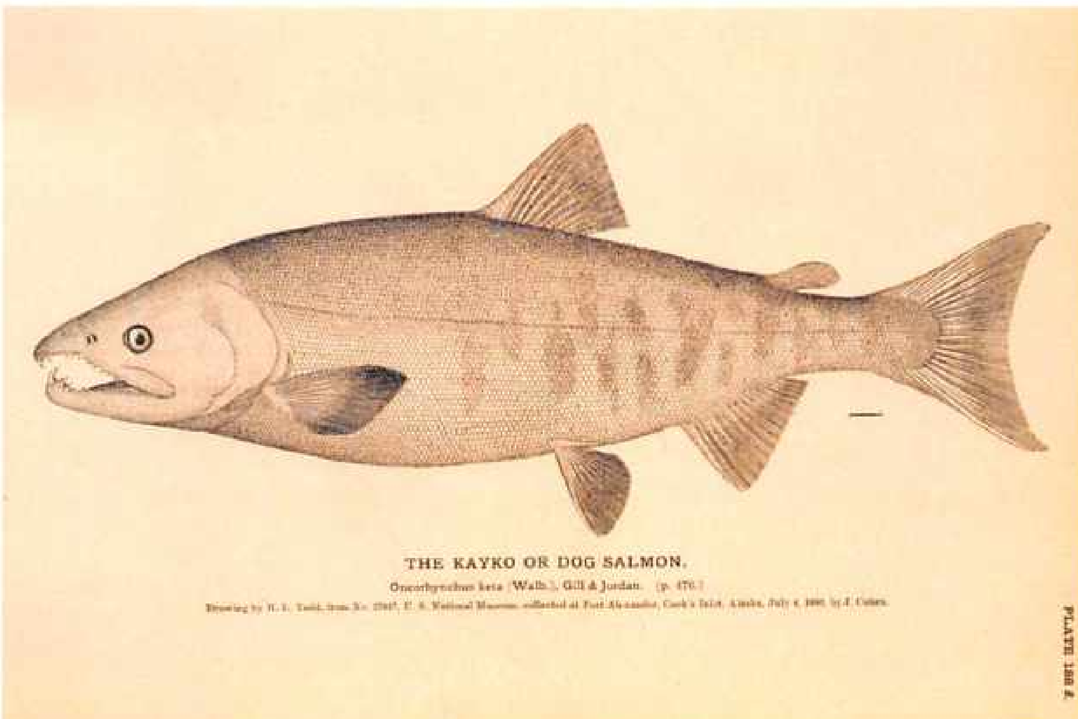
AGENDA C-2(b)(1)
MARCH 2012
REVISED VERSION
MARCH 21, 2012

Bering Sea Non-Chinook Salmon PSC Management Measures

Initial Review Draft Environmental Assessment



North Pacific Fishery Management Council

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

March 2012

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Executive Summary

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

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

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

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

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

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

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

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

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

Bering Sea Pollock Fishery

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

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

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

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

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

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

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

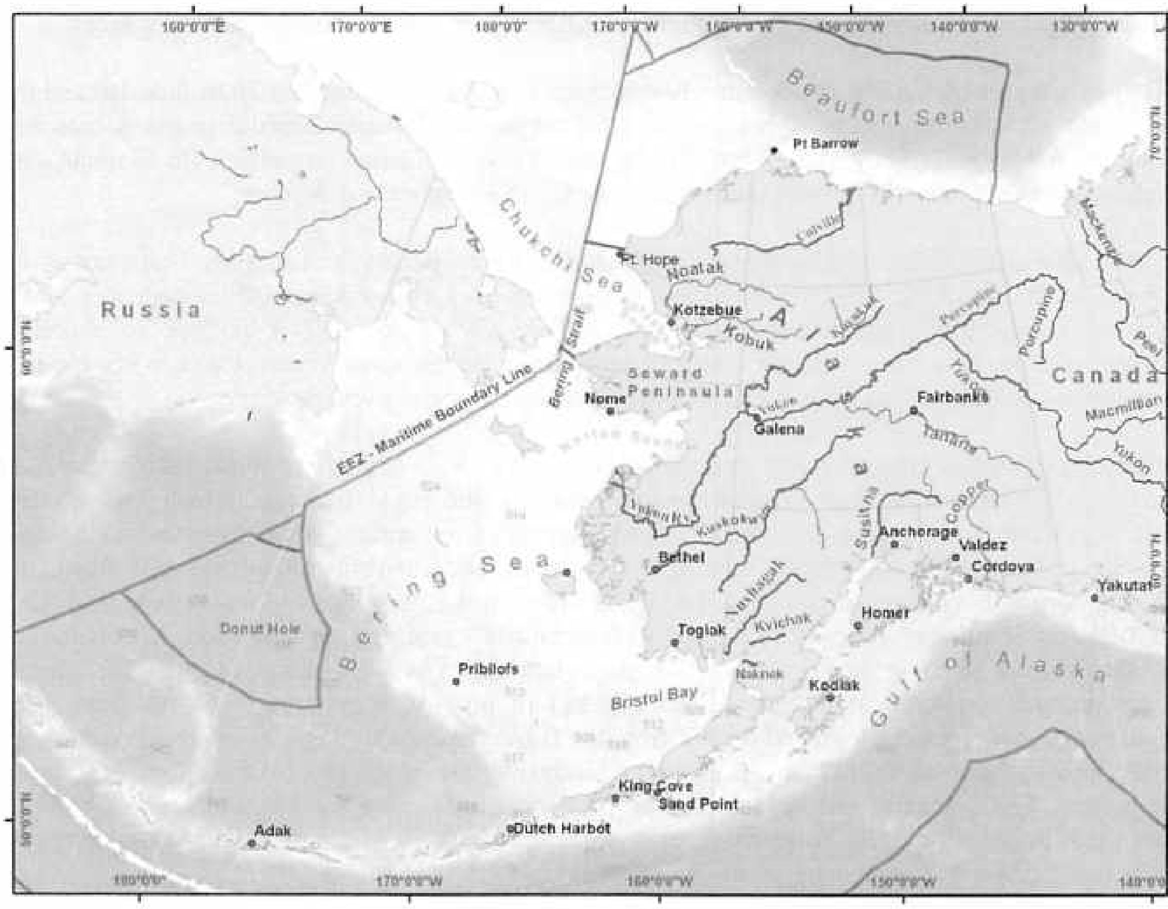


Figure ES-1. Map of the Bering Sea and major connected salmon producing rivers in Alaska and Northwest Canada

Salmon Bycatch in the Bering Sea Pollock Fishery

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

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

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

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

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

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

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

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

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

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

Chum Salmon stock status

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

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

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

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

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

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

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

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

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

Description of Alternatives

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

Alternative 1: Status Quo (No Action)

Alternative 2: Hard cap

Alternative 3: Triggered closure with rolling hotspot exemption

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

Alternative 1: Status Quo (No Action)

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

Chum Salmon Savings Area

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

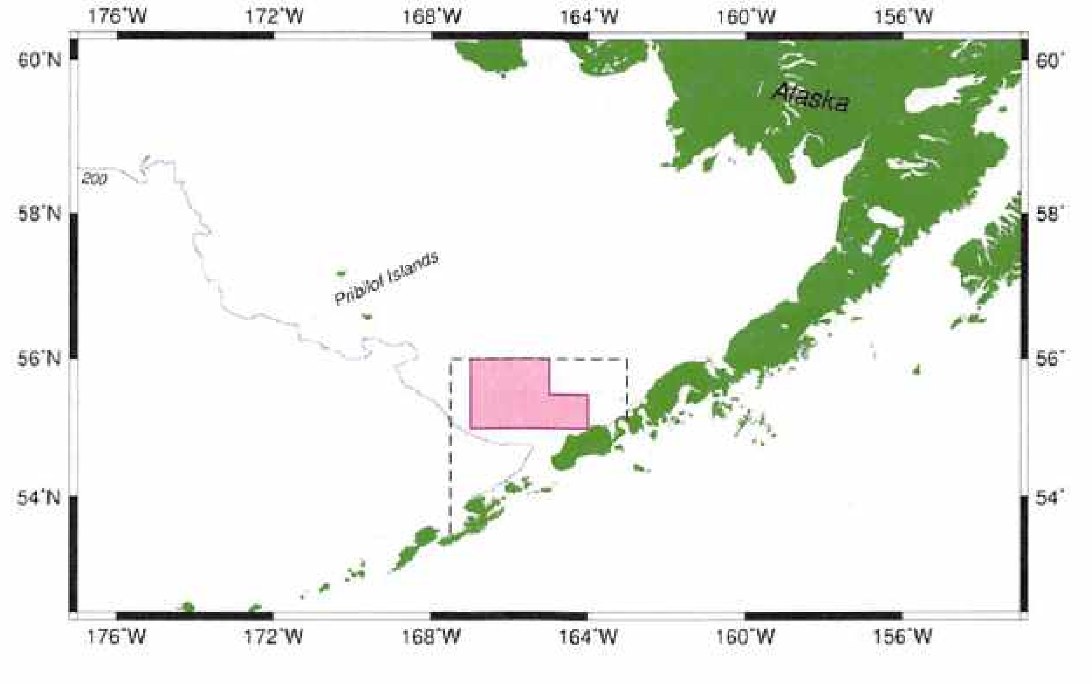


Figure ES-2. Chum Salmon Savings Area (CSSA), shaded, and Catcher Vessel Operational Area (CVOA), dashed line.

PSC limits for the CDQ Program

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

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

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

Rolling Hotspot System Intercooperative Agreement

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

Chinook Salmon PSC Management Measures under Amendment 91

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

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

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

Alternative 2: Hard cap (PSC limit)

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

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

Setting the Hard Cap

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

Range of numbers for a hard cap

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

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

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

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

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

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

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

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

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

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

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

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

Apportioning the hard cap

The hard caps could be apportioned as:

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

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

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

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

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

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

Transfers and Rollovers

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

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

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

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

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

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

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

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

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

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

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

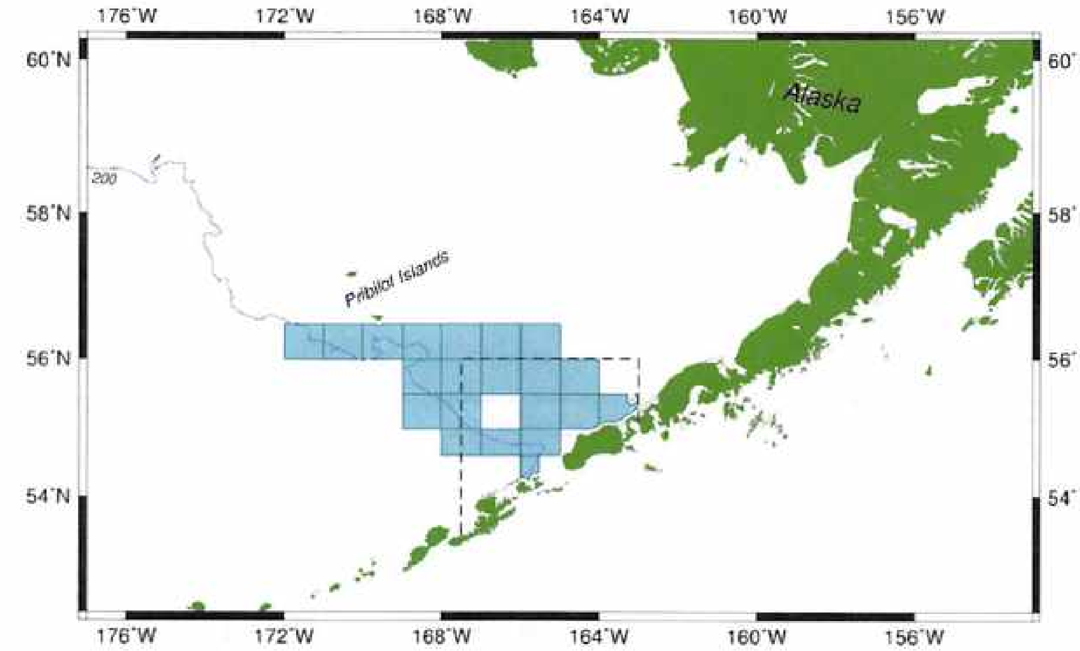


Figure ES-3. Selected area closures covering 80% of B season 2003 through 2011 chum bycatch.

Component 1: 80% Closure aggregate trigger PSC cap levels

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

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

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

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

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

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

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

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

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

Suboption 1a) Trigger closure would apply for the B season (June-October; Figure ES-4)

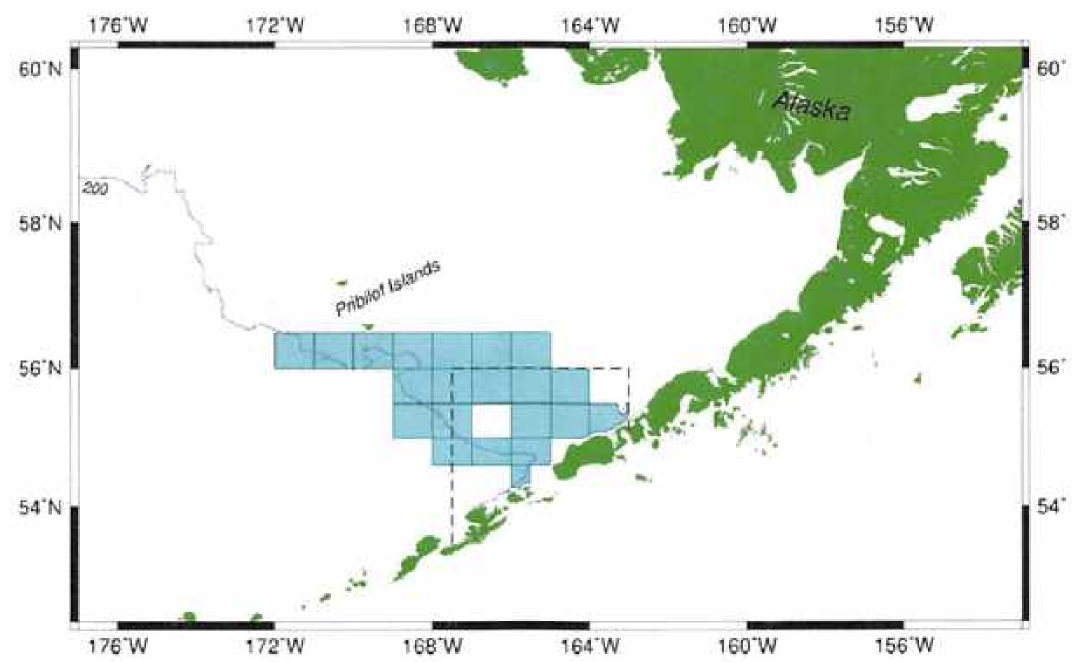


Figure ES-4. Selected area closures covering 80% of B season (Option 1a) 2003-2011 chum bycatch.

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

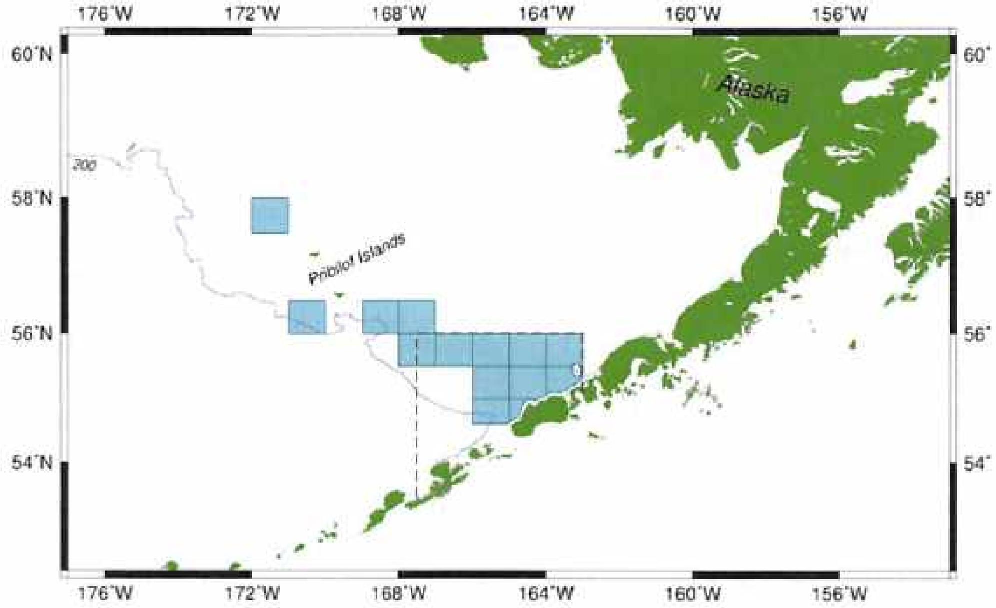


Figure ES-5. Selected area closures covering 80% of June-July (Option 1b) 2003 through 2011 chum bycatch.

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

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

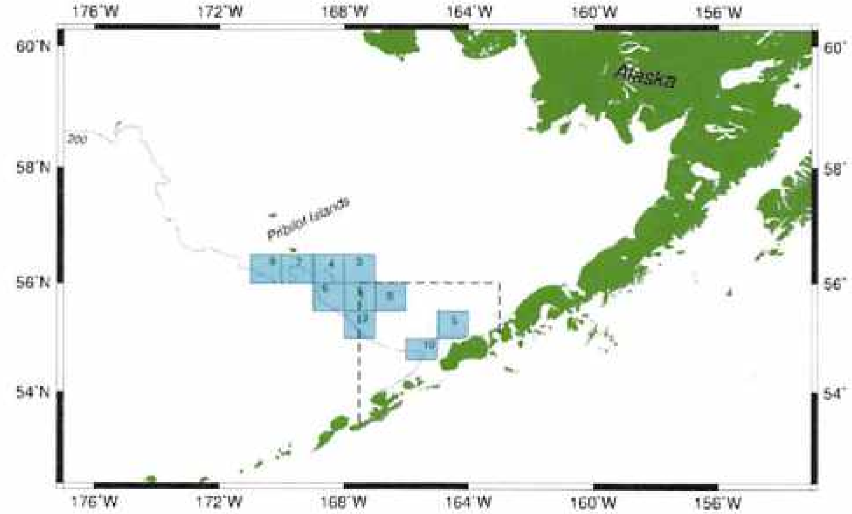


Figure ES-6. Selected area closures covering 60% of B season 2003 through 2011 chum bycatch.

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

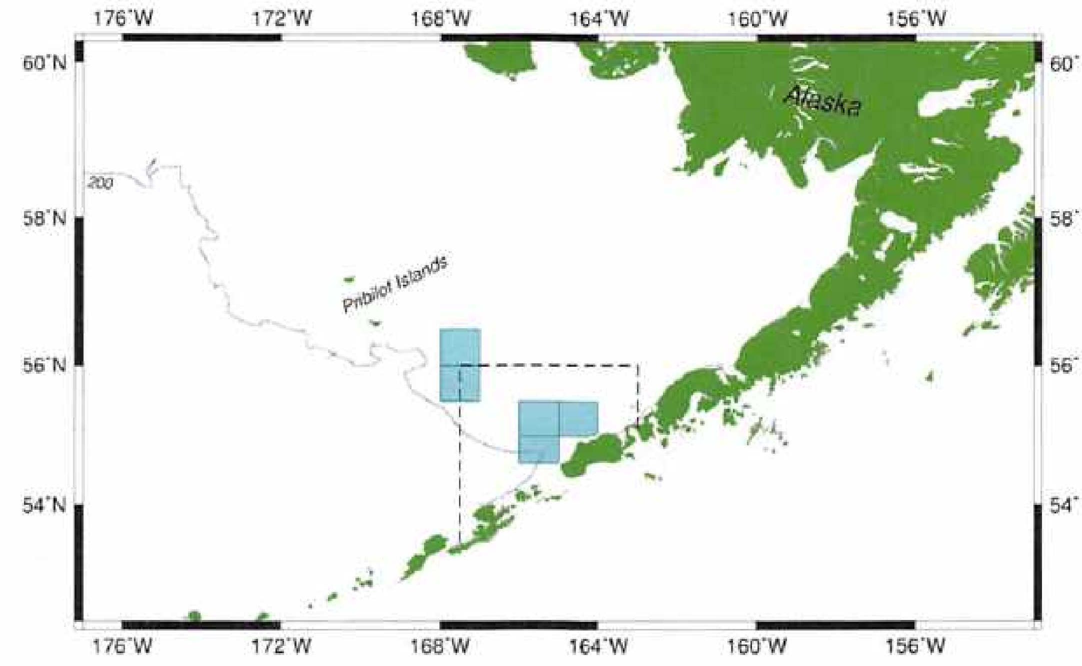


Figure ES-7. Selected area closures covering 60% of June-July 2003 through 2011 chum bycatch.

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

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

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

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

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

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

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

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

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

Comparison of Alternatives

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

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

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

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

Managing and Monitoring the Alternatives

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

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

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

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

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

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

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

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

Effects of the Alternatives

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

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

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

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

Chum salmon impacts

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

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

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

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

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

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

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

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

Adult Equivalent mortality

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

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

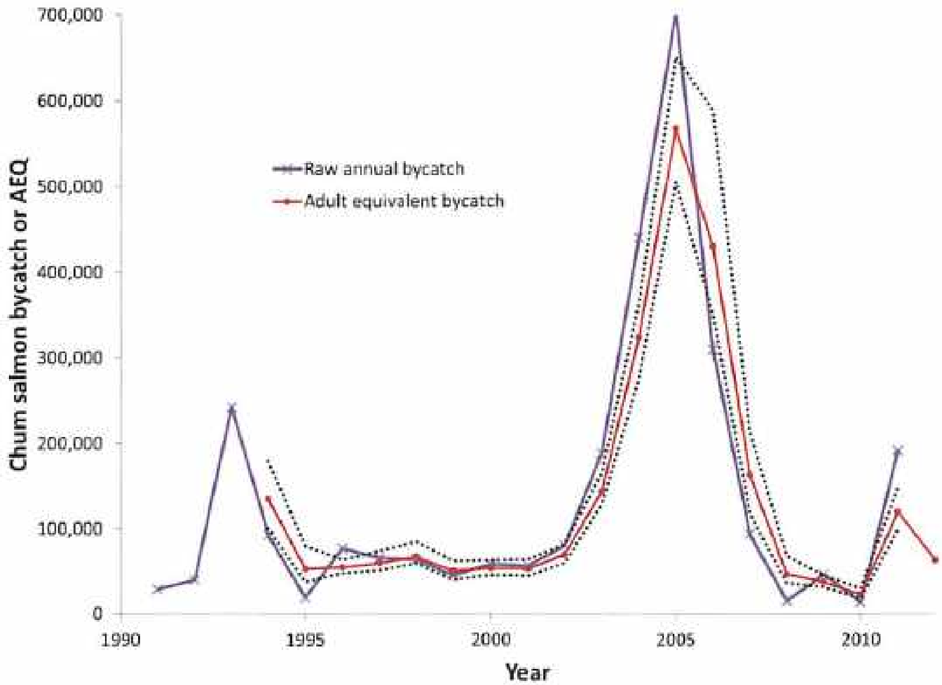


Figure ES-8. Estimated chum bycatch age-equivalent (AEQ) chum bycatch with stochastic (CV=0.4) age-specific oceanic natural mortality scenario 2 and rates compared to the annual tally. Dashed lines represent 5th and 95th percentiles based on 100 simulations. Note that values from 2011 and 2012 are based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

AEQ chum salmon returns to rivers of origin

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

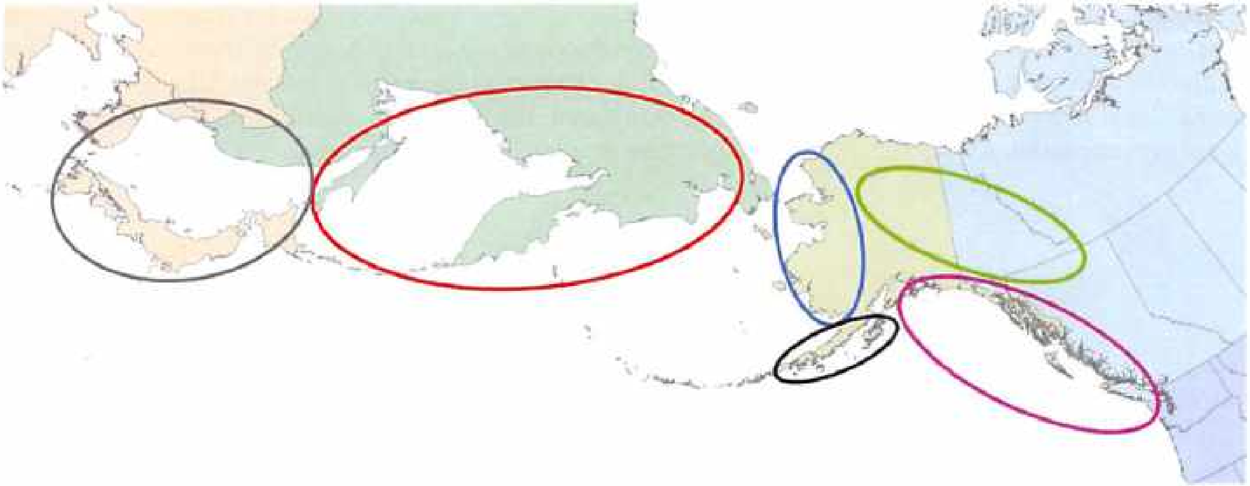


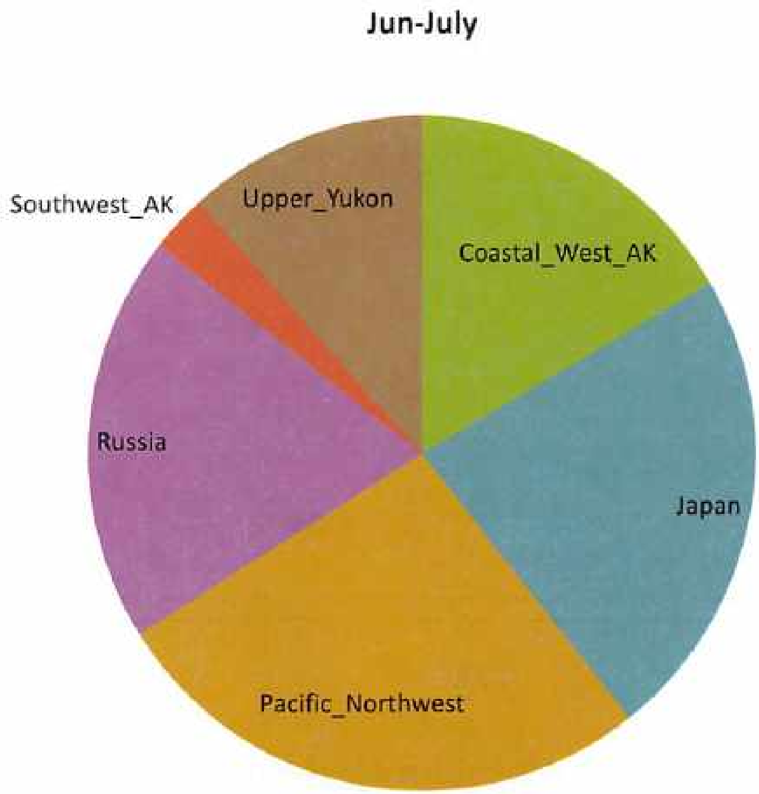
Figure ES-9. Six regional groupings of chum salmon populations used in the analysis including east Asia (grey), north Asia (red), coastal western Alaska (blue), upper/middle Yukon (green), southwest Alaska (black), and the Pacific Northwest (magenta). From Gray et al. 2010.

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

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

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

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



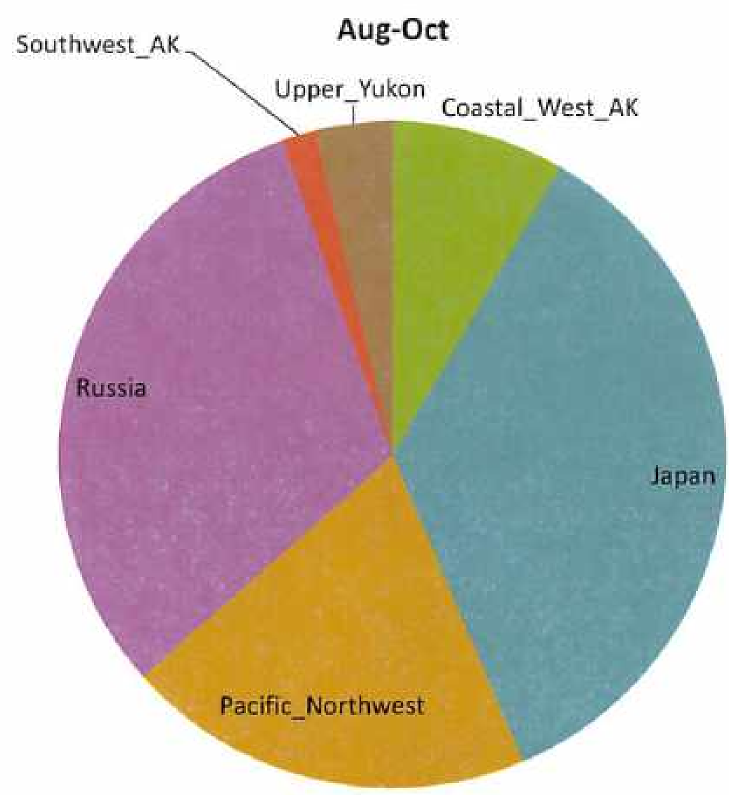


Figure ES-10. Average breakout of bycatch based on genetic analysis by early and late B-season strata, 2005-2009.

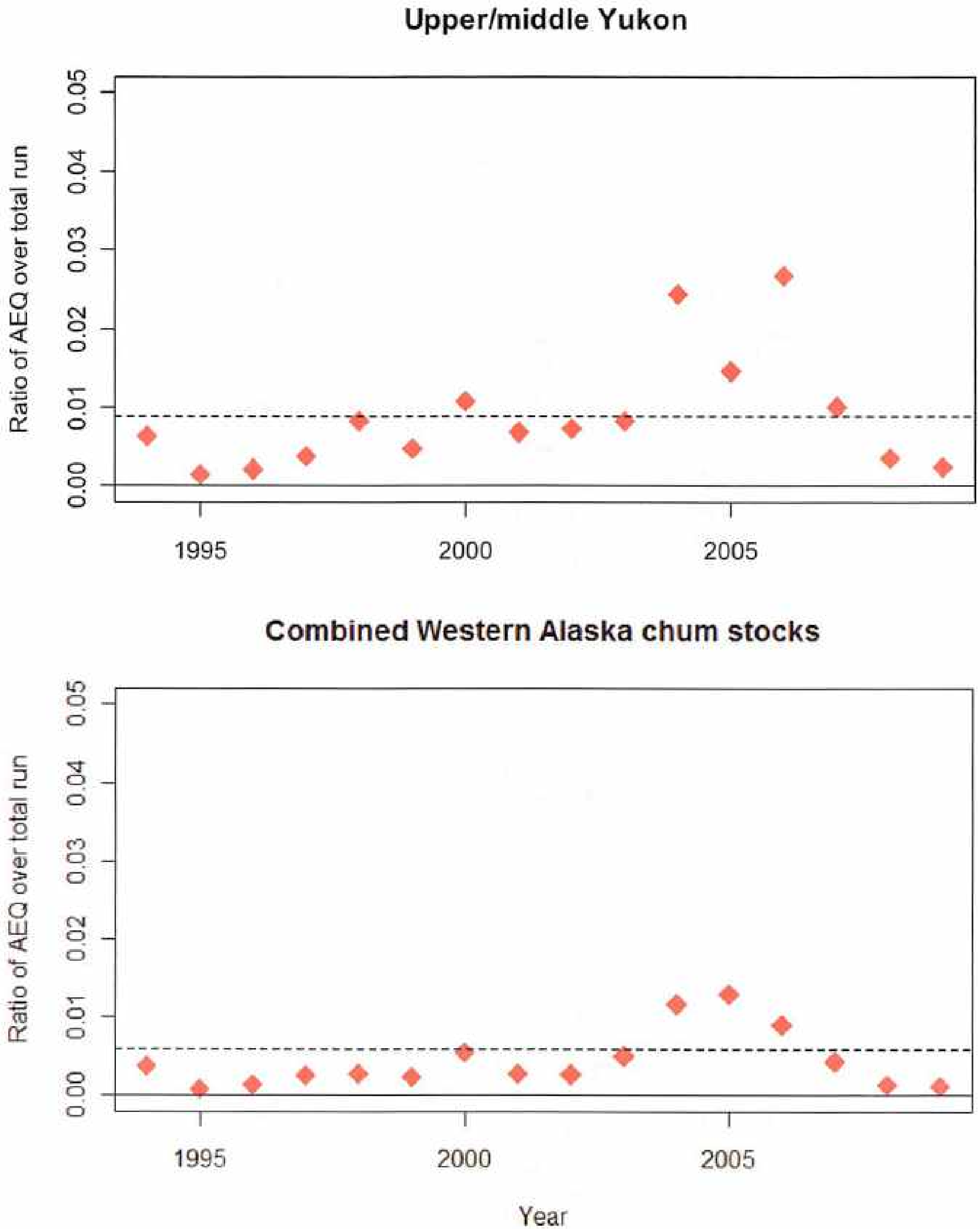
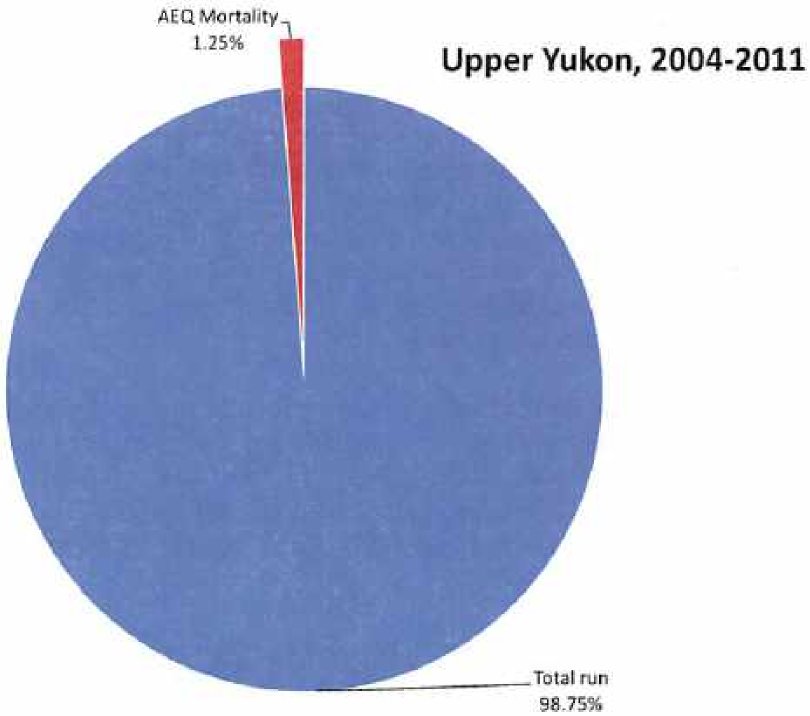


Figure ES-11. Estimated impact rates due to pollock fishery bycatch of chum salmon run sizes for Upper/middle Yukon (top) and for western Alaska stocks (coastal west Alaska stocks plus Upper/middle Yukon combined; bottom). Dashed horizontal line represents the mean value.



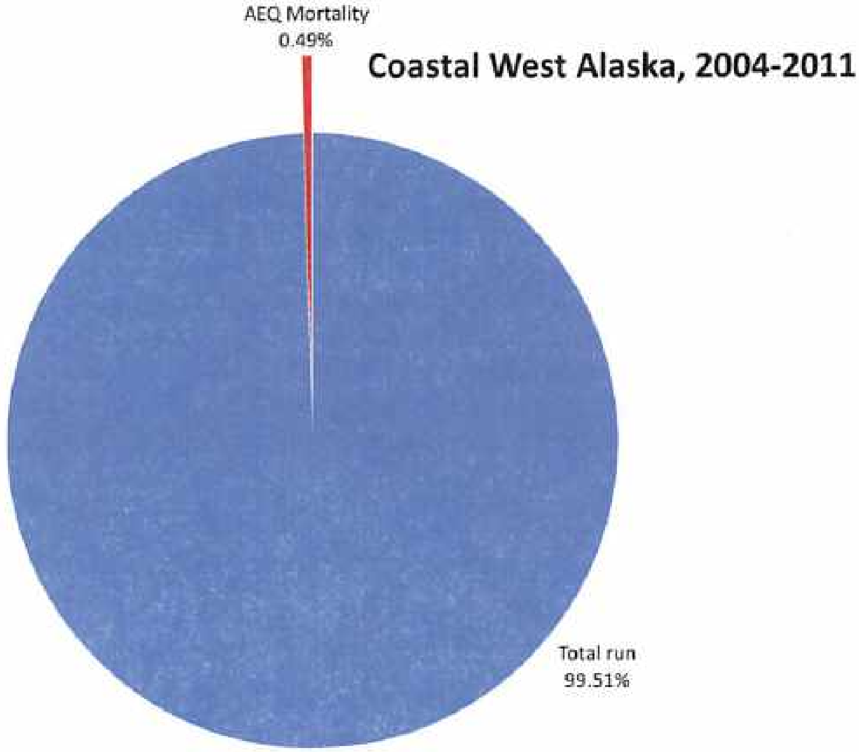


Figure ES-12. Estimated chum 2004-2011 summed AEQ mortality due to pollock fishery bycatch of chum salmon run sizes for Upper/middle Yukon (top) and for coastal western Alaska stocks (bottom).

Alternative 2, hard cap

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

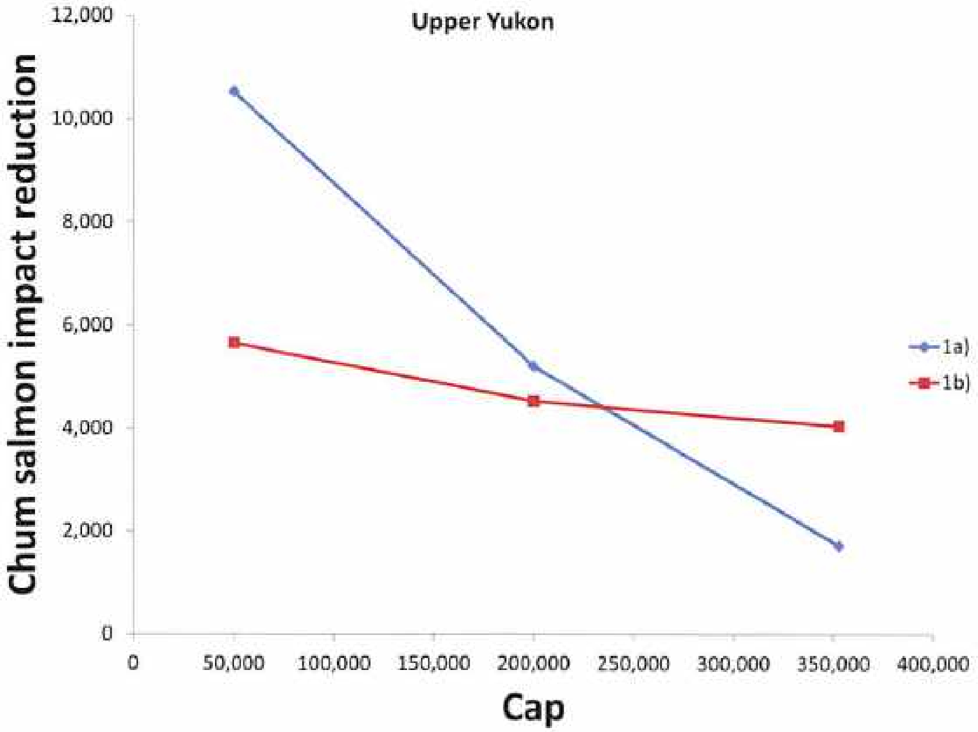
Under the analyzed options for the hard caps and sector allocations, the numbers of salmon saved is quite high for some years and varies by sector, especially for suboption 1a (Table ES-8). In percentage terms the low cap had the biggest chum salmon savings for most stocks (~80% but lowest savings for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

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

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

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

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



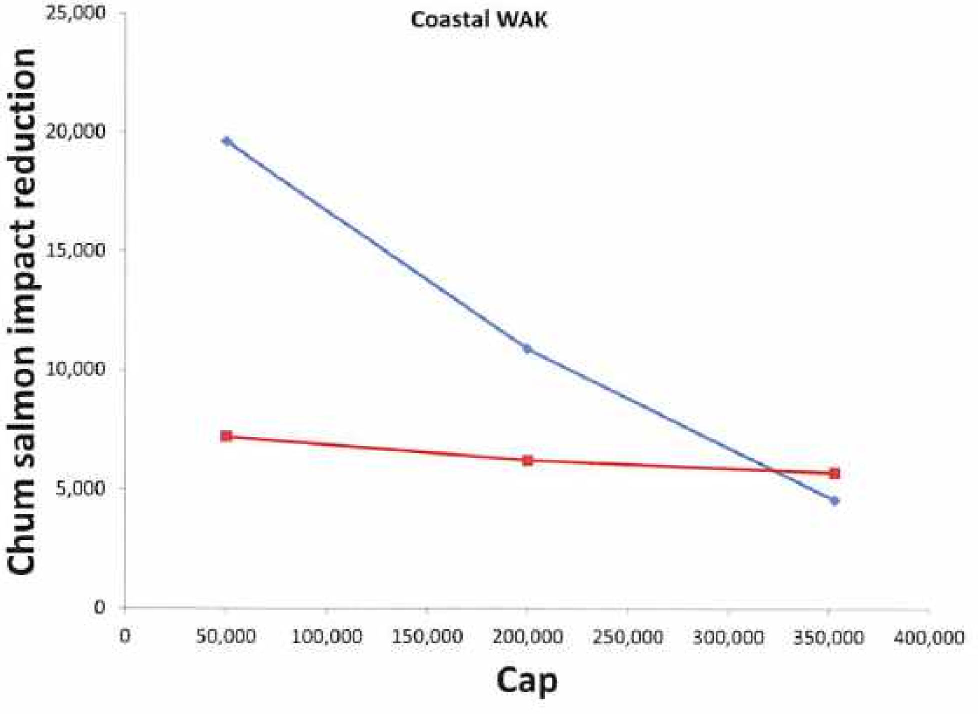


Figure ES-13. Average chum salmon impact reduction (AEQ) by suboption for Alternative 2, sector allocation 2ii, for years 2004-2011 for Upper Yukon (top) and Coastal WAK (bottom). Note that for 1b options the cap considered is that proportion of the B season cap shown in the horizontal axis.

Alternative 3, Triggered area closures

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

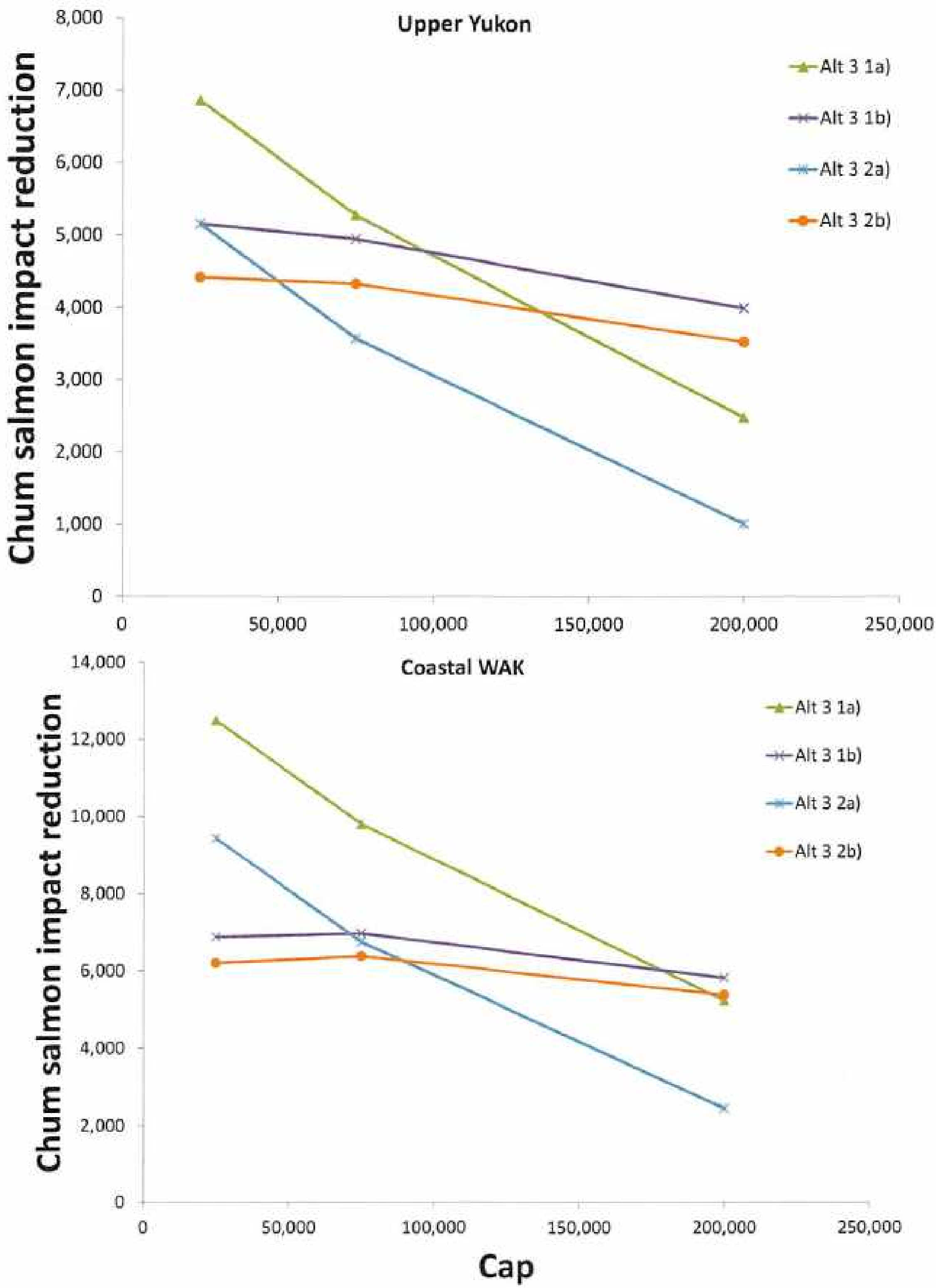


Figure ES-14. Average chum salmon impact reduction (AEQ) by suboption for Alternative 3, sector allocation 2ii, for years 2004-2011 for Upper Yukon (top) and Coastal WAK (bottom). Note that for 1b options the cap considered is that proportion of the B season cap shown in the horizontal axis.

Chinook salmon impacts

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

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

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

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

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

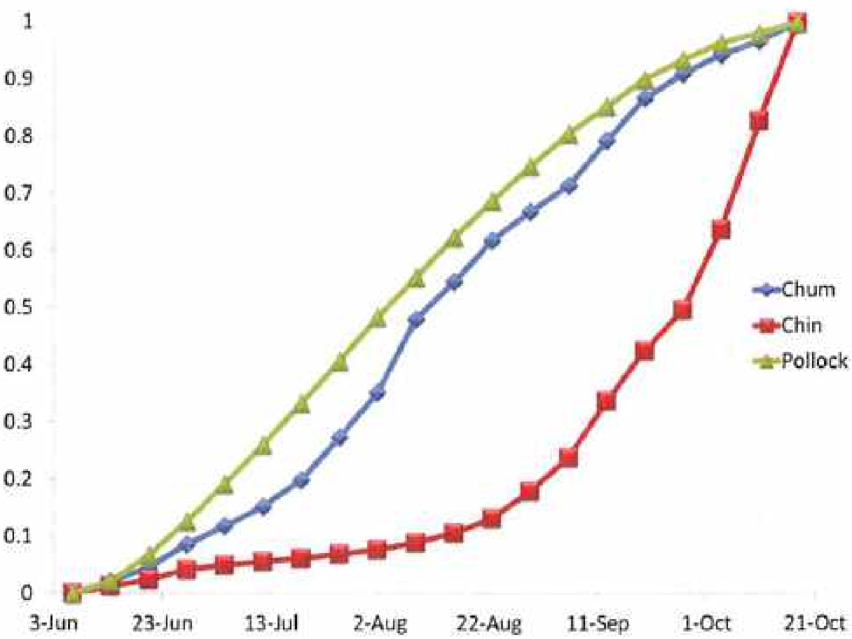


Figure ES-15. Mean relative values of pollock catch (triangles) compared with catch of chum (diamonds) and Chinook (squares) salmon species in the pollock fishery during the B-season.

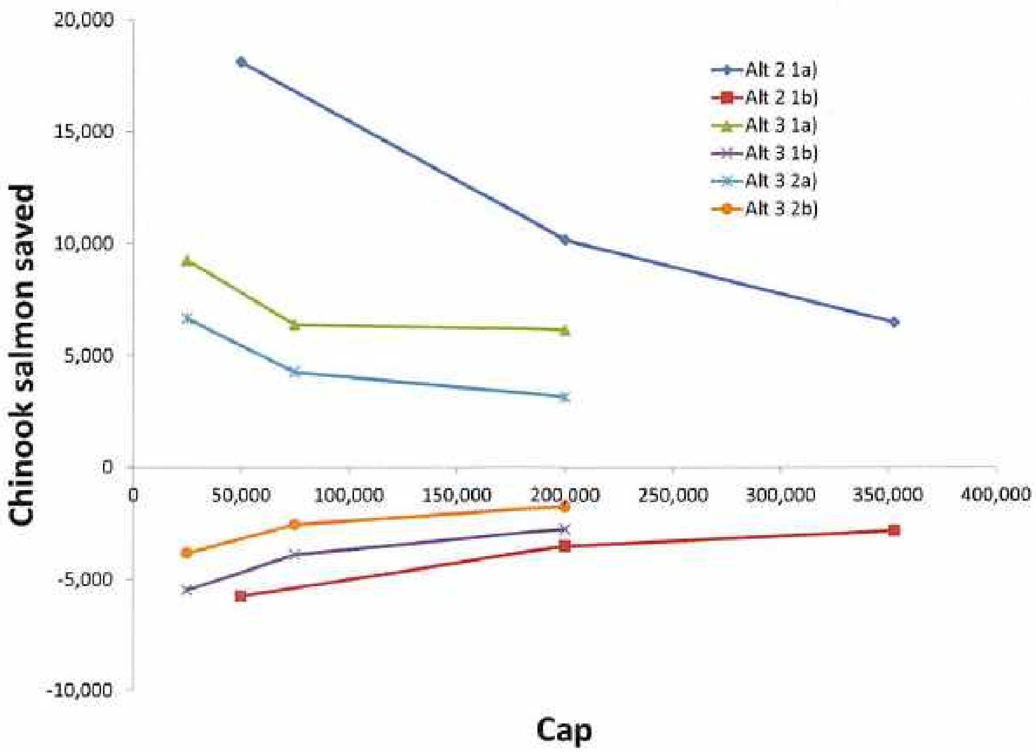


Figure ES-16. Average Chinook salmon saved by suboption for Alternatives 2 and 3 (and their sub-options) given sector allocation 2ii, for years 2004-2011. Note that for 1b options the cap considered is that proportion of the B season cap shown in the horizontal axis.

Pollock stocks

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

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

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

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

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

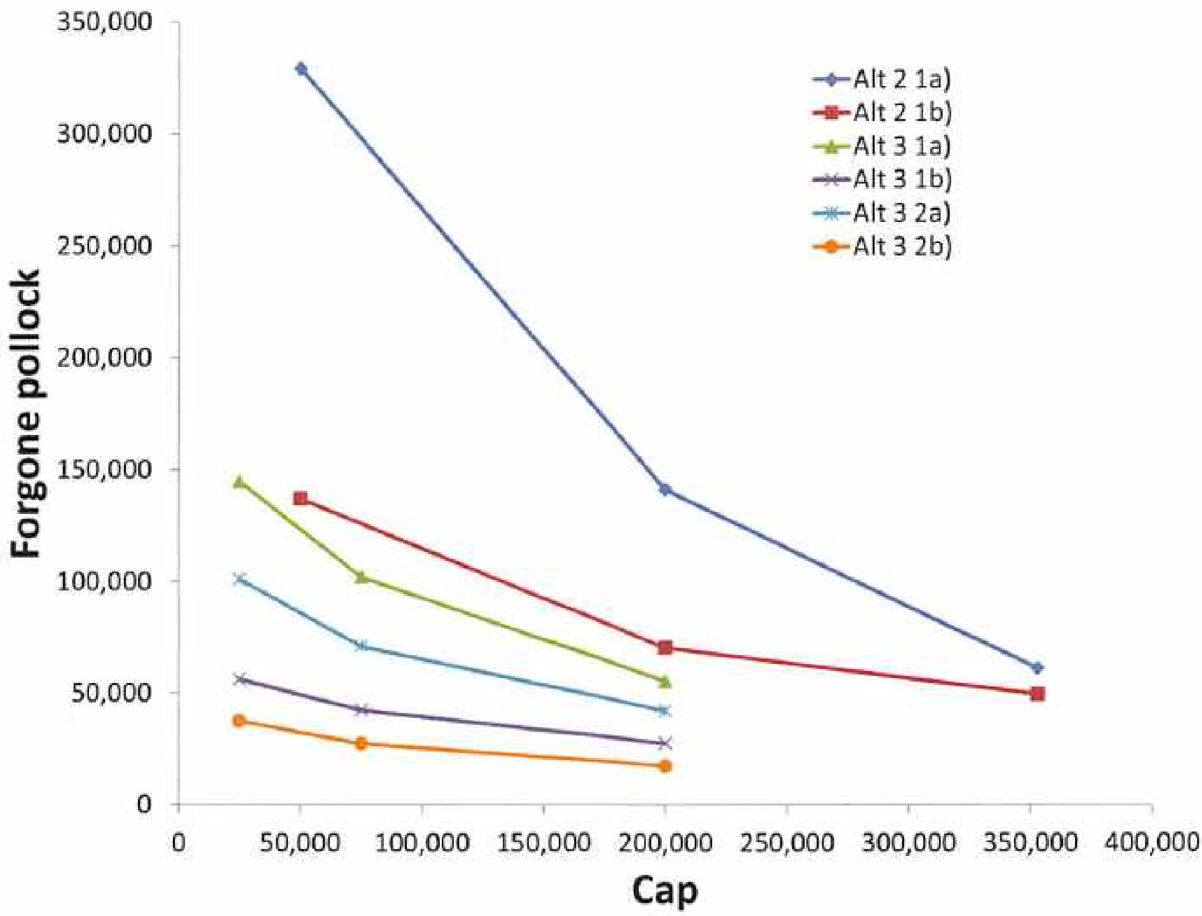


Figure ES-17. Average pollock forgone (t) by suboption for Alternatives 2 and 3 (and their sub-options) given sector allocation 2ii, for years 2004-2011. Note that for 1b and 2b options the cap considered is that proportion of the B season cap shown in the horizontal axis.

Economic Impacts of the Alternatives

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Other marine resources

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

Cumulative effects

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

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

Policy considerations

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

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

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

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

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

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

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

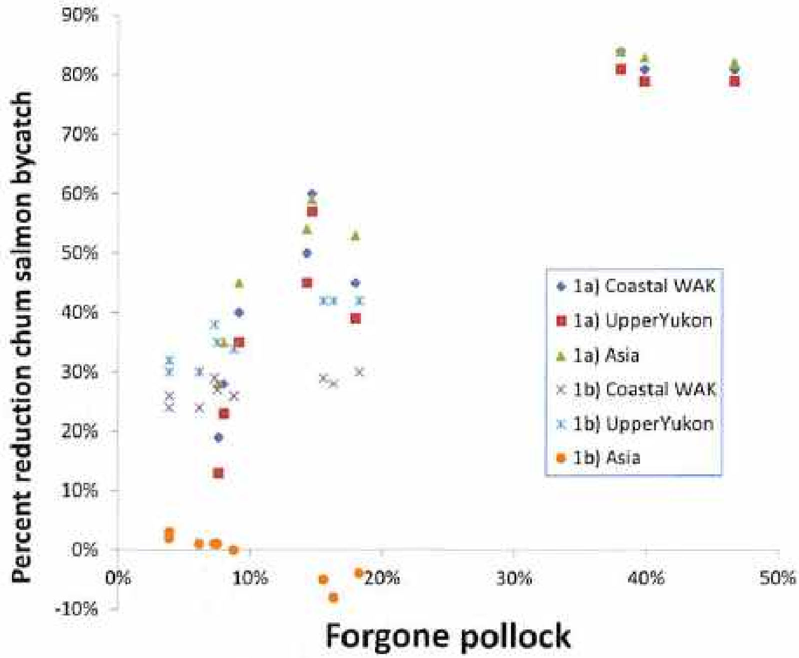


Figure ES-18. Relative reduction of chum salmon AEQ mortality (vertical axis) compared to relative amounts of pollock forgone (or diverted for 1b) by suboption for **Alternative 2**. Each point represents a different combination of sector allocation and cap level summed over 2003-2011. Note that for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

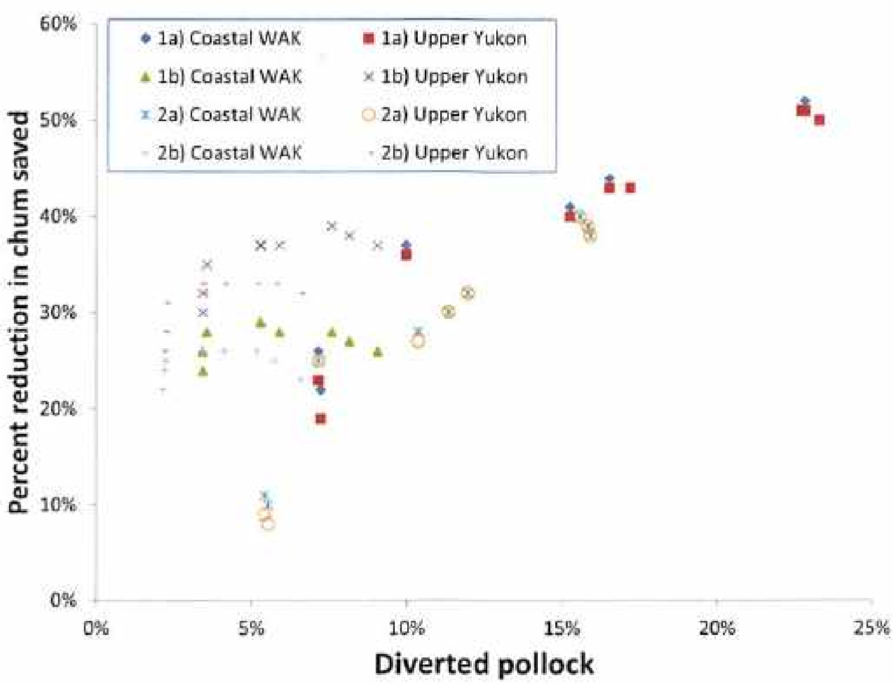


Figure ES-19. Relative reduction of chum salmon AEQ mortality (vertical axis) compared to relative amounts of pollock diverted by suboption for **Alternative 3**. Each point represents a different combination of sector allocation and cap level summed over 2003-2011. Note that for 1b and 2b options the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

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

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

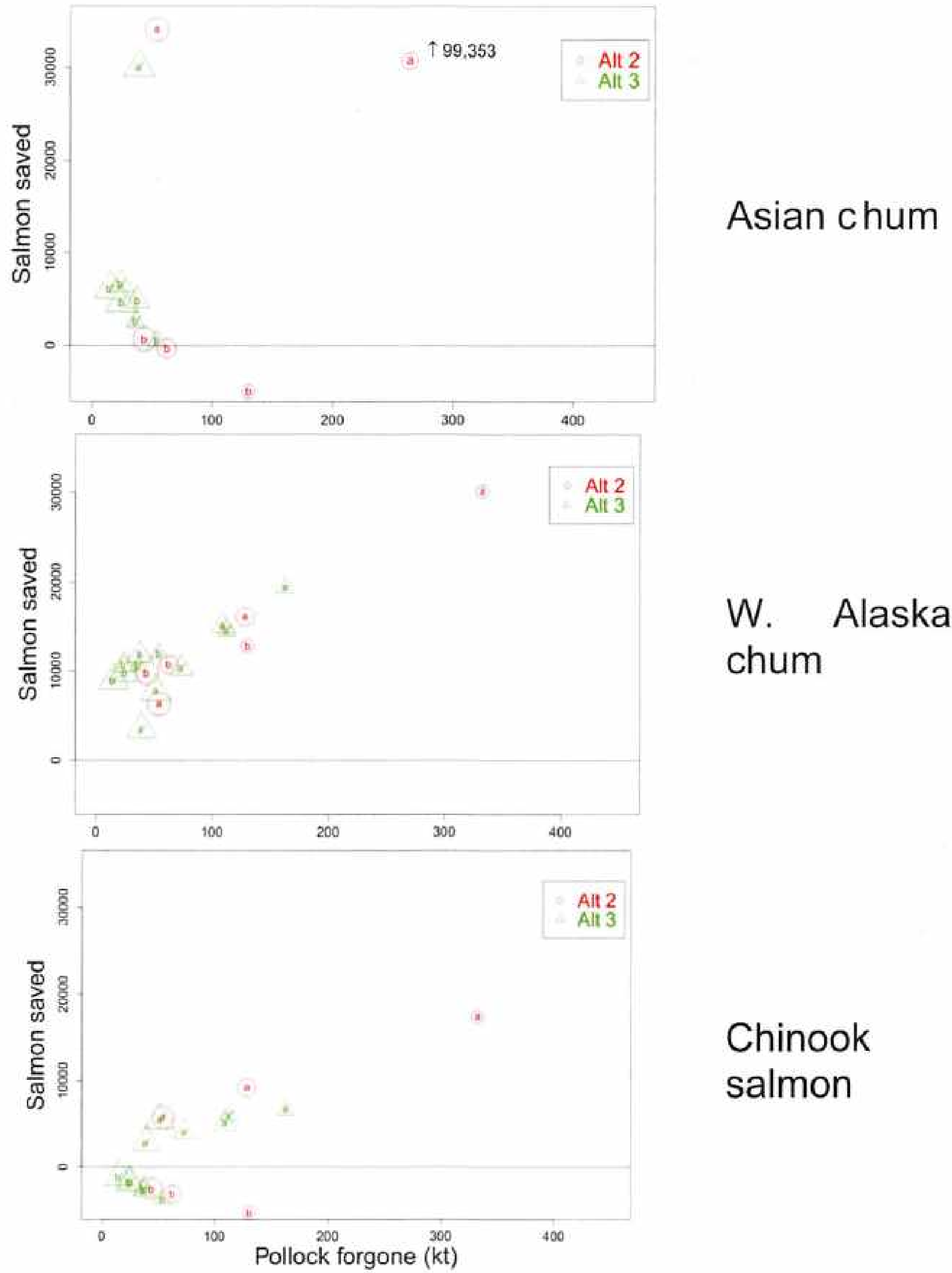


Figure ES-20. Mean expected reduction of salmon mortality (vertical axis) compared to relative amounts of pollock forgone or diverted (thousands of t) for different alternatives, caps and options. Western Alaska stocks include coastal W Alaska and Upper Yukon combined, size of symbols indicates the size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

Rural community outreach

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

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

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

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

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

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

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

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

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

6.0 POLLOCK INDUSTRY IMPACT ANALYSIS

This section examines the expected potential impacts on the pollock industry's gross revenues attributable to potential reductions in pollock products being delivered to market as a result of fishery closure (potentially forgone gross revenue) or due to relocation of effort outside of a closure area (revenue at risk)[32]. To better place these impacts in a comparable empirical context, an analytical approach is adopted here, in which the question evaluated is expressed as follows: "What would the effects of these alternatives have been, had each, in turn, been in place in 2003 through 2011" By posing the analytical question in this way, it is possible to use actual empirical information and official data records on fleet participation, catch composition, production patterns, first wholesale prices, PSC quantities, spatial and temporal distribution of effort, and geographical patterns of deliveries to primary processors or transshipping facilities. These estimates can provide at least a crude empirical measure of the potential economic impact of the alternatives on different fleet sectors. Moreover, if it is assumed that harvest foreclosed to a fleet sector could not have been made up elsewhere by that fleet sector, then the forgone or at-risk estimate becomes an approximation of the potential maximum forgone gross revenues directly attributable to the proposed action.

The Council has chosen to consider the proposed action because of high numbers of non-Chinook salmon PSC in the Bering Sea pollock fishery. The analytical timeframe was chosen because it represents the most recent time period that is most reflective of recent fishing patterns. Those status quo conditions include observed high levels of non-Chinook salmon PSC under present regulations that provide an exemption to Chum Salmon Savings area closures for operators that participate in the VRHS. The analytical period encompasses years when the VRHS was in place, either via industry initiative, via an experimental fishery, or as a formal program under present regulations. Including data prior to 2003 would not be representative of current PSC levels, of current regulations, or of current efforts by industry to avoid non-Chinook PSC.

In addition, in 2003 NMFS implemented the current catch accounting system known as e-landings. Thus, the period of 2003 thorough 2011 is covered by e-landings data. Prior to 2003, a "blend" system was used and differs from the present methodology. These data represents the most consistent and uniform data set available on a sector-specific basis for analysis. Thus, for data consistency, accuracy, and to meet the agency's obligation to use the "best scientific information," the analytical period of 2003-2011 was chosen and NMFS asserts that it is the appropriate analytical period.

The analysts acknowledge that the use of potentially forgone first wholesale gross revenues is not an ideal reflection of the expected economic impacts (or, conversely, benefits if the catch reduction can be mitigated by actions of the operator) attributable to the proposed changes in non-Chinook PSC management. However, in order to estimate "profits," one must have data on costs, not simply revenues. NMFS does not have data to estimate net impacts until such time as the Council develops a socioeconomic data collection program that requires the industry to submit cost data under new MSA authority. These gross receipts may, of course, not be, in any meaningful way, indicative of realized net revenues, but by default serve as the best available "proxy" for economic earnings in these fisheries.

[32] "Revenue at risk" should be regarded as an upper-bound estimate. That is, it represents a projection, based upon historical effort and landings data, of the gross value of the catch that would be forgone as a result of one or more provisions of the proposed action, assuming none of that displaced catch could be made up by shifting effort to another area. In many cases, this will not be the case. Therefore, the true impact on gross revenue is likely to be smaller than the estimated revenue at risk, although that is not assured.

The ability to mathematically derive net economic welfare measures is fundamentally dependent upon empirical data on input prices, costs, capital investment, debt service, consumer demand, sources of supply, market structure, substitutes and complements, measures of consumer responsiveness to changes in price, quantity, quality, income, tastes, and preferences. Exogenous factors also influence rigorous derivation of these welfare measures, such as, currency exchange rates, tariffs, political and economic instability. Very few of these necessary data are available to NMFS, at present. At present, the analysts must employ methods and strategies predicated on extremely limited data and virtually non-existent economic modeling of these resources and uses.

Without accurate verifiable cost data and operational information for the pollock trawl fleets operating in the BSAI, gross revenue estimates constitute the "best" empirical economic information available. NMFS fully acknowledges that changes in first wholesale (or ex-vessel, as appropriate) revenues cannot be regarded as indicative of net results. That said, these estimates represent the current limit of NMFS's ability to empirically characterize the expected outcome for each sector in the pollock fishery, from the changes in non-Chinook PSC management under consideration. And, further, this explains the very extensive reliance upon, and systematic treatment of, "qualitative" cost and benefit analysis, reflected in the RIR, as required under E.O.12866.

It must also be understood that the proposed action is not to close the pollock fishery; it is to create incentives for pollock fishermen to avoid non-Chinook salmon. Thus, the impacts 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 impact 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. Clearly, the Council's intent is to incentivize non-Chinook salmon PSC avoidance in order to reduce it and the hard cap 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 contraction in pollock harvest.

Thus, it is acknowledged that the gross revenue estimates shown in this analysis reflect highly simplified assumptions about the outcome of competing alternative PSC rules. In a sense, they are intended to portray the "worst case" outcome if the pollock fishery was required to forgo a specific catch amount in response to each of the non-Chinook PSC prohibition actions being examined. There is no expectation that this outcome will be realized as a result of any of the proposed non-Chinook PSC management measures under consideration, and these "techniques" are employed solely to provide a crude approximation of the first wholesale gross dollar value associated with unharvested pollock, by sector, processing mode, etc.

Confronted with these facts, NMFS is nonetheless legally obligated to analyze, to the fullest extent practicable, the benefits and costs (as well as their expected distribution) of the proposed management actions being considered. These mandates (e.g., E.O.12866, OMB Circular A-4, MSA) recognize and explicitly provide for adoption of qualitative analytical strategies and approaches to evaluating benefits and costs in the absence of fully adequate empirical data and quantitative models. Thus, this analysis will first provide qualitative discussions of the potential effects. The qualitative treatment is then followed by the revenue analysis.

6.1 Fleet Operational Effects

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 as described below. 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 minimization 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 following sections address 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.

6.1.1 Fixed Costs

As suggested earlier, many costs confronting operators in these fisheries are fixed; that is, they do not change with the level of production. Fixed costs include such expenses as debt payments, the opportunity cost of the investment in the vessel (or plant), the cost of having the vessel or plant ready to participate in the fisheries, some insurance costs, property taxes, and depreciation. Following an action that negatively affects, for example, CPUE, TAC, or catch share, these fixed costs must be distributed across a smaller volume of product output, raising the average fixed cost per unit of production. As previously noted, available information on the cost structure of operations fishing for and processing pollock is very limited. This is largely so because cost information is often considered highly proprietary by industry members and is, under the best of circumstances, expensive to collect and analyze. Only scattered anecdotal information at the operation level is available on fishing costs (fixed or variable). It is, therefore, impossible to do more than provide a qualitative discussion of the impact of the proposed alternatives on pollock industry's operating costs.

6.1.2 Variable Costs

Of all the categories of variable factor costs, fuel ranks at or near the top of the list of operating expenses in the fisheries under consideration. Even a qualitative evaluation of the elements of the non-Chinook salmon PSC minimization actions of Alternative 3 (e.g., triggered area closures) suggest that the proposed regulatory changes may likely result in the following: 1) longer average trip duration to travel to remaining open fishing grounds; 2) greater total distances traveled per trip, perhaps under more extreme operating conditions. In addition, the non-Chinook salmon PSC minimization actions of Alternative 2 (e.g., hard caps) may induce a race for fish that could result in vessels operating at maximum speed and capacity in order to harvest as much pollock as possible prior to a hard-cap-induced fishery closure. Figure 6-1 provides representative diesel fuel cost information for the Bristol Bay area and for Dutch Harbor. These data, provided by the Pacific States Marine Fisheries Commission Economic Information System, clearly show that diesel fuel prices more than doubled in the region between 2005 and 2008 and approached $6 per gallon in the Bristol Bay area in 2008. These increases have likely had a severe impact on the variable costs of all fishing operations in the region, including those for non-Chinook salmon. While it is true that some fuel is purchased by the pollock fleet in other areas, such as Seattle, there is, at present, no comprehensive accounting of costs or expenditures in the pollock fishery that would allow analysis of actual fuel consumption and costs.

How changes in running time would affect fuel costs depends on how much fuel must be burned per unit catch. While it is not possible to place a numerical estimate on this factor, it is reasonable to conclude that, on average, total fuel consumption would potentially increase, due to movement to avoid non-Chinook salmon, relative to the status quo under each of the proposed alternatives provided that a hard cap had the potential to be reached and/or a trigger closure level of PSC was expected to be reached. This increased fuel use would apply except in the case of vessels that cease to fish as a result the non-Chinook salmon PSC minimization measures, and perhaps in the case of vessels that switch to a different fishery, although opportunities to do the latter are highly restricted for the AFA pollock fleet.

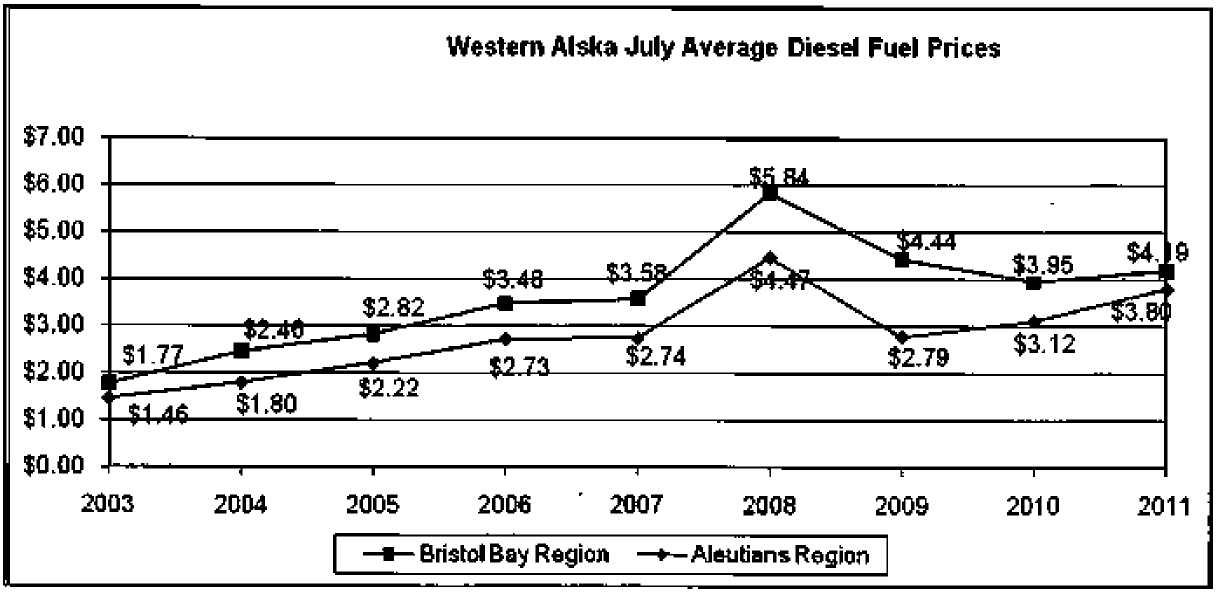


Figure 6-1 Representative Diesel fuel costs from western Alaska, 2001-20011 ($/gallon).

What economists refer to as the 'opportunity cost' of labor is another variable cost that may increase by triggered closure scenarios contained within Alternative 3. Measures that increase fishing time would reduce the time available for other activities and, in so doing, would impose a cost on fishermen. Several of the contemplated measures may increase the time required for fishing in affected fisheries. As noted elsewhere, avoiding non-Chinook salmon PSC may increase transit time to and from fishing grounds; fishermen may be forced to fish on grounds with lower CPUE, thus increasing the time required to harvest any given amount of fish; or they may force fishermen to learn new fishing grounds, thus increasing fishing time, at least initially. Because fishing crew members are generally paid with shares of an operation's net (or modified gross) revenues, the additional time spent at sea as a result of these measures may actually decrease crew earnings, if the operating expenses of the fishing vessel increase.

This opportunity cost is also reflected in lost time, which reduces the individual's opportunities to engage in other activities and is treated as a cost in economic benefit/cost analysis. The limitations of available models for predicting how fishing operations would behave, given the constraints, and the limited amount of cost information available for fishing operations, make it impossible to make quantitative estimates of the change in fishing hours or days associated with these alternatives, or to make monetary estimates of the changes in associated opportunity costs.

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 (addressed separately below in section 6.2)

Increased Travel Costs

Vessels that had formerly been able to fish areas nearer shore, and in relative proximity to their preferred port of operation, could be pushed farther offshore and/or into more remote fishing areas, as a result of specific provisions contained in Alternative 3. Running to the remaining open fishing areas, prospecting for harvestable concentrations of target species, then (depending on operating mode) running back to port with raw catch or product would, as previously noted, require increased expenditures of fuel and other consumable inputs, as well as more time on the water (i.e., trips may be longer, and all variable operating costs and wear and tear on equipment and crew would increase). These changes in fleet operating patterns would likely require a greater total number of days for a given vessel to take its share of the available TAC, other things being equal.

How many additional days may be required would vary by stock and ocean conditions, by rates of success in locating fishable concentrations of the target species in remaining open areas or time periods, by operational mode and capacity, by the level of aggregate effort exerted by the fleet or sub-sector in the remaining open areas, and by other factors. But clearly, if catch per unit effort declines, cost per unit of catch would increase. Smaller vessels may be so disadvantaged by the distances that must be traversed between port and open fishing grounds that they may be unable to operate economically (perhaps, even physically) under these circumstances. While the formation of the triggred closure areas specifically recognizes areas with high non-Chinook PSC but relatively low catches of pollock, implying little or no impact on CPUE from relocation of effort, it is still important to recognize that the limitations of a retrospective analysis absent behavioral feedbacks prevent one from saying definitively that vessels would be able to make up revenue at risk with little or no additional cost.

The smallest, least mobile vessels could be effectively closed out of some fisheries. Even vessels that have the capacity to reach open fishing grounds may incur prohibitively high operating costs (e.g., excessive fuel consumption), increased risk (e.g., should sea or weather conditions change unexpectedly), and reduced product quality (i.e., as hold-time increases). Longer distances and more time in transit mean higher operating costs and less time fishing.

Costs of Learning New Grounds or Using New Gear

It is axiomatic that fishermen fish when and where they believe the fish are most valuable and most readily available. Under the triggered closure area provisions, triggered closures would compel operators to alter the pattern of operations they would voluntarily choose to maximize profits. That is, in many instances, fishermen would be required to fish on grounds with which they may be unfamiliar. Fishermen would face a learning curve on these new grounds. They would have to become accustomed to a new physical geography underwater and perhaps more extreme and/or exposed sea surface conditions, to new fish locations, behaviors, and habits, and, importantly, to new patterns of PSC.

While fishermen learn to operate within these new parameters, they would likely incur increased operating costs. Gear could be more frequently lost or damaged, and while it is not clear that CPUE would be lower PSC of other species could be higher. Higher PSC could force early closures of fishing grounds, and with fewer optional open areas available, it would be more difficult (and, thus, more costly) for operators to voluntarily move off hot spots to reduce or avoid PSC of both non-Chinook salmon and other prohibited species.

Costs of PSC Avoidance Measures

While, as a general rule in pollock trawl fishery, the selectivity of the gear fished varies, pollock fishermen unavoidably take other species as incidental catch when they fish for pollock. In some instances (e.g., PSCes of halibut, salmon, herring, and some species of crabs), pollock fishermen are subject to limitations on the amounts of PSC that they may take. When the PSC limits (or caps) are reached, the fishery is closed. Fishermen can, to a greater or lesser degree, reduce PSC by modifying their gear or the way they use it, and by learning the times and places when unacceptably large PSCes might take place (Queirolo et al. 1995). Both PSCes and the avoidance measures that they make necessary impose costs on the operations. Finally, with temporal and geographic dispersion provisions associated with the triggered closure alternative, there is the potential for increased interactions with protected species (e.g., short-tailed albatross, ESA-listed PNW Chinook salmon), which could require Section 7 consultation (with the potential to trigger further and more extensive fishing closures).

Reduced CPUE Due to Less Concentrated Target Stocks

The economic, operational, and socioeconomic response of individual operators may take several forms following adoption of a triggered closure. For example, anecdotal information supplied by the industry in public meetings and through individual contacts suggests that CPUE may decline, in some cases substantially, as a result of significant fishing effort being forced into unfamiliar or unfavorable areas. The effect of these declines would not likely be uniformly distributed across each management area, gear type, processing mode, or vessel size category and, thus, would carry with them very different implications for profitability, economic viability, and sustained participation in these fisheries.

Potential Gear Conflicts

Concerns have been expressed, from a variety of sources, about the adverse economic effects associated with forcing gear-specific effort out of traditional operating areas and into proximity with other gear groups and/or target fisheries. Trawl gear, pot gear, and longline gear are incompatible when fished simultaneously in a given area. Gear damage or loss is a common outcome when these competing fishing technologies come into contact with one another on the fishing grounds. Each gear group perceives itself as facing unique operating challenges with respect to such conflicts. For example, Pacific cod longline fisheries occur north of the Pribilof Islands at the same time that bottom trawl fisheries target flathead, yellowfin, and rock sole in the same area. By voluntarily isolating themselves in well defined and generally recognized areas, they insulate themselves from the high cost and frustration associated with gear conflicts (loss of longline gear and catch). If either a total pollock fishery closure and/or a triggered closure induced pollock vessels to switch, to the extent that sideboard regulations allow, to bottom trawl fishing on the flatfish fishing grounds gear conflicts could emerge. The likelihood of occurrence and magnitude of any such conflict is speculative at this time.

Effects on Processors Built for Higher Throughput

If CPUEs decline and fishing is more geographically dispersed under the triggered closure alternative, the aggregate rate of catch could slow. This implies that the rate of delivery to processors would also decline.

Because existing processing plant capacity has been built, in many cases, for peak through-put (i.e., to maximize the rate at which catch is received and processed in response to the race-for-fish on the grounds), lower and slower deliveries may not supply sufficient quantities of raw fish for the largest plants to operate profitably. Many plants have been designed, configured, and operated to exploit economies-of-scale in production. They are designed to move an optimal volume of fish through the processing plant at the most efficient, most cost effective rate, given the capacity of the facility and expectations of catch and delivery rates from the catcher-vessel fleet. If operated at rates that significantly deviate from those for which the plant was designed, these economies would be lost, and a plant could become unprofitable to operate.

The nature of these interactive and compounding relationships is important to keep in mind. None of these economic, operational, or logistical elements works in isolation from one another. Further, while many of these considerations have specifically been identified as being related to relocation of effort under a triggered closure alternative, they may also affect overall fleet operations under the threat of a hard cap induced total, and/or sector level, pollock fishery closure. Given the level of cooperation that exists within the pollock industry presently, and the fact that the VRHS ICA is a system conceived and implemented by industry (before Amendment 84 regulations took effect) for proactive PSC avoidance, it is not unreasonable to expect that the pollock industry may continue to operate the VRHS ICA, or some variant of it, in order to try to prevent attainment of a hard cap. As such, they would invoke various closures upon their membership that could have similar effects on operational costs as described above for Alternative 3. It follows that these cost impacts are presently being felt by the members of the ICA due to VRHS closures under the status quo and would also likely continue under the VRHS/80% closure option of Alternative 4.

6.2 Safety Impacts

Commercial fishing is a dangerous occupation. Lincoln and Conway, of the National Institute of Occupational Safety and Health (NIOSH), estimate that, from 1991 to 1998, the occupational fatality rate in commercial fishing off Alaska was 116 persons per 100,000 full time equivalent jobs, or about 26 times the national average of 4.4/100,000 (Lincoln and Conway 1999). Fatality rates were highest for the Bering Sea crab fisheries. Groundfish fishing fatality rates, at about 46/100,000, were the lowest of the major fisheries identified by Lincoln and Conway. Even this relatively lower rate was about ten times the national average (Lincoln and Conway 1999).

During most of the 1990s, commercial fishing appeared to become relatively safer. While annual vessel accident rates remained comparatively stable, annual fatality per incident rates (case fatality rates) dropped. The result was an apparent decline in the annual occupational fatality rate. From 1991 to 1994, the case fatality rate averaged 17.5 percent per year; from 1995 to 1998 the rate averaged 7.25 percent per year. Lincoln and Conway report that, "The reduction of deaths related to fishing since 1991 has been associated primarily with events that involve a vessel operating in any type of fishery other than crab" (Lincoln and Conway 1999, page 693). Lincoln and Conway described their view of the source of the improvement in the following quotation. "The impressive progress made during the 1990s, in reducing mortality from incidents related to fishing in Alaska, has occurred largely by reducing deaths after an event has occurred, primarily by keeping fishermen who have evacuated capsized (sic.) or sinking vessels afloat and warm (using immersion suits and life rafts), and by being able to locate them readily, through electronic position indicating radio beacons" (Lincoln and Conway 1999, page 694).

There could be many explanations for this improvement. Lincoln and Conway point to improvements in gear and training, flowing from provisions of the Commercial Fishing Industry Vessel Safety Act of 1988 that were implemented in the early 1990s. Other causes may be improvements in technology and in fisheries management. Technological improvements may include advances in Emergency Position

Indicating Radio Beacon (EPIRB, sometimes also called an ELT or Emergency Locator Beacon) technology. Current 406 MHz EPIRBs are more effective as a means of communicating distress than the 121.5 MHz EPIRBs in use in the early 1990s, in that they now transmit a unique identification code in addition to position information, which allows USCG personnel ashore to quickly identify the vessel, use point of contact telephone numbers, and more effectively filter out false alarms.

Fishery management changes have included the introduction of individual quotas for halibut and sablefish, actions that have dramatically slowed the historically frenetic pace of these fisheries. The introduction of co-ops in the pollock fisheries in 1999 and 2000 is not reflected in these statistics. Rationalization of the pollock fishery in the BSAI, however, may have furthered safety improvements. The Lincoln-Conway study implies that safety can be affected by management changes that affect the vulnerability of fishing boats, and thus the number of incidents, and by management changes that affect the case fatality rate. These may include changes that affect the speed of response by other vessels and the USCG. Starting in 1997, the Coast Guard's Seventeenth District instituted a practice of forward deploying a long range search helicopter to Cold Bay, Alaska, to improve agency response time during the Bristol Bay red king crab fishery. This practice was expanded in 1998 to cover the snow crab fishery. In 1999, approximately 11 lives were saved, in a 6-day period of extreme weather, when the forward deployed helicopter responded to several vessel sinkings and other marine casualties in short order.

In this RIR, several safety-related issues have been considered with respect to the alternatives. These include the following:

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

Fishing Farther Offshore

Changes in fishery management regulations that result in vessels, particularly smaller vessels, operating farther offshore appear likely to increase the risk of property loss, injury to crew members, and loss of life. Non-Chinook salmon PSC minimization measures that close nearshore areas to fishing operations, such as the triggered closures of Alternative 3, could compel vessel operators to choose between assuming these increased risks or exiting these fisheries entirely. Weather and ocean conditions in the BSAI are among the most extreme in the world. The region is remote and sparsely populated, with relatively few developed ports. The commercial fisheries are conducted over vast geographic areas. While many vessels in these fisheries are large and technologically sophisticated, some are relatively small vessels with limited operational ranges.

Several factors associated with fishing farther from shore can reduce the safety of fishing operations by increasing the likelihood of emergency incidents. Vessels would probably have to spend more time at sea in order to take a given amount of fish. It would take more time to travel between port and the remaining open fishing grounds. Operators would also be likely to be fishing in less familiar conditions and on stocks that may be less highly aggregated, thus reducing CPUE. Increases in the time spent at sea increase the length of time fishermen are potentially exposed to accidents. Furthermore, longer trips are likely to increase fatigue and thus the potential for mistakes and accidents.

Other factors may tend to increase the case fatality rate. Fishing vessels may be farther from help if an accident occurs. In many cases, the initial response to trouble comes from other fishermen. If fishing farther offshore, on more extensive fishing grounds, increases the dispersion of the fishing fleet, assistance from other fishermen may not be as readily available. In addition, regulatory actions that force fishing vessels to work farther offshore may turn what would normally have been a request for assistance search and rescue case into an emergency or life threatening situation. Many search and rescue cases involving fatalities start as a casualty to the vessel that degrades its stability or survivability, but does not immediately threaten the vessel or crew. After the initial casualty, other environmental factors (e.g., heavy seas, winds, freezing spray, etc.) may quickly cause the situation to deteriorate. The ability to render assistance early is essential. Vessels fishing farther from shore and/or in more remote and exposed locations may experience additional delays before help can arrive.

In a similar respect, the ability to satisfactorily treat personnel injuries is often determined by the speed with which the injured can receive adequate medical attention. While these factors may affect all operations, they are likely to be most serious for the smaller vessels based in Alaska ports, which have tended to fish relatively close to the shore in the past.

Reduced Profitability

As discussed throughout this RIR, proposed restrictions on fishing to minimize non-Chinook salmon PSC could reduce the profitability of many operations, especially including many of the smaller operations. Reduced profitability could be an indirect cause of higher accident rates. For example, fishermen facing a profit squeeze could defer needed maintenance on vessels and equipment, reduce operating costs by cutting back on safety expenditures, or scale back the size of their crew in order to reduce crew share expenses. Remaining crew would have expanded responsibilities and could risk greater fatigue, increasing the likelihood of accidents. Finally, these operators could decide to fish more aggressively, even in marginal conditions, in an effort to recoup lost revenues. These factors may affect the incident rate and the case fatality rate, as well.

Changes in Risk

Each of the factors described above increases risk. On the other hand, the potential for increased risk may be offset to some extent by changes in fleet behavior. An increase in risk effectively increases the cost of each additional day of fishing that, in turn, may contribute to reduced levels of participation (e.g., fewer fishing days) by smaller vessels. If this leads to a safety-induced reallocation of harvest from smaller to larger vessels, risk calculations may be affected. Similarly, smaller crew sizes mean that fewer people on a vessel are exposed to danger. Furthermore, skippers who have less invested in safety gear may have an incentive to behave more cautiously or conservatively in other respects in order to offset some of this perceived increased risk. Very little is known about factors that might increase risk, or that might offset risk increases, for fishermen in the North Pacific and Bering Sea. Even the best estimates of statistics as fundamental as the occupational fatality rate are not precise, and are not available at all for recent years. Rough estimates of the relative ranking of occupational fatality rates in different fisheries are known. Little more than qualitative speculation is available concerning the factors that affect the rates in the different fisheries, however. Available information does not permit quantitative modeling of changes in these rates in response to changes in fishery management regulations that could be induced by fishing impact minimization measures. These changes in fishing behavior and patterns could lead to an increased level of risk to vessels and crews, albeit an increase that cannot be empirically estimated.

Unfortunately, it is not possible to predict the changes in behavior that the industry might undertake to avoid non-Chinook salmon PSC and the effect on vessel, and human, safety. It is important to recognize; however, that the AFA pollock fishery is a rationalized fishery operating under a cooperative structure. A careful review of the alternative set reveals that the hard cap alternatives all contain provisions for cooperative level allocations, rollovers, and transfers. Thus, the alternative set includes measures to mitigate the possibility for a "race for fish" that could occur under unallocated PSC caps. These provisions also provide some mitigation of the associated impacts on vessel, and human, safety that might exist if a "race for fish" were created due to a PSC cap.

6.2.1 Pollock Product Quality, Markets, & Consumers

This section discusses the economic impacts of the alternatives on (1) product quality and revenue impacts, including changes in the time between harvest and delivery and changes in the average size of pollock, (2) costs to consumers, (3) impacts on related fisheries, and (4) impacts of fishery dependent communities.

This RIR is developed in compliance with Executive Order 12866, which specifies a cost-benefit analytical framework, either qualitatively or quantitatively where possible, and consideration of the implications for net national benefits. It is important to understand that the Office of Management and Budget has determined that effects on non-us citizens do not enter into the net national benefit calculation defined as the appropriate analytical metric in Executive Order 12866. Thus, implications on world markets, world food supply, and non-US consumers are not appropriate considerations in the analysis contained in the RIR.

6.2.2 Product Quality & Revenue Impacts

The non-Chinook salmon PSC minimization alternatives considered in lieu of the status quo may impose restrictions on pollock fishing vessel operations that might lead to a decline in product quality and associated reductions in the price the industry receives for fishery products. Changes in product quality may occur for at least three reasons:

- If a triggered closure occurs, CV operations may have to fish farther away from shoreside processors, requiring them to travel greater distances taking more time to deliver their catch;
- If forced out of the most productive grounds, either by a triggered spatial closure or a voluntary hot spot closure, fishermen may be induced to target stocks of sub-optimal sized fish;
- If a hard cap threatens a fishery closure, a race for fish may occur and catcher processors and motherships may change product mix in order to speed up production, thereby possibly reducing product quality and/or finished product value.

These potential effects on product quality would all be expected to lower the value of payments to CV operators as well as returns to shoreside processing value added.

The interval between catching and initiating processing pollock is, reportedly, negatively correlated with product quality (and, thus, value). Some reports suggest that, on a product-for-product basis, the quality of pollock harvested and processed at-sea is uniformly higher than that of product produced onshore, owing primarily to the significant difference in the interval of time between catching and processing. Inshore processors routinely place limits on the maximum holding time for pollock onboard catcher vessels, and deduct from the price or refuse delivery if the delivery time is exceeded. For those vessels that do not have the capability to process their own catch, given a fixed catch rate and hold capacity, any action that substantially increases the time between catch and delivery imposes costs, both on the harvester and the processor. Beyond some point (which varies by vessel size, configuration, condition of the target fish, and weather/sea conditions) delivery of a usable catch (i.e., one with an economic value to the fisherman and processor) is not feasible.

In this latter connection, a concern common to all operators delivering catch ashore for processing is the effective time limit that exists from 'first catch onboard' until offloading to deliver a salable catch. Informed sources in the industry place the maximum interval at 72 hours (at least in the case of pollock). If fishing grounds that remain open under one or another of the fishing impact minimization alternatives are more remote from sites of inshore processing facilities than the traditional fishing locations, the delivery time for the raw product by the catcher vessel may be lengthened and the value of the delivered product lowered. For smaller vessels with more limited holding capacity and slower running speeds, this limit would impose relatively greater constraints (i.e., operational burdens). The result may be an effective intra-sectoral redistribution of catch share.

Closures (or other operational restrictions) of fishing grounds adjacent to inshore processing facilities may inadvertently redistribute the catch within a sub-sector, from the smaller, least operationally mobile vessels to the larger, faster, more seaworthy elements of the fleet. In the long run, this may have the added and undesirable effect of inducing further 'capital stuffing' behavior within the industry as those disadvantaged small boat owners perceive the need to invest in added capacity to continue to participate profitably in the fishery.

A corollary effect of altering the timing and/or location of catch might accrue if the average size of fish in the catch falls below the minimum requirement for specific product forms. These minimums are often dictated by the marketplace, but may also be directly linked to the technical limits of the available processing technology. These impacts could accrue to any or all segments of the fishery. For example, on average, fillet production requires a larger pollock than does, say, surimi production. If spatial displacement (e.g. via a triggered area closure) results in a significant decline in the average size of fish harvested by a given operation, there could be adverse effects on product mix, quality, grade, and value.

In contrast to potential declines in product value that could occur, there may be upward price pressure due to reduced quantity of pollock supplied to markets if a PSC management measure results in forgone pollock catch. The economic law of demand (e.g., a downward sloping demand curve) suggests that (assuming all other factors are held constant), if fewer units of a normal good or service are supplied, the individual unit price would be expected to rise. This means that, within the limits of this model and the context of this action, if fewer fish of a given species are harvested, then fishermen should receive more for each unit of that species they continue to catch and deliver to the market, all else being equal. Any increase in price that would actually occur would depend on, among other things, how responsive the price consumers are willing to pay is to changes in the quantity of catch supplied. The consumers' willingness to pay more for these products is dependent upon how unique the products are, that is, whether the consumer can substitute a lower cost alternative product. There is evidence to support the idea that reduced pollock production would tend to push prices up. The prices shown in this analysis reveal an upward trend in the past several years as pollock TACs have declined from roughly 1.4 million metric tons to approximately 800,000 metric tons. However, very little empirical information is available at this time concerning the responsiveness of price to quantity supplied for the species and product forms potentially affected by the alternatives over the range of possible quantity change that might be anticipated.

To the extent that these pollock fishery products are consumed in the United States, any producer benefit accruing from a price response to diminished supply would be, to a very large extent, offset by a reduction in consumer welfare from the increase in price. That is, the benefit to the industry would simply be the result of a transfer from consumers. Thus, under these conditions, this hypothesized supply-induced price increase would create no net benefits to Americans that could be revealed in a cost-benefit analysis for domestically consumed fish. Quantity changes under some alternatives under consideration in this action may be small enough to have no perceptible impact on prices, while under other alternatives they may. It is not possible, at this time, to estimate the likelihood or magnitude of these hypothetical supply and price effects.

Alternatively, to the extent that these fish are exported and consumed outside of the United States, any supply-induced price increase would create an attributable net benefit improvement to the Nation, from a cost/benefit perspective. This is because the price increase would accrue, in the form of increased gross revenues, to United States producers, while the loss in consumer welfare would be imposed on citizens of other countries. Under OMB guidelines, costs incurred by (and, for that matter, benefits accruing to) foreign producers and consumers are excluded from the net benefit analysis performed in a Regulatory Impact Analysis. Such changes would (all else equal) have no effect on net benefits to the nation.

6.2.3 Costs to Consumers

Ultimately, fish are harvested, processed, and delivered to market because consumers place a value on the fish that is over and above what they have to pay to buy them. A person who buys something would often have been willing to pay more than they actually did for the good. The difference between what they would have been willing to pay and what they had to pay is treated, by economists, as an approximation of the value of the good or service to consumers (i.e., consumer's surplus) and as one component of its social value. If the price of the good rises, the size of this benefit will be reduced, all else equal. If the amount of the good available for consumption is reduced, the size of this benefit is also reduced. Provisions of the proposed non-Chinook salmon PSC minimization actions could reduce the value consumers of seafood (and associated fish products) receive from the fisheries for several reasons, including 1) consumers may be supplied fewer fish products; 2) consumers may have to pay a higher price for the products they do consume; and 3) the quality of fish supplied by the fishing industry may be reduced and, thus, the value consumers place on (and receive from) them will decline.

The domestic consumer losses would fall into two parts. One part, corresponding to the loss of benefits from fish products that are no longer produced, would be a total loss to society. This is often referred to as a deadweight loss. The second part, corresponding to a reduction in consumer benefits because consumers have to pay higher prices for the fish they continue to buy, would be offset by a corresponding increase in revenues to industry (i.e., producers' surplus gains). While a loss to consumers, this is not a loss to society. It is a measure of the benefit that consumers used to enjoy, but that now accrues to industry in the form of increased prices and additional revenues.

The actual loss to society cannot be measured with current information about the fisheries. Estimation would require better empirical information about domestic consumption of the different fish species and products, and information about the responsiveness of consumers to the reduction in the supply (e.g., their willingness and ability to substitute other available sources of protein). In addition in the present case, because, under the status quo, society is already in a suboptimal state (i.e., incurring a welfare loss associated with the economic negative externalities imposed by salmon PSC), actions taken to reduce these externality impacts (i.e., minimizing pollock trawl fishing impacts on salmon) will result in an aggregate welfare improvement to society, offsetting any apparent welfare reduction in the retail/wholesale domestic seafood/fish products commercial marketplace (i.e., no deadweight loss is incurred).

6.2.4 Impacts on Related Fisheries

Direct changes to a fishery, induced by non-Chinook salmon PSC minimization measures, could have indirect and unanticipated impacts on other fisheries beyond the gear conflict issue addressed earlier. Some of these impacts could impose (perhaps substantial) costs on these other fisheries. The following costs have been considered in this RIR:

- Displacing capacity and effort,
- Compression/overlapping of fishing season, and
- Increased costs of gearing up and standing down.

Displacing Capacity and Effort: While AFA sideboard provisions and license limitation program constraints seek to manage and control transfer of effort and capacity across fisheries, they are not absolute barriers to this phenomenon. Should salmon PSC minimization measures become too constraining to support existing levels of effort, it is possible that effectively displaced capacity would redistribute to remaining open target fisheries within the limits imposed by AFA sideboards, imposing potentially increased costs on the operations that currently prosecute them.

Compression/Overlapping of Fishing Season: Many of the larger operations in the Bering Sea pollock fishery are highly specialized (e.g., AFA surimi C/Ps). Many others, however, rely upon diversification (i.e., fishing a sequential series of different target fisheries over the course of the year) to sustain an economically viable operation. Communities have developed around, and invested in facilities and infrastructure to support, these fishery participation patterns. The classic Alaska example has come to be the 58-foot Limit Seiner. This class of commercial fishing vessel was specifically designed to meet the State of Alaska's regulatory limit (i.e., maximum 58 feet LOA) for participation in the salmon seine fishery. Over time, these, as well as many other, small boats have evolved patterns of operation that include participation in fisheries for (among others) crab, halibut, and various combinations of groundfish species.

Because these operations are economically dependent on participation in a suite of fisheries, anything that alters their ability to move sequentially from fishery opening to fishery opening places them at economic risk. For example, should the Council select a non-Chinook salmon PSC minimization action that results in temporal displacement of fisheries (either directly or indirectly), placing fishery openings in conflict, it could reduce the economic viability of some fishing operations. They could find themselves in the position of choosing to participate in only one fishery, among two or more alternative openings, and foregoing participation in the others. It may not be possible, under these circumstances, for such an operation to remain economically viable in the long run. Besides losing the revenues from participation in fisheries that overlap, these operations could find themselves idled during portions of the year when weather and sea conditions would otherwise permit fishing operations. This could have unintended consequences, such as difficulty retaining a professional crew and smaller gross revenues over which to spread fixed costs. It could also mean lost wages to the community.

There could be an analogous concern about the inshore processing sector. Processing plants often are equally dependent on the predictable sequential prosecution of fisheries during their operating year. Many plants in Alaska are specifically designed and configured to take advantage of efficiencies attributable to a consistent seasonal sequence of species delivered for processing. Crews are hired, maintained, or let go, as needed, based on expected demand for processing services. Likewise, start-up, maintenance, and shut-down costs are predicated on the timing and duration of fishery openings, as are logistical and staging costs to assure production inputs are in place when needed, and outputs reach markets on time.

In the worst case scenarios considered in this RIR, owners of processing capacity could be forced to consider not opening their plants because of uncertainty about the timing and duration of fisheries. If some plants fail to open on schedule, fishermen who otherwise would have participated in a fishery may have no market for their catch. This may be particularly significant for small catcher boats operating in relatively remote areas of the state. Furthermore, these effects need not necessarily accrue only to operators in the pollock fishery. In some areas, processors are able to provide markets for, say, salmon, only because they can underwrite some of their fixed staging costs by keeping their operations employed over an extended season with deliveries of crab, halibut, groundfish, etc. The extent to which these potential adverse effects are actually realized cannot be assessed at this time. Nonetheless, they represent potentially significant sources of economic disruption for these sectors of the industry, and the coastal communities dependent upon them.

Increased Costs of Gearing Up and Standing Down: Logistical and staging costs can represent a significant expense for many operations participating in the fisheries of the Bering Sea. Should one or more of the non-Chinook salmon PSC minimization measures result in temporal displacement of fisheries there would be adverse economic and operational impacts on vessels, plants, and crews that could not be readily avoided or compensated for. That is, if a salmon PSC minimization measure results in, for example, an early fishery shutdown due to attainment of a hard cap, the immediate result would be an idling of the fleet and associated processing plant capacity. In effect, the fishery would be required to stand-down until the next scheduled seasonal opening. From the perspective of the fishing industry, mandatory idle periods between openings impose direct costs. The longer the duration of imposed idleness and the more numerous these periods, the greater the potential economic and operational burden.

Presumably, there exists some form of a step function that characterizes these potential adverse impacts. That is, it may be likely that a mandatory stand-down of 24 hours, or 48 hours, or even 72 hours, would impose costs that could be absorbed by most operators participating in the target fishery (although all would likely prefer to avoid them). Indeed, over such a relatively brief interval, an operator might keep the crew productively employed with maintenance and/or other forms of preparation for the anticipated re-opening. Nonetheless, the plant or vessel must continue to pay its variable costs (e.g., wages and salaries, food and housing expenses, fuel and other consumable input costs, etc.) during the stand-down while producing no marketable output, and therefore earning no revenues.

Under such circumstances, each operator could eventually reach a threshold, beyond which the cost of standing-by would become a significant economic burden. Precisely where this threshold lies would likely vary by operation. At present, no empirical information is available with which to predict when these thresholds might be attained by any given plant or vessel. However, if the threshold were reached, the operator would face a series of decisions with potentially significant economic costs and operational consequences.

These costs may be characterized as staging expenses. For example, transporting crews by air to and from remote Alaska locations multiple times in a fishing year (rather than once or twice, as has historically been required) would represent a significant additional operating expense. In association with analysis of the Bering Sea Pollock/Steller RPA analysis undertaken in late 1999 and early 2000, the At-sea Processors Association reported that each C/P that participates in the pollock target fishery carries a crew of 100 to 125. Motherships and inshore plants in that same fishery have at least as many transient employees. Repeated movement of crew to and from staging areas in remote Alaska ports in response to stand-down periods, on the scale suggested by these estimates, would represent a potentially significant economic and logistical burden for these fleets and plants.

Similarly, moving fishing supplies and support materials to and from the vessel's staging port or onshore plant location two or more times each season, as well as providing for secure stand-down status of the vessel or plant and its equipment between openings, could impose considerably higher operating costs, and thus smaller profit margins. Moorage slips, especially for the larger vessels in these fleets, may be in short supply, given the limited physical facilities that currently exist in ports and harbors. If entire fleets must lay-up for weeks or even longer periods between openings, existing moorage facilities could be overwhelmed. Even if adequate space could be found, it is probable that rental/leasing costs for that space would be bid up significantly. In the long run, this induced demand could result in investment in additional port and harbor facilities.

As suggested above, inshore processors may experience equivalent logistical costs, depending upon their relative level of operational diversification, geographic location, length of current operating season, etc. Presumably, there exists a balance-point between the minimum necessary volume of deliveries of catch to a plant, the duration of idleness between delivery flows, and the ability to operate a processing facility at all. While likely varying from plant to plant, operator to operator, and even species to species delivered, it is clear that if a plant cannot cover its variable operating costs, it is better off (from an economic perspective) to cease operation altogether. As staging costs (e.g., moving crews and supplies to and from the facility) increase, this operating margin shrinks. Data limitations preclude estimating which plants can or would choose to operate under these circumstances. It is apparent, however, that significant temporal changes in fishery openings and/or duration (as implicitly or explicitly provided for under several of the proposed alternatives) would increase the likelihood that some may not continue to operate.

6.3 The Voluntary Rolling Hotspot System Under Alternative 1: Status Quo

An examination and analysis of the effectiveness of the volungtary rolling hotspot system, under the status quo, has been conducted by Dr. Alan Haynie, of the Alaska Fisheries Science Center. The analysis, in its entirety, is contained in section 5.3 of the accompanying EA. This analysis, which spans approximately 40 pages in section 5.3, is the most comprehensive treatement of the efficacy of the VRHS conducted to date. While all of the analysis is highly pertinent in the evaluation of the status quo, and in comparing the potential effects of Alternatives 2 and 3 with the status quo, the analysts have chosen to limit the treatment here to the summary of findings of that analysis rather than reprinting all 40 pages. It should be understood; however, that the full treatment of that analysis is applicable here and is hereby incorporated both by the association of the EA and RIR as accompanying documents and by reference!

Summary of Findings on Status Quo Chum PSC-reduction measures

Collectively, the Chinook and non-Chinook salmon PSC measures implemented through the VRHS system and Amendment 91 arguably represent the most extensive PSC reduction efforts that have ever been undertaken. Given the importance of the VRHS in the status quo as well as a component of the action alternatives, an extensive analysis of the efficacy of this system has been developed and is presented in Chapter 5 section 3 of the accompanying EA. What is presented here is a synopsis of the findings of that analysis.

Key findings of this analysis include:

- From 2003-2010, comparing chum PSC rates in the 1-3 days following RHS closures are approximately 8 percent lower
- Annual average chum PSC in the 5-days before closures were imposed from 2003-2010 ranged from 11-33 percent for CVs and from 2-30 percent for other sectors, with the majority of years being in the upper end of this range. The average percentage of pollock range from 7-21 percent for CVs and was less than 5 percent for other sectors.
- Evaluating the 1993-2000, an RHS-like system would likely have reduced chum PSC by 9-22 percent on average with about 4-10% percent of pollock fishing have been relocated to other areas.
- The pre-RHS analysis suggest that often 'what's good for chum is good for Chinook' with the range of Chinook savings as 6-14 percent per year.
- Based on 1993-2000 data, large closures reduce salmon PSC more but at the cost of moving additional pollock. Also, closures based on the most recent information possible leads to larger average reductions and relatively small base rates appear on average to be more effective.
- The current "tier system" of the RHS program allows cooperatives with low PSC relative to the base rate to fish inside closed areas. This provides some incentive for cooperatives to have lower chum PSC rates in order to be able to fish in closed areas, though these vessels often choose to fish elsewhere. During closure periods, 4.6 percent of CV pollock and 0.3 percent of pollock by the other sectors was taken inside the closure areas.
- An examination of the chum PSC rates in the chum Salmon Savings Area (SSA) indicates that in over 90 percent of months from 2003-2010, chum PSC rates were *lower* in the Chum SSA than outside of it, suggesting that trigger this area could be actually increase chum PSC.

- In 2011, chum RHS closures were in place throughout the B season, whereas in previous years Chinook closures were explicitly given regulatory priority.

Compared to alternative spatial management systems, the RHS system has advantages and limitations. Key advantages of the hotspot system relative to fixed closures include:

- Sea State has shown the ability to make trade-offs between chum and Chinook PSC and to consider how vessels will respond.
- Adjustments to what areas will be closed can be made regularly in response to the substantial inter-annual variability in the quantity and concentration of PSC. This prevents the possibility that fixed closures would consistently force vessels from low-PSC areas, which is a possibility with any system that cannot adjust.
- Anecdotal information from vessel operators and plant managers can be combined with observer data, VMS data, and knowledge of how seasonal PSC conditions evolve to make well-informed predictions of where salmon PSC will occur in the near-term.
- The system can adapt with new information. For example, from the 8/27/07 SeaState report – "It would be particularly useful to know if there is a temperature front associated with higher or lower PSC, as there was further up on the shelf."
- Through regular reporting to the Council and independent audits of potential violations, there is transparency in whether vessels adhere to closures. The number of violations of the closures has been very limited and seemingly generally due to honest mistakes by vessel operators.

The Council's June 2010 motion requested an analysis of potential means to modify the chum rolling hotspot system. Options for adjusting the system include:

- Modifications of the RHS program to the vessel-level would follow the current shoreside and catcher-processor Chinook RHS programs. An individual-level system would increase the likelihood that vessels face consequences for high PSC. Because there may also be some advantages to having cooperative-level incentives, a RHS system could also include *both* individual and cooperative-level incentives.
- Sea State strives to have recent information available for deciding which areas to close. There is no easy technical fix to reduce the utilization of information. Shortening the approximately 24-hour delay between when closures are announced and implemented would improve the quality of data and could provide some additional incentive to avoid high-PSC areas immediately before closures are implemented. However, this would occur at additional cost to the fleet and historical simulation results suggest that the reduction in PSC would be relatively small.
- The RHS could be adjusted to focus on benefits to Western Alaska stocks by being more active early in the B season. However, if extremely large closures are imposed in this period so that fishing is slowed down significantly, it could have the unintended consequence of pushing a larger amount of fishing effort into October, when Chinook PSC is usually highest.
- Historical simulation results indicate that larger closures are likely to further reduce PSC, but at a decreasing rate as they get larger. Larger areas at high-PSC periods would allow more high-PSC areas to be closed.
- When PSC rates change quickly, the current 3-week moving basis for determining the base rate means that all cooperatives or few cooperatives are subject to closures. The base rate could be based on the most recent behavior to ensure that vessels or cooperatives with relatively high PSC rates in the most recent period would be subject to closures.
- Modifying the incentives associated with the tier system has the potential to significantly strengthen the effectiveness of the RHS system. Larger and longer closures or any other reward and penalty could be incorporated into the tier system. If a more stringent chum RHS is developed,

vessels could be made exempt from some of the closures if they have relatively low *Chinook* PSC, further increasing the incentive to avoid Chinook PSC as well.

In balancing the chum and Chinook PSC, the RHS system has demonstrated the ability to carefully balance the trade-offs in a manner that could not be done with fixed closures. The program has continued to evolve and learn from new challenges.

6.4 Pollock Fishery Gross Revenue under Alternative 1: Status Quo

The analysis of potential effects on pollock industry revenue uses a retrospective analysis of fishery conditions during the 2003 through 2011 seasons. Constraints, in the form of fishery closures, are applied in each year, by season and sectors. Thus, the constraints are applied to calculate potentially forgone gross revenue as that portion of revenue that was actually earned, as reported by industry, up to the date of the closure. The actual total first wholesale gross revenue values that the industry earned during the 2003-2011 time-frame (i.e. under Alternative 1, the status quo) are presented below. Their use in calculating prices used in the impact analysis is detailed in the next section.

Table 6-1 A and B Season total (Annual) Round weight equivalent nominal first wholesale gross value of retained pollock by sector 2003–2011.

YEAR	A and B Season Annual Total First Wholesale Gross Value			Total Annual First Wholesale Value
	CDQ	CP/M	Shoreside	
2003	$103	$468	$456	$1,026
2004	$116	$520	$446	$1,082
2005	$131	$597	$536	$1,264
2006	$133	$597	$517	$1,247
2007	$139	$602	$500	$1,241
2008	$145	$647	$540	$1,331
2009	$109	$472	$446	$1,027
2010	$106	$491	$438	$1,035
2011**	$139	$660	$612	$1,410

Sources: Terry Hiatt: Alaska Fisheries Science Center, from data compiled for the Economic Status and Fishery Evaluation Report, 2008 and 2010.

*Estimated using pollock catch by season and sector, from catch accounting, and applying the 2010 price per round metric ton as a price proxy.

Harvest tonnages were valued using annual round weight equivalent first wholesale prices derived from the catch accounting system (Hiatt 2011). The first wholesale prices were estimated by dividing the total wholesale value of pollock production by estimated retained tons of pollock, to yield a round weight per ton of catch equivalent value. First wholesale prices are the prices received by the first level of inshore processors, or by catcher-processors and motherships. They reflect the value added by the initial processor of the raw catch. They are not, therefore, equivalent to ex-vessel prices. The first wholesale values by species group, fishing gear, and area for the catcher-processor fleet used in this analysis are summarized in the tables below.

6.5 Calculation of Potentially Forgone Pollock Revenue and Pollock Revenue at Risk

The analysis of potential forgone gross revenue has used the estimated date on which the pollock fishery would have hit the various non-Chinook salmon PSC caps in each of the years 2003-2011 in order to conduct a retrospective analysis to answer the question of what would have happened had the proposed action been in place in those years. The estimate of potentially forgone pollock harvest that results is then multiplied by a price to estimate potentially forgone gross revenue. Since the impact estimate is calculated in terms of the metric tons of pollock catch potentially forgone, it is necessary to use a price that is reflective of the total value of that catch. This process is necessarily complicated by the fact that pollock is processed into several product forms and is processed both at sea (on CPs and Motherships) and in shoreside processing facilities that receive deliveries from Catcher Vessels. Thus, reported values in the offshore sector (CPs and Motherships) are inclusive of all processing value added to the first wholesale level, which is also the point of departure for export of pollock products. Effects in export markets are not an appropriate consideration in a RIR. Thus, this is a logical level at which to value potential impacts because exports and effects on export markets lie outside this level of valuation. Further, potential welfare impacts in domestic markets cannot be determined with available data. Thus, first wholesale value is an appropriate value by which to capture the total quantifiable domestic market effect on potential forgone pollock harvest and revenue.

The analysis is complicated by the fact that deliveries to shoreside plants by Catcher Vessels are paid an ex-vessel price that is considerably less than, and thus not comparable to, the first wholesale value. To provide comparable first wholesale values for both the offshore and inshore sectors, the analysis does not use ex-vessel value and, instead, calculates a shoreside sector price that is inclusive of all processed value added. This is done by annually aggregating the total value of all pollock products processed by shoreside processors, as reported by industry to NMFS in the COAR report and compiled by the Alaska Fisheries Science Center, and dividing that value by the total round weight of retained metric tons of pollock harvested by Catcher Vessels in the Bering Sea pollock fishery as reported in the e-landings catch accounting system.

This calculation provides a round weight equivalent first wholesale value for the shoreside sector that can be multiplied by estimates of potentially forgone pollock harvest, in round metric tons, to determine potentially forgone gross revenue at the first wholesale level. This is done annually from 2003 through 2011 in the RIR for each of the sectors and these prices are reported in Table 6-2 and Table 6-3. These are the prices that are applied by year for each year from 2003 through 2011.

Table 6-2 B Season Round weight equivalent nominal first wholesale value of retained pollock by sector, 2003-2011 ($/mt).

YEAR	Round Weight Equivalent First Wholesale Value/mt		
	CDQ	CP/M	Shoreside
2003	$537.68	$540.30	$632.96
2004	$564.94	$559.48	$595.94
2005	$687.96	$712.30	$700.32
2006	$704.51	$713.41	$697.62
2007	$834.10	$818.19	$762.63
2008	$1,232.55	$1,248.65	$1,113.88
2009	$1,153.11	$1,122.08	$1,189.18
2010	$1,185.42	$1,236.22	$1,178.04
2011*	$1,185.42	$1,236.22	$1,178.04

Sources: Terry Hiatt: Alaska Fisheries Science Center, from data compiled for the Economic Status and Fishery Evaluation Report, 20109. * 2010 price is used to proxy 2011 prices.

Table 6-3 B Season nominal first wholesale value of retained pollock by sector 2003–2011.

YEAR	B Season First Wholesale Gross Value			Total B Season First Wholesale Value
	CDQ	CP/M	Shoreside	
2003	$49	$218	$249	$515
2004	$51	$221	$225	$498
2005	$63	$283	$274	$619
2006	$64	$288	$268	$620
2007	$70	$303	$251	$624
2008	$75	$337	$283	$695
2009	$57	$248	$249	$554
2010	$59	$278	$249	$585
2011**	$60	$390	$353	$803

Sources: Terry Hiatt: Alaska Fisheries Science Center, from data compiled for the Economic Status and Fishery Evaluation Report, 2010.

** Estimated using pollock catch by season and sector, from catch accounting, and applying the 2010 price per round metric ton as a price proxy.

The analysis of revenue impacts of the alternatives on the pollock industry was conducted in terms of two gross revenue categories. The first is the potential forgone gross revenues that could have been generated under various non-Chinook salmon PSC hard caps contained within Alternative 2. This is simply the gross revenue that would have been generated by the pollock TACs, and their allocations among sectors, that have historically been caught after the projected closure date under the hard cap scenarios. These differ between the alternatives depending upon the sector, cap amount, seasonal split options, and historic allocation options.

The second general category is gross revenues at risk under the triggered closure area options contained in Alternative 3. The affected fishing fleets may or may not have been able to make up the displaced catch and the gross revenues that would have been lost because of these restrictions, by fishing outside of the closure area. Because some sectors may potentially have been able to recover some or all of these gross revenues, the gross income from these catches cannot, strictly speaking, be described as lost. Instead, they have been described here as "at risk."

Only if it is assumed that harvest foreclosed to a fleet sector in one area by Alternative 3 could not have been made up elsewhere by that fleet sector would at-risk gross revenues be an estimate of lost gross revenues. Accurate estimates of the abilities of fleets to make up a reduction in harvests in one area, due to closures under Alternative 3, by fishing in another require information on the following: (1) the volume of catch (and resulting production) affected by the Alternative 3 closure areas, (2) the extent to which each fleet sector would have redirected its operations into other fishing areas, and (3) the comparative productivity of the fleet sectors in the new areas. Currently, it is possible to quantitatively estimate only the first of these, (i.e., the volume of catch coming from areas that would no longer have been available to fishermen under each triggered closure scenario contained within Alternative 3.

As noted above, gross revenues at risk are forgone **only** if a fishing fleet is unable to modify its operation to accommodate the imposed limits and, thus, cannot make up displaced catches elsewhere (either in remaining open fishing areas or during alternative open fishing periods). Having estimated the maximum gross revenues that might be lost to each sector, on the assumption that the fleet is unable to make up the affected harvests, it is possible to incrementally relax this assumption and assess the effects. If one assumes that the underlying behavioral model is linear in its parameters, evaluating an alternative assumption about the total forgone catch is straightforward. For example, if one assumes that a given sector is able to make up 10 percent of the harvest elsewhere, the estimated at risk gross revenue impact would be multiplied by 0.90; if the assumption is that, say, 20 percent is made up elsewhere, the total is multiplied by a factor of 0.80, and so forth. This is done without specifying where (or when) the sector might operate, or at what cost. With total gross revenue at risk information available for each fleet segment, the reader may apply his or her own assumptions about the extent to which each fleet segment would be able to make up its catch elsewhere, thus producing his or her own estimates of the gross revenues that might be forgone.

6.6 Potentially Forgone Gross Revenue and "Revenue at Risk" under Alternative 2

Under the non-Chinook salmon PSC hard cap scenarios included in Alternative 2, option 1a, the pollock trawl fishery, and/or specific sectors that participate in it (depending on apportionments of hard caps) would be required to stop fishing once a specific hard cap is reached. In such a circumstance, any remaining TAC that is not harvested when the cap is reached would remain unharvested unless specific provisions of the hard cap alternative dealing with transfers, rollovers, and/or cooperative level management are applied. These may in mitigate potential losses in revenue due to unharvested pollock TAC.

While the hard cap option of Alternative 2 has the potential effect of fishery closure and resulting forgone pollock fishery revenue, option 1b would close the fishery in June and July and reopen it in August. The fleet would be required to stand down during this closure and would, presumably, then return to the grounds and attempt to harvest all remaining pollock allocation in the remainder of the B season. Thus, option 1b is essentially a triggered closure of the Bering Sea pollock fishery that puts the gross revenue earned historically in June and July at risk of not being realized. The revenue associated historically with June and July harvests is placed at risk of not being earned if the fishing post closure is not sufficiently productive to offset any operational costs increases, opportunity costs associated with switching to another fishery (e.g. Pacific whitting) , associated with relative harvesting inefficiencies post closure, and provided that the fleet feels that is able to sufficiently avoid Chinook salmon PSC late in the B season such that Chinook PSC will not affect future constraints on the pollock fishery under the Chinook salmon PSC management measures of Amendment 91. The previous discussion contained in the overview of costs and benefits provides a treatment of some of the implications and limitations of this "revenue at risk" analysis.

This section specifically details the impacts on gross revenue and gross revenue put at risk via an unmitigated closure of the pollock fishery, or sectors within it, due to hard caps under option 1a. This analysis provides hypothetical estimates of potentially forgone pollock first wholesale gross revenue by year and season under non-Chinook PSC option for fleet wide caps, and for the CDQ fishery and non-CDQ fishery. Also provided are estimates of revenue put at risk, with similar sector level breakouts, by option 1b of Alternative 2.

Table 6-4 provides hypothetical estimates of potentially forgone pollock first wholesale gross revenue, by year and season, under the options for fleet wide caps, and for the CDQ fishery and the non-CDQ fishery. As expected, the greatest adverse economic impact 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 $482 million would potentially have been forgone. That gross value is composed of $209 million from the CV sector, $202 million from the CP sector, $53million from the Mothership sector, and $18 million from CDQ pollock fisheries.

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

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

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

Table 6-4 Alternative 2, Option 1a: Estimated hypothetical forgone pollock nominal gross revenue ($ millions) in the B season by sector and year under three different allocation schemes and hard caps, 2003-2011.

2ii (sector allocation 1)

Cap:	50,000					200,000					353,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	$27	$36	$24	$123	$211	$7		$7		$13					
2004	$42	$170	$35	$119	$366	$16	$124	$5	$53	$199		$74		$22	$96
2005	$18	$202	$53	$209	$482	$7	$75	$19	$179	$279		$57	$5	$141	$203
2006		$160		$251	$412				$168	$168					
2007	$15	$98	$25	$62	$200										
2008															
2009															
2010															
2011	$25	$253	$78	$222	$577		$115	$63		$178		$13	$26		$39

4ii (sector allocation 2)

Cap:	50,000					200,000					353,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	$18	$18	$15	$139	$191				$18	$18					
2004	$29	$162	$28	$122	$342		$74	$0	$57	$131				$40	$40
2005	$15	$91	$49	$213	$367		$46	$9	$185	$240				$167	$167
2006		$67		$251	$318				$203	$203				$141	$141
2007	$13	$68	$19	$79	$178										
2008															
2009				$16	$16										
2010															
2011	$3	$187	$75	$254	$519			$34		$34			$9		$9

6 (sector allocation 3)

Cap:	50,000					200,000					353,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	$7	$3	$11	$157	$178				$44	$44					
2004	$19	$148	$21	$135	$322		$11		$91	$101				$53	$53
2005	$14	$80	$47	$225	$366				$204	$204				$179	$179
2006				$261	$261				$229	$229				$170	$170
2007	$5	$51	$11	$91	$158										
2008															
2009				$77	$77										
2010															
2011		$161	$75	$286	$522			$21	$72	$94					

The following tables provide the data, discussed above, by sector (CDQ, CP, CV, and motherships) as a percent of B season total gross revenue and then as a percent of annual total revenue. What is immediately obvious is that potentially forgone revenue in the CV sector can represent nearly 94% of B season total revenue in the worst case under the 50,000 fish cap. Also evident it that CPs can also have as much as 77% and the CDQ sector as much as 81% of their B season revenue placed at risk under the lowest cap, while motherships have relatively lower percentages of less than 20 percent of B season revenue placed at risk. As is the case with revenue estimates, percent of revenue show increasing impacts to CVs, under the scenario 2 and 3, with reductions is other sectors, while the effect of increasing the cap is to concentrate impacts , albeit at reduced levels due to the larger cap, within the CV sector under scenario 2 and 3. If these impacts are considered as a percent of annual total instead of B season revenue one sees that the percentage impacts fall by roughly half of their value but remain farily high.

Table 6-5 Alternative 2, Option 1a: Estimated hypothetical forgone pollock nominal gross revenue, as a percent of B season total gross revenue, by sector and year under three different allocation schemes and hard caps, 2003-2011.

2ii (sector allocation 1)															
Cap:			50,000					200,000					353,000		
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	56.1%	16.7%	11.0%	49.5%	40.9%	14.0%		3.0%		2.6%					
2004	81.5%	76.9%	16.0%	52.8%	73.6%	30.4%	56.2%	2.3%	23.7%	39.9%		33.6%		9.6%	19.3%
2005	28.2%	71.3%	18.6%	76.5%	77.8%	10.9%	26.6%	6.6%	65.3%	45.1%		20.2%	1.8%	51.4%	32.8%
2006		55.7%		93.7%	66.4%				62.5%	27.1%					
2007	21.7%	32.2%	8.2%	24.6%	32.0%										
2008															
2009															
2010															
2011	41.0%	64.8%	19.9%	63.0%	71.8%		29.4%	16.2%		22.2%		3.4%	6.7%		4.9%
4ii (sector allocation 2)															
Cap:			50,000					200,000					353,000		
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	37.4%	8.2%	7.1%	55.9%	37.0%				7.2%	3.5%					
2004	57.3%	73.2%	12.9%	54.1%	68.6%		33.6%	0.1%	25.1%	26.4%				17.8%	8.0%
2005	24.7%	32.0%	17.2%	77.7%	59.3%		16.4%	3.1%	67.8%	38.8%				61.0%	27.0%
2006		23.3%		93.7%	51.4%				75.7%	32.8%				52.5%	22.7%
2007	18.3%	22.4%	6.2%	31.5%	28.6%										
2008															
2009				6.5%	2.9%										
2010															
2011	4.6%	48.0%	19.1%	72.0%	64.6%			8.8%		4.3%			2.4%		1.2%
6 (sector allocation 3)															
Cap:			50,000					200,000					353,000		
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	14.0%	1.6%	4.9%	63.1%	34.6%				17.6%	8.5%					
2004	36.3%	66.9%	9.4%	59.8%	64.7%		4.7%		40.4%	20.4%				23.7%	10.7%
2005	21.9%	28.3%	16.6%	82.2%	59.0%				74.7%	33.0%				65.4%	28.9%
2006				97.2%	42.1%				85.5%	37.0%				63.4%	27.5%
2007	7.7%	16.7%	3.6%	36.5%	25.4%										
2008															
2009				30.8%	13.9%										
2010															
2011		41.2%	19.1%	81.1%	64.9%			5.5%	20.5%	11.7%					

Table 6-6 Alternative 2, Option 1a: Estimated hypothetical forgone pollock nominal gross revenue, as a percent of Annual total gross revenue (A and B season combined), by sector and year under three different allocation schemes and hard caps, 2003-2011.

2ii (sector allocation 1)															
Cap:			50,000					200,000					353,000		
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	26.5%	7.8%	5.1%	27.1%	20.5%	6.6%		1.4%		1.3%					
2004	35.9%	32.8%	6.8%	26.7%	33.9%	13.4%	23.9%	1.0%	12.0%	18.3%		14.3%		4.8%	8.9%
2005	13.4%	33.8%	8.8%	39.1%	38.1%	5.2%	12.6%	3.1%	33.3%	22.1%		9.6%	0.9%	26.2%	16.0%
2006		26.8%		48.6%	33.0%				32.5%	13.5%					
2007	11.0%	16.2%	4.1%	12.3%	16.1%										
2008															
2009															
2010															
2011	17.8%	38.3%	11.8%	36.3%	40.9%		17.4%	9.6%		12.6%		2.0%	3.9%		2.8%
4ii (sector allocation 2)															
Cap:			50,000					200,000					353,000		
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	17.6%	3.8%	3.3%	30.6%	18.6%				3.9%	1.8%					
2004	25.2%	31.2%	5.5%	27.3%	31.6%		14.3%	0.0%	12.7%	12.1%				9.0%	3.7%
2005	11.8%	15.2%	8.2%	39.7%	29.1%		7.8%	1.4%	34.6%	19.0%				31.1%	13.2%
2006		11.2%		48.6%	25.5%				39.3%	16.3%				27.3%	11.3%
2007	9.3%	11.3%	3.1%	15.8%	14.4%										
2008															
2009				3.6%	1.6%										
2010															
2011	2.0%	28.4%	11.3%	41.5%	36.8%			5.2%		2.4%			1.4%		0.7%
6 (sector allocation 3)															
Cap:			50,000					200,000					353,000		
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	6.6%	0.7%	2.3%	34.5%	17.4%				9.6%	4.3%					
2004	16.0%	28.5%	4.0%	30.2%	29.8%		2.0%		20.4%	9.4%				12.0%	4.9%
2005	10.4%	13.4%	7.9%	41.9%	28.9%				38.1%	16.2%				33.4%	14.2%
2006				50.5%	20.9%				44.4%	18.4%				32.9%	13.6%
2007	3.9%	8.4%	1.8%	18.3%	12.8%										
2008															
2009				17.2%	7.5%										
2010															
2011		24.4%	11.3%	46.7%	37.0%			3.2%	11.8%	6.6%					

Table 6-7 Alternative 2, Option 1b: Estimated hypothetical pollock nominal gross revenue ($ millions) at risk in the B season by sector and year under three different allocation schemes and caps, 2003-2011.

2ii (sector allocation 1)

Cap:	50,000					200,000					353,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	$27	$36	$24	$123	$211	$7		$7		$13					
2004	$6	$98	$11		$115		$89	$2		$91		$86			$86
2005		$81	$27	$83	$191		$24	$26	$59	$108			$20	$54	$74
2006		$62	$4	$105	$171		$8		$80	$88				$73	$73
2007		$39	$12		$51										
2008															
2009		$14	$21	$4	$40										
2010			$7		$7										
2011	$24	$106	$37	$163	$330		$63	$35	$48	$147		$7	$33		$39

4ii (sector allocation 2)

Cap:	50,000					200,000					353,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			$3	$15	$18										
2004		$96	$9	$3	$109		$78			$78		$28			$28
2005		$75	$27	$93	$195			$22	$59	$81				$54	$54
2006		$31		$105	$136				$95	$95				$73	$73
2007			$7	$6	$13										
2008															
2009			$10	$27	$37										
2010															
2011	$35	$267	$79	$326	$707		$178	$75	$226	$479		$102	$63	$119	$284

6 (sector allocation 3)

Cap:	50,000					200,000					353,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			$1	$31	$33										
2004		$96	$9	$11	$116		$50			$50					
2005		$72	$27	$101	$200			$15	$68	$82				$59	$59
2006		$18		$105	$123				$105	$105				$80	$80
2007			$4	$18	$22										
2008															
2009				$67	$67										
2010															
2011	$25	$253	$79	$333	$689		$115	$70	$263	$448		$13	$54	$204	$272

Table 6-8 Alternative 2, Option 1b: Estimated hypothetical pollock nominal gross revenue at risk, as a percent of B season total gross revenue, by sector and year under three different allocation schemes and caps, 2003-2011.

2ii (sector allocation 1)															
Cap:	50,000					200,000					353,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	56.1%	16.7%	11.0%	49.5%	40.9%	14.0%		3.0%		2.6%					
2004	12.1%	44.3%	4.8%		23.1%		40.3%	0.8%		18.3%		38.7%			17.2%
2005		28.7%	9.5%	30.3%	30.9%		8.5%	9.1%	21.4%	17.5%			7.0%	19.8%	12.0%
2006		21.6%		39.0%	27.6%		2.7%		30.0%	14.2%				27.2%	11.8%
2007		12.8%	3.9%		8.1%										
2008															
2009		5.8%	8.4%	1.8%	7.2%										
2010			2.6%		1.2%										
2011	39.7%	27.1%	9.6%	46.1%	41.1%		16.2%	9.1%	13.7%	18.3%		1.7%	8.3%		4.9%
4ii (sector allocation 2)															
Cap:	50,000					200,000					353,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			1.4%	6.0%	3.5%										
2004		43.3%	4.3%	1.5%	21.8%		35.3%			15.7%		12.4%			5.5%
2005		26.5%	9.5%	34.2%	31.5%			7.7%	21.7%	13.1%				19.8%	8.7%
2006		10.9%		39.0%	21.9%				35.4%	15.3%				27.2%	11.8%
2007			2.3%	2.3%	2.0%										
2008															
2009			4.2%	10.8%	6.7%										
2010															
2011	57.4%	68.4%	20.2%	92.5%	88.0%		45.7%	19.1%	64.1%	59.6%		26.1%	16.2%	33.8%	35.3%
6 (sector allocation 3)															
Cap:	50,000					200,000					353,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			0.7%	12.6%	6.4%										
2004		43.3%	4.3%	4.8%	23.3%		22.6%			10.1%					
2005		25.6%	9.5%	36.8%	32.3%			5.1%	24.7%	13.3%				21.4%	9.5%
2006		6.3%		39.0%	19.8%				39.0%	16.9%				30.0%	13.0%
2007			1.3%	7.0%	3.5%										
2008															
2009				26.7%	12.0%										
2010															
2011	41.0%	64.8%	20.2%	94.4%	85.8%		29.4%	17.9%	74.7%	55.8%		3.4%	14.0%	57.9%	33.8%

Table 6-9 Alternative 2, Option 1b: Estimated hypothetical pollock nominal gross revenue at risk, as a percent of Annual total gross revenue (A and B season combined), by sector and year under three different allocation schemes and caps, 2003-2011.

2ii (sector allocation 1)															
Cap:			50,000					200,000					353,000		
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	26.5%	7.8%	5.1%	27.1%	20.5%	6.6%		1.4%		1.3%					
2004	5.4%	18.9%	2.1%		10.6%		17.2%	0.4%		8.4%		16.5%			7.9%
2005		13.6%	4.5%	15.5%	15.1%		4.0%	4.3%	10.9%	8.6%			3.3%	10.1%	5.9%
2006		10.4%	0.7%	20.2%	13.7%		1.3%		15.5%	7.1%				14.1%	5.9%
2007		6.4%	2.0%		4.1%										
2008															
2009		3.1%	4.4%	1.0%	3.9%										
2010			1.5%		0.7%										
2011	17.2%	16.1%	5.7%	26.6%	23.4%		9.6%	5.4%	7.9%	10.4%		1.0%	4.9%		2.8%
4ii (sector allocation 2)															
Cap:			50,000					200,000					353,000		
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			0.7%	3.3%	1.8%										
2004		18.5%	1.8%	0.8%	10.0%		15.0%			7.2%		5.3%			2.5%
2005		12.6%	4.5%	17.4%	15.4%			3.7%	11.1%	6.4%				10.1%	4.3%
2006		5.3%		20.2%	10.9%				18.4%	7.6%				14.1%	5.9%
2007			1.2%	1.2%	1.0%										
2008															
2009			2.2%	6.0%	3.6%										
2010															
2011	24.9%	40.5%	12.0%	53.3%	50.1%		27.0%	11.3%	36.9%	34.0%		15.4%	9.6%	19.5%	20.1%
6 (sector allocation 3)															
Cap:			50,000					200,000					353,000		
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			0.3%	6.9%	3.2%										
2004		18.5%	1.8%	2.4%	10.7%		9.6%			4.6%					
2005		12.1%	4.5%	18.8%	15.8%			2.4%	12.6%	6.5%				10.9%	4.6%
2006		3.0%		20.2%	9.8%				20.2%	8.4%				15.5%	6.4%
2007			0.7%	3.5%	1.7%										
2008															
2009				14.9%	6.5%										
2010															
2011	17.8%	38.3%	12.0%	54.4%	48.9%		17.4%	10.6%	43.1%	31.8%		2.0%	8.3%	33.4%	19.3%

6.7 Revenue at Risk under Alternative 3

While the hard cap alternatives have the potential effect of fishery closure and resulting forgone pollock fishery revenue, the triggered closures do not directly create forgone gross revenue, 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 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 previous discussion contained in the overview of costs and benefits provides a treatment of some of the implications and limitations of this "revenue at risk" analysis.

As was the case for forgone gross revenue, the revenue at risk estimate is the answer to the question of how much revenue they earned, in each of the years 2003-2011, from the projected date of the triggered closure (see EA Chapter 4) through the end of the season. Thus, it is a retrospective assessment of actual revenue earned in those years from the projected triggered closure date forward. Presented here are the estimates of revenue at risk and the percent of total revenue that these estimates comprise.

It is also possible to take a further step with regard to analysis of triggered closure areas (Alternative 3). Having estimated the maximum gross revenues that might be lost by each fleet segment, on the assumption that the fleet is unable to make up reduced harvests by fishing in other areas, it is possible to gradually relax that analytical constraint by assuming the fleet component would have been able to make up some percentage of the revenue at risk by fishing in other areas not affected by non-Chinook salmon PSC minimization measures. This is done without specifying where the fleet segment might otherwise have operated (or at what cost), except to assume that the effort would have been redistributed to remaining open areas, during remaining open periods, under existing management regulations. With this information available for each fleet segment, readers may apply their own assumptions about the extent to which each fleet segment would be able to make up its catch elsewhere, under the differing temporal and geographic constraints and limitations provided across competing non-Chinook salmon PSC minimization alternatives, should these measures be applied to future fishing effort. In this way, individuals may produce their own estimates of the future gross revenues that might be forgone under each alternative.

To be precise, the gross revenues at risk were estimated using information about the following: (1) projected fleet segment harvests for the 2003 through 2011 fishing years assuming the provisions of each non-Chinook salmon PSC minimization alternative had been in place in that year; (2) the actual proportions of harvest of different allocations, by different sectors (e.g. CDQ, CP, CV, Motherships), based upon historical catch patterns in 2003 through 2009; and (3) estimated product mix and first wholesale product values for all pollock products by sector and year from 2001 through 2011.

Component 1 of this alternative sets the trigger PSC cap level for this large scale closure. PSC from all vessels will accrue towards the cap level selected. However if the cap level is reached, the triggered closure would not apply to participants in the RHS program. Under Component 2, however, in addition to the large closure for non-RHS participants, a select triggered area closure would apply to RHS participants. Four options of triggered closure areas and time frames are provided under Component 2. Component 3 then sets the trigger PSC cap level for the area selected under Component 2. Given that, at present, full participation in the RHS is occurring; component 1 is likely to have no effect on the fleet unless an entity drops out of the system. What is analyzed here are Options 1a, 1b, 2a, and 2b, where a triggered closure would apply to participants in the RHS with the level of impact depending on the seasonal timing of June-July (Options 1a and 2a) versus all of the B season (Options 1b, and 2b) and on the size of the closure area being at an 80% level (Options 1a and 1b), versus a 60% level (Options 2a, and 2b). Chapter 2, of the accompanying EA provides an extensive discussion of how these alternative coponents and options were developed and also provides a treatment of the management and enforcement implications associated with thes various options. A thorough review of EA Chapter 2 is quite necessary in order to contextualize the potential impacts presented here.

Table 6-10 through Table 6-12 provide these numbers in terms of dollars of revenue and also as a percent of B season total revneu and as a percent of total annual revenue by sector. A review of the data presented in these tables reveals that shore based CVs would have the vast majority of the revenue at risk and the greatest percentages of B season total first wholesale revenue at risk as well as annual total gross first wholesale revenue. Under the smallest trigger cap of 25,000 and in allocation scenario 1 the CV sector is estimated to have had as much as $168 million in revenue at risk in2005 out of the $183 million total for all fleet sectors combined. This represents approximately 61 percent of the CV B season total gross revenue and approximately 30 percent of total gross revenue.

As is expected, relaxing the trigger caps has the result of decreasing the revenue at risk. The 2005 CV revenue at risk (scenario 1), for example, decreases from $168 million to $1502 million and $127 million as the trigger cap is relaxed to 75,000 and then 200,000. The opposite effect is shown when shifting from allocation scenario 1 to allocation scenario 2 and then allocation scenario 3 with the 2005 CV revenue at risk, for example, increasing from $168 million to $172 million, and $186 million.

In percentage of B season gross revenue terms, the potential impacts to sectors other than the CV sector are very small in nearly all years under consideration. There is one relatively high impact to the CDQ sector in 2003; however, the CDQ sector has had considerably lower revenue at risk on all years since 2003. When considering revenue at risk as a percent of annual total revenue the potential impacts appear to be considerably reduced in almost all years, allocation scenarios, and cap levels for all sectors other than the CV sector. Thus, it is not likely that the CDQ, CP, or Mothership sectors will have difficulty mitigating revenue at risk under Alternative 3, option 1. The CV sector, in contrast, bears as much as 30 percent of its revenue being placed at risk in several of the years within this retrospective analysis and, therefore, would likely experience costs associated with effort relocation.

Table 6-10 Alternative 3, Option 1a: Estimated hypothetical nominal gross revenue at risk ($ millions) due to diverted fishing activities from historical fishing grounds by sector allocation (panels) and trigger cap levels for Option 1a, 2003-2011.

2ii (sector allocation 1) Option 1a															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	$20	$11	$11	$144	$186	$17	$6	$8	$66	$97	$6		$4		$11
2004	$13	$47	$10	$122	$191	$11	$44	$4	$91	$149	$1	$20		$42	$63
2005		$7	$7	$168	$183		$4	$4	$150	$157		$4		$127	$131
2006		$8		$140	$147				$113	$113				$77	$77
2007	$1	$12		$66	$79	$1	$12			$13					
2008															
2009			$1	$29	$30										
2010															
2011	$11	$31	$37	$196	$275	$7	$31	$34	$116	$188		$26	$26		$52
4ii (sector allocation 2) Option 1a															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	$19	$8	$8	$144	$181	$6	$3	$6	$99	$115				$17	$17
2004	$12	$47	$9	$122	$189	$2	$38	$3	$95	$137		$12		$46	$57
2005		$7	$7	$172	$187		$4	$2	$154	$160				$132	$132
2006				$140	$140				$117	$117				$90	$90
2007	$1	$12		$70	$83		$12		$44	$56					
2008															
2009			$1	$29	$30										
2010															
2011	$10	$31	$37	$214	$292		$26	$29	$159	$214			$23		$23
6 (sector allocation 3) Option 1a															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	$17	$6	$8	$157	$188	$1		$6	$128	$134				$37	$37
2004	$11	$44	$7	$122	$183		$15		$106	$121				$80	$80
2005		$4	$7	$186	$196		$4		$154	$158				$150	$150
2006				$140	$140				$131	$131				$113	$113
2007	$1	$12		$74	$87				$57	$57					
2008				$14	$14										
2009				$29	$29				$12	$12					
2010															
2011	$7	$26	$35	$220	$289		$21	$29	$171	$221			$18	$67	$85

Table 6-11 Alternative 3, Option 1a: Estimated hypothetical B season nominal gross revenue at risk, as a percent of B season total gross revenue, due to diverted fishing activities from historical fishing grounds by sector allocation (panels) and trigger cap levels, Option 1a, 2003-2011.

2ii (sector allocation 1) Option 1a

Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	41.2%	5.2%	4.9%	58.0%	36.2%	34.6%	2.6%	3.9%	26.5%	18.8%	13.2%		1.9%		2.1%
2004	24.7%	21.0%	4.6%	54.0%	38.4%	21.4%	19.7%	1.6%	40.5%	30.0%	1.7%	9.2%		18.6%	12.7%
2005		2.6%	2.6%	61.4%	29.5%		1.3%	1.3%	54.7%	25.4%		1.3%		46.4%	21.1%
2006		2.6%		52.1%	23.8%				42.0%	18.2%				28.6%	12.4%
2007	1.7%	4.0%		26.2%	12.6%	1.7%	4.0%			2.1%					
2008															
2009			0.3%	11.7%	5.4%										
2010															
2011	18.4%	8.0%	9.4%	55.5%	34.2%	11.5%	8.0%	8.7%	33.0%	23.5%		6.7%	6.6%		6.5%

4ii (sector allocation 2) Option 1a

Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	39.6%	3.9%	3.9%	58.0%	35.1%	13.2%	1.3%	2.9%	39.7%	22.2%				6.6%	3.2%
2004	23.1%	21.0%	4.2%	54.0%	38.0%	3.3%	17.1%	1.3%	42.2%	27.6%		5.3%		20.2%	11.5%
2005		2.6%	2.6%	63.0%	30.2%		1.3%	0.7%	56.4%	25.8%				48.1%	21.2%
2006				52.1%	22.6%				43.7%	18.9%				33.6%	14.5%
2007	1.7%	4.0%		27.9%	13.3%		4.0%		17.4%	8.9%					
2008															
2009			0.3%	11.7%	5.4%										
2010															
2011	16.1%	8.0%	9.4%	60.7%	36.3%		6.7%	7.3%	45.1%	26.6%			5.9%		2.9%

6 (sector allocation 3) Option 1a

Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	34.6%	2.6%	3.9%	62.9%	36.4%	1.6%		2.6%	51.3%	26.1%				14.9%	7.2%
2004	21.4%	19.7%	3.3%	54.0%	36.8%		6.6%		47.2%	24.3%				35.4%	16.0%
2005		1.3%	2.3%	68.0%	31.7%		1.3%		56.4%	25.5%				54.7%	24.2%
2006				52.1%	22.6%				48.7%	21.1%				42.0%	18.2%
2007	1.7%	4.0%		29.7%	14.0%				22.7%	9.1%					
2008				5.0%	2.1%										
2009				11.7%	5.3%				5.0%	2.3%					
2010															
2011	11.5%	6.7%	9.0%	62.4%	35.9%		5.4%	7.3%	48.6%	27.5%			4.5%	19.1%	10.6%

Table 6-12 Alternative 3, Option 1a: Estimated hypothetical B season nominal gross revenue at risk, as a percent of total annual revenue, due to diverted fishing activities based on historical fishing grounds by sector allocation (panels) and trigger cap levels for Option 1a, 2003-2011.

2ii (sector allocation 1) Option 1a

Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	19.5%	2.4%	2.3%	31.7%	18.2%	16.4%	1.2%	1.8%	14.5%	9.5%	6.2%		0.9%		1.0%
2004	10.9%	8.9%	1.9%	27.3%	17.6%	9.4%	8.4%	0.7%	20.4%	13.8%	0.7%	3.9%		9.4%	5.8%
2005		1.2%	1.2%	31.3%	14.5%		0.6%	0.6%	27.9%	12.4%		0.6%		23.7%	10.3%
2006		1.3%		27.0%	11.8%				21.8%	9.0%				14.8%	6.1%
2007	0.8%	2.0%		13.1%	6.3%	0.8%	2.0%			1.1%					
2008															
2009			0.2%	6.5%	2.9%										
2010															
2011	8.0%	4.8%	5.6%	32.0%	19.5%	5.0%	4.8%	5.1%	19.0%	13.4%		4.0%	3.9%		3.7%

4ii (sector allocation 2) Option 1a

Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	18.7%	1.8%	1.8%	31.7%	17.6%	6.2%	0.6%	1.4%	21.7%	11.2%				3.6%	1.6%
2004	10.2%	8.9%	1.8%	27.3%	17.5%	1.5%	7.3%	0.6%	21.3%	12.7%		2.2%		10.2%	5.3%
2005		1.2%	1.2%	32.2%	14.8%		0.6%	0.3%	28.8%	12.6%				24.5%	10.4%
2006				27.0%	11.2%				22.7%	9.4%				17.4%	7.2%
2007	0.8%	2.0%		14.0%	6.7%		2.0%		8.7%	4.5%					
2008															
2009			0.2%	6.5%	2.9%										
2010															
2011	7.0%	4.8%	5.6%	35.0%	20.7%		4.0%	4.3%	26.0%	15.2%			3.5%		1.6%

6 (sector allocation 3) Option 1a

Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	16.4%	1.2%	1.8%	34.4%	18.3%	0.8%		1.2%	28.1%	13.1%				8.2%	3.6%
2004	9.4%	8.4%	1.4%	27.3%	17.0%		2.8%		23.9%	11.2%				17.9%	7.4%
2005		0.6%	1.1%	34.7%	15.5%		0.6%		28.8%	12.5%				27.9%	11.8%
2006				27.0%	11.2%				25.3%	10.5%				21.8%	9.0%
2007	0.8%	2.0%		14.9%	7.0%				11.4%	4.6%					
2008				2.6%	1.1%										
2009				6.5%	2.8%				2.8%	1.2%					
2010															
2011	5.0%	4.0%	5.4%	36.0%	20.5%		3.2%	4.3%	28.0%	15.7%			2.7%	11.0%	6.0%

Table 6-13 through Table 6-21 provide estimates of revenue at risk, percent of total B season gross revenue, and percent of total annual gross revenue, as presented above for option 1a, under each of options 1b, 2a, and 2b.

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

In percentage of B season gross revenue terms, the potential impacts to sectors other than the CV sector are very small in nearly all years under consideration. When considering revenue at risk as a percent of annual total revenue the potential impacts appear to be considerably reduced in almost all years, allocation scenarios, and cap levels for all sectors other than the CV sector. Thus, it is not likely that the CDQ, CP, or Mothership sectors will have difficulty mitigating revenue at risk under Alternative 3, option 1. The CV sector, in contrast, bears as much as 30 percent of its revenue being placed at risk in several of the years within this retrospective analysis and, therefore, would likely experience costs associated with effort relocation.

Table 6-13 Alternative 3, Option 1b: Estimated hypothetical nominal gross revenue at risk ($ millions) due to diverted fishing activities from historical fishing grounds by sector allocation (panels) and trigger cap levels for Option1b, 2003-2011.

2ii (sector allocation 1) Option 1b															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	$0	$3	$3	$16	$22			$1		$1					
2004	$3	$22	$7	$7	$39	$1	$20	$6		$26		$20	$1		$21
2005		$4	$8	$86	$97		$3	$8	$63	$74		$1	$7	$48	$55
2006	$0	$6		$63	$70		$5		$63	$68		$0		$43	$43
2007		$2	$1	$5	$8			$0		$0					
2008															
2009		$1	$3	$15	$18				$2	$2					
2010			$4		$4										
2011	$4	$10	$20	$101	$136	$1	$10	$19	$74	$104		$9	$18	$23	$50
4ii (sector allocation 2) Option 1b															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003		$1	$3	$23	$27										
2004	$2	$22	$7	$20	$50		$20	$5		$25		$15			$15
2005		$3	$8	$86	$97		$1	$7	$68	$76			$3	$49	$52
2006		$5		$67	$72		$2		$63	$65				$54	$54
2007		$0	$1	$9	$10										
2008				$2	$2										
2009			$1	$16	$17				$2	$2					
2010			$2	$6	$8										
2011	$4	$10	$20	$101	$136		$9	$19	$78	$107		$1	$15	$33	$49
6 (sector allocation 3) Option 1b															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			$3	$31	$34				$9	$9					
2004	$1	$20	$6	$30	$56		$18	$4	$3	$25		$7			$7
2005		$3	$8	$95	$106			$7	$78	$85				$53	$53
2006		$5		$67	$72		$0		$63	$63				$63	$63
2007			$0	$15	$15				$1	$1					
2008				$11	$11										
2009			$1	$26	$27				$5	$5					
2010				$15	$15										
2011	$1	$10	$20	$101	$132		$9	$18	$95	$122			$10	$49	$59

Table 6-14 Alternative 3, Option 1b: Estimated hypothetical B season nominal gross revenue at risk, as a percent of B season total gross revenue, due to diverted fishing activities from historical fishing grounds by sector allocation (panels) and trigger cap levels, Option 1b, 2003-2011.

2ii (sector allocation 1) Option 1b															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	0.4%	1.2%	1.6%	6.3%	4.2%			0.4%		0.2%					
2004	5.9%	9.8%	3.3%	3.1%	7.8%	1.0%	9.0%	2.7%		5.3%		9.0%	0.6%		4.3%
2005		1.3%	2.8%	31.3%	15.7%		1.1%	2.8%	23.0%	11.9%		0.2%	2.3%	17.6%	8.9%
2006		2.1%		23.5%	11.2%		1.8%		23.5%	11.0%		0.1%		15.9%	6.9%
2007		0.6%	0.2%	2.2%	1.3%			0.1%		0.0%					
2008															
2009		0.3%	1.1%	5.9%	3.3%				0.6%	0.3%					
2010			1.6%		0.7%										
2011	7.2%	2.5%	5.2%	28.7%	16.9%	1.2%	2.5%	5.0%	21.1%	13.0%		2.4%	4.6%	6.5%	6.3%
4ii (sector allocation 2) Option 1b															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003		0.5%	1.6%	9.1%	5.3%										
2004	3.8%	9.8%	3.2%	8.7%	10.1%		9.0%	2.4%		5.1%		6.7%			3.0%
2005		1.1%	2.8%	31.3%	15.6%		0.4%	2.5%	24.8%	12.2%			1.2%	17.7%	8.4%
2006		1.8%		25.0%	11.7%		0.8%		23.5%	10.5%				20.0%	8.6%
2007		0.1%	0.2%	3.6%	1.6%										
2008				0.6%	0.2%										
2009			0.5%	6.3%	3.1%				0.8%	0.4%					
2010			0.6%	2.5%	1.4%										
2011	7.0%	2.5%	5.2%	28.7%	16.9%		2.4%	5.0%	22.2%	13.4%		0.2%	3.9%	9.5%	6.1%
6 (sector allocation 3) Option 1b															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			1.6%	12.4%	6.6%				3.5%	1.7%					
2004	1.0%	9.0%	2.7%	13.1%	11.3%		8.3%	1.7%	1.3%	5.1%		3.1%			1.4%
2005		1.1%	2.8%	34.6%	17.1%			2.3%	28.6%	13.7%				19.3%	8.5%
2006		1.8%		25.0%	11.7%		0.1%		23.5%	10.2%				23.5%	10.2%
2007			0.1%	6.0%	2.4%				0.5%	0.2%					
2008				3.8%	1.5%										
2009			0.3%	10.5%	4.9%				2.1%	0.9%					
2010				6.0%	2.5%										
2011	1.2%	2.5%	5.2%	28.7%	16.4%		2.4%	4.6%	26.8%	15.2%			2.7%	13.9%	7.4%

Table 6-15 Alternative 3, Option 1b: Estimated hypothetical B season nominal gross revenue at risk, as a percent of total annual revenue, due to diverted fishing activities from historical fishing grounds by sector allocation (panels) and trigger cap levels , Option 1b, 2003-2011.

2ii (sector allocation 1) Option 1b

Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	0.2%	0.6%	0.7%	3.4%	2.1%			0.2%		0.1%					
2004	2.6%	4.2%	1.4%	1.6%	3.6%	0.4%	3.8%	1.2%		2.4%		3.8%	0.3%		2.0%
2005		0.6%	1.3%	16.0%	7.7%		0.5%	1.3%	11.7%	5.9%		0.1%	1.1%	9.0%	4.4%
2006	0.4%	1.0%		12.2%	5.6%		0.8%		12.2%	5.5%		0.1%		8.2%	3.4%
2007		0.3%	0.1%	1.1%	0.6%			0.0%		0.0%					
2008															
2009		0.1%	0.6%	3.3%	1.8%				0.4%	0.2%					
2010			0.9%		0.4%										
2011	3.1%	1.5%	3.1%	16.6%	9.6%	0.5%	1.5%	3.0%	12.2%	7.4%		1.4%	2.7%	3.7%	3.6%

4ii (sector allocation 2) Option 1b

Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003		0.2%	0.7%	5.0%	2.6%										
2004	1.7%	4.2%	1.4%	4.4%	4.6%		3.8%	1.0%		2.3%		2.9%			1.4%
2005		0.5%	1.3%	16.0%	7.6%		0.2%	1.2%	12.6%	6.0%			0.6%	9.1%	4.1%
2006		0.9%		13.0%	5.8%		0.4%		12.2%	5.2%				10.4%	4.3%
2007		0.1%	0.1%	1.8%	0.8%										
2008				0.3%	0.1%										
2009			0.2%	3.5%	1.7%				0.5%	0.2%					
2010			0.3%	1.4%	0.8%										
2011	3.0%	1.5%	3.1%	16.6%	9.6%		1.4%	3.0%	12.8%	7.6%		0.1%	2.3%	5.5%	3.5%

6 (sector allocation 3) Option 1b

Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			0.7%	6.8%	3.3%				1.9%	0.9%					
2004	0.4%	3.8%	1.2%	6.6%	5.2%		3.6%	0.7%	0.6%	2.3%		1.3%			0.6%
2005		0.5%	1.3%	17.7%	8.4%			1.1%	14.6%	6.7%				9.8%	4.2%
2006		0.8%		13.0%	5.8%		0.0%		12.2%	5.1%				12.2%	5.1%
2007			0.0%	3.0%	1.2%				0.3%	0.1%					
2008				2.0%	0.8%										
2009			0.2%	5.9%	2.6%				1.2%	0.5%					
2010				3.4%	1.4%										
2011	0.5%	1.5%	3.1%	16.6%	9.4%		1.4%	2.7%	15.5%	8.6%			1.6%	8.0%	4.2%

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

In percentage of B season gross revenue terms, the potential impacts to sectors other than the CV sector are realtively small in nearly all years under consideration. However, CDQ impacts are approximately 30 percent of B season gross revenue in 2003 and impacts to the CDQ and CP sectors exeed 13 percent and 14 percent, respectively, in 2004. When considering revenue at risk as a percent of annual total revenue the potential impacts appear to be considerably reduced in almost all years, allocation scenarios, and cap levels for all sectors other than the CV sector. Thus, it is not likely that the CDQ, CP, or Mothership sectors will have difficulty mitigating revenue at risk under Alternative 3, option 2a. The CV sector, in contrast, bears as much as 25 percent of its revenue being placed at risk in several of the years within this retrospective analysis and, therefore, would likely experience costs associated with effort relocation.

Table 6-16 Alternative 3, Option 2a: Estimated hypothetical nominal gross revenue at risk ($ millions) due to diverted fishing activities from historical fishing grounds by sector allocation (panels) and trigger cap levels for Option 2a, 2003-2011.

2ii (sector allocation 1) Option 2a															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	$15	$11	$6	$95	$127	$12	$6	$6	$33	$56	$6		$4		$11
2004	$7	$32	$5	$72	$116	$6	$32	$1	$53	$92	$1	$17		$30	$49
2005		$4	$5	$122	$131		$4	$2	$113	$119				$91	$91
2006		$4		$108	$112				$86	$86				$59	$59
2007	$1	$12		$52	$66	$1	$12			$13					
2008															
2009			$1	$17	$17										
2010															
2011	$10	$26	$26	$122	$184	$6	$26	$24	$67	$123		$21	$18		$39
4ii (sector allocation 2) Option 2a															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	$14	$6	$6	$95	$121	$6	$3	$6	$54	$69				$12	$12
2004	$6	$32	$4	$72	$114	$1	$26	$1	$53	$81		$9		$34	$43
2005		$4	$5	$127	$135			$2	$113	$115				$100	$100
2006				$108	$108				$90	$90				$72	$72
2007	$1	$12		$52	$66		$12		$39	$51					
2008															
2009			$1	$17	$17										
2010															
2011	$8	$26	$26	$122	$183		$26	$20	$92	$138			$16		$16
6 (sector allocation 3) Option 2a															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	$12	$6	$6	$99	$122	$1		$6	$78	$85				$25	$25
2004	$6	$32	$2	$72	$112		$12		$65	$76				$46	$46
2005			$5	$136	$141				$113	$113				$113	$113
2006				$108	$108				$99	$99				$86	$86
2007	$1	$12		$52	$66				$48	$48					
2008				$10	$10										
2009				$17	$17				$4	$4					
2010															
2011	$6	$26	$24	$135	$191		$21	$20	$104	$145			$11	$49	$60

Table 6-17 Alternative 3, Option 2a: Estimated hypothetical B season nominal gross revenue at risk, as a percent of B season total gross revenue, due to diverted fishing activities from historical fishing grounds by sector allocation (panels) and trigger cap levels, Option 2a, 2003-2011.

2ii (sector allocation 1) Option 2a															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	31.3%	5.2%	2.6%	38.1%	24.7%	24.7%	2.6%	2.6%	13.2%	10.9%	13.2%		1.9%		2.1%
2004	13.2%	14.4%	2.3%	32.0%	23.3%	11.5%	14.4%	0.3%	23.6%	18.4%	1.7%	7.9%		13.5%	9.8%
2005		1.3%	1.6%	44.8%	21.1%		1.3%	0.7%	41.5%	19.2%				33.2%	14.7%
2006		1.3%		40.3%	18.1%				31.9%	13.8%				21.8%	9.5%
2007	1.7%	4.0%		20.9%	10.5%	1.7%	4.0%			2.1%					
2008															
2009			0.3%	6.7%	3.2%										
2010															
2011	16.1%	6.7%	6.6%	34.7%	22.9%	9.2%	6.7%	6.3%	19.1%	15.4%		5.4%	4.5%		4.8%
4ii (sector allocation 2) Option 2a															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	29.7%	2.6%	2.6%	38.1%	23.4%	13.2%	1.3%	2.6%	21.5%	13.3%				5.0%	2.4%
2004	11.5%	14.4%	2.0%	32.0%	23.0%	1.7%	11.8%	0.3%	23.6%	16.3%		3.9%		15.2%	8.6%
2005		1.3%	1.6%	46.4%	21.9%			0.7%	41.5%	18.6%				36.5%	16.1%
2006				40.3%	17.5%				33.6%	14.5%				26.9%	11.6%
2007	1.7%	4.0%		20.9%	10.5%		4.0%		15.7%	8.2%					
2008															
2009			0.3%	6.7%	3.2%										
2010															
2011	13.8%	6.7%	6.6%	34.7%	22.7%		6.7%	5.2%	26.0%	17.2%			4.2%		2.0%
6 (sector allocation 3) Option 2a															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	24.7%	2.6%	2.6%	39.7%	23.7%	1.6%		2.6%	31.5%	16.5%				9.9%	4.8%
2004	11.5%	14.4%	1.0%	32.0%	22.6%		5.3%		28.7%	15.3%				20.2%	9.2%
2005			1.6%	49.8%	22.7%				41.5%	18.3%				41.5%	18.3%
2006				40.3%	17.5%				37.0%	16.0%				31.9%	13.8%
2007	1.7%	4.0%		20.9%	10.5%				19.2%	7.7%					
2008				3.4%	1.4%										
2009				6.7%	3.0%				1.7%	0.8%					
2010															
2011	9.2%	6.7%	6.3%	38.2%	23.7%		5.4%	5.2%	29.5%	18.1%			2.8%	13.9%	7.4%

Table 6-18 Alternative 3, Option 2a: Estimated hypothetical B season nominal gross revenue at risk, as a percent of total annual revenue, due to diverted fishing activities from historical fishing grounds by sector allocation (panels) and trigger cap levels, Option 2a, 2003-2011.

2il (sector allocation 1) Option 2a

Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	14.8%	2.4%	1.2%	20.8%	12.4%	11.7%	1.2%	1.2%	7.2%	5.5%	6.2%		0.9%		1.0%
2004	5.8%	6.2%	1.0%	16.2%	10.7%	5.1%	6.2%	0.1%	11.9%	8.5%	0.7%	3.4%		6.8%	4.5%
2005		0.6%	0.8%	22.9%	10.4%		0.6%	0.3%	21.2%	9.4%				16.9%	7.2%
2006		0.6%		20.9%	9.0%				16.6%	6.9%				11.3%	4.7%
2007	0.8%	2.0%		10.5%	5.3%	0.8%	2.0%			1.1%					
2008															
2009			0.2%	3.7%	1.7%										
2010															
2011	7.0%	4.0%	3.9%	20.0%	13.1%	4.0%	4.0%	3.7%	11.0%	8.8%		3.2%	2.7%		2.7%

4il (sector allocation 2) Option 2a

Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	14.0%	1.2%	1.2%	20.8%	11.8%	6.2%	0.6%	1.2%	11.8%	6.7%				2.7%	1.2%
2004	5.1%	6.2%	0.8%	16.2%	10.6%	0.7%	5.0%	0.1%	11.9%	7.5%		1.7%		7.7%	4.0%
2005		0.6%	0.8%	23.7%	10.7%			0.3%	21.2%	9.1%				18.6%	7.9%
2006				20.9%	8.7%				17.4%	7.2%				14.0%	5.8%
2007	0.8%	2.0%		10.5%	5.3%		2.0%		7.9%	4.1%					
2008															
2009			0.2%	3.7%	1.7%										
2010															
2011	6.0%	4.0%	3.9%	20.0%	13.0%		4.0%	3.1%	15.0%	9.8%			2.5%		1.2%

6 (sector allocation 3) Option 2a

Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003	11.7%	1.2%	1.2%	21.7%	11.9%	0.8%		1.2%	17.2%	8.3%				5.4%	2.4%
2004	5.1%	6.2%	0.4%	16.2%	10.4%		2.2%		14.5%	7.0%				10.2%	4.2%
2005			0.8%	25.4%	11.1%				21.2%	9.0%				21.2%	9.0%
2006				20.9%	8.7%				19.2%	8.0%				16.6%	6.9%
2007	0.8%	2.0%		10.5%	5.3%				9.6%	3.9%					
2008				1.8%	0.7%										
2009				3.7%	1.6%				0.9%	0.4%					
2010															
2011	4.0%	4.0%	3.7%	22.0%	13.5%		3.2%	3.1%	17.0%	10.3%			1.6%	8.0%	4.2%

The potential impact of Alternative 3, option 2b in the years with greatest revenue impacts under this alternative (2005, 2011) and under the most restrictive PSC cap of 50,000 non-Chinook salmon with allocation scenario 1 are estimated to be approximately $72 million and $65 million in 2005 and 2011, respectively. The 2005 gross value is composed of $63 million from the CV sector, $2 million from the CP sector, and $7 million from the Mothership sector. The 2011 gross value is composed of $54 million from the CV sector, $1 million from the CP sector, $9 million from the Mothership sector, and less than $1 million from CDQ pollock fisheries. Of note is that these impacts tend to incrase under allocation scenarios 2 and 3, with 2005 all fleet revenue at risk estimated to be $80 million.

Consistent with analysis of the preivious options, in percentage of B season gross revenue terms the potential impacts to sectors other than the CV sector are realtively small in nearly all years under consideration. When considering revenue at risk as a percent of annual total revenue the potential impacts appear to be considerably reduced in almost all years, allocation scenarios, and cap levels for all sectors other than the CV sector. Thus, it is not likely that the CDQ, CP, or Mothership sectors will have difficulty mitigating revenue at risk under Alternative 3, option 2a. The CV sector, in contrast, bears as much as 10 to 13 percent of its revenue being placed at risk in several of the years within this retrospective analysis.

Table 6-19 Alternative 3, Option 2b: Estimated hypothetical nominal gross revenue at risk ($ millions) due to diverted fishing activities from historical fishing grounds by sector allocation (panels) and trigger cap levels for Option 2b.

2ii (sector allocation 1) Option 2b

Cap:			25,000					75,000					200,000		
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003		$1	$3	$15	$19			$1		$1					
2004	$3	$15	$6	$7	$31	$1	$15	$4		$19		$15	$1		$16
2005		$2	$7	$63	$72		$2·	$7	$44	$52		$0	$6	$32	$39
2006		$3		$47	$50		$3		$47	$50				$27	$27
2007			$0	$3	$3			$0		$0					
2008															
2009		$0	$2	$11	$12				$2	$2					
2010			$4		$4										
2011	$0	$1	$9	$54	$65	$0	$1	$9	$34	$45		$1	$7	$9	$18

4ii (sector allocation 2) Option 2b

Cap:			25,000					75,000					200,000		
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			$3	$22	$25										
2004	$2	$15	$6	$19	$42		$15	$4		$19		$11			$11
2005		$2	$7	$63	$72		$0	$7	$46	$53			$3	$33	$37
2006		$3		$50	$54		$0		$47	$47				$37	$37
2007			$0	$5	$5										
2008				$1	$1										
2009			$1	$11	$12				$2	$2					
2010			$1	$5	$6										
2011	$0	$1	$9	$54	$65		$1	$9	$38	$48			$7	$10	$18

6 (sector allocation 3) Option 2b

Cap:			25,000					75,000					200,000		
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			$3	$29	$33				$9	$9					
2004	$1	$15	$5	$27	$47		$15	$3	$3	$21		$4			$4
2005		$2	$7	$72	$80			$6	$56	$63				$34	$34
2006		$3		$50	$54				$47	$47				$47	$47
2007			$0	$8	$8				$1	$1					
2008				$7	$7										
2009			$1	$21	$22				$3	$3					
2010				$10	$10										
2011	$0	$1	$9	$54	$65		$1	$7	$54	$63			$3	$22	$25

Table 6-20 Alternative 3, Option 2b: Estimated hypothetical B season nominal gross revenue at risk, as a percent of B season total gross revenue, due to diverted fishing activities from historical fishing grounds by sector allocation (panels) and trigger cap levels, Option 2b, 2003-2011.

Cap:	25,000					75,000					200,000				
2ii (sector allocation 1) Option 2b															
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003		0.3%	1.6%	6.2%	3.8%			0.4%		0.2%					
2004	5.7%	6.8%	2.7%	3.1%	6.2%	1.2%	6.7%	1.7%		3.9%		6.7%	0.6%		3.3%
2005		0.6%	2.3%	23.2%	11.6%		0.5%	2.3%	16.2%	8.5%		0.0%	2.2%	11.9%	6.3%
2006		1.2%		17.4%	8.1%		1.1%		17.4%	8.0%				10.0%	4.3%
2007			0.0%	1.2%	0.5%			0.0%		0.0%					
2008															
2009		0.0%	0.7%	4.3%	2.3%				0.6%	0.3%					
2010			1.5%		0.7%										
2011	0.7%	0.4%	2.3%	15.3%	8.0%	0.5%	0.4%	2.3%	9.7%	5.6%		0.3%	1.9%	2.6%	2.3%
4ii (sector allocation 2) Option 2b															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			1.6%	8.6%	4.8%										
2004	4.0%	6.8%	2.7%	8.5%	8.4%		6.7%	1.7%		3.7%		5.1%			2.3%
2005		0.6%	2.3%	23.2%	11.6%		0.0%	2.3%	16.8%	8.5%			1.2%	12.1%	5.9%
2006		1.1%		18.8%	8.6%		0.2%		17.4%	7.6%				13.8%	6.0%
2007			0.0%	2.0%	0.8%										
2008				0.4%	0.2%										
2009			0.4%	4.3%	2.1%				0.6%	0.3%					
2010			0.5%	2.0%	1.1%										
2011	0.6%	0.4%	2.3%	15.3%	8.0%		0.3%	2.3%	10.8%	6.0%			1.9%	2.9%	2.2%
6 (sector allocation 3) Option 2b															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			1.6%	11.8%	6.4%				3.5%	1.7%					
2004	1.2%	6.7%	2.2%	11.8%	9.5%		6.7%	1.5%	1.3%	4.2%		1.6%			0.7%
2005		0.5%	2.3%	26.2%	12.9%			2.2%	20.6%	10.1%				12.5%	5.5%
2006		1.1%		18.8%	8.6%				17.4%	7.5%				17.4%	7.5%
2007			0.0%	3.1%	1.3%				0.5%	0.2%					
2008				2.3%	0.9%										
2009			0.4%	8.3%	3.9%				1.0%	0.5%					
2010				4.1%	1.7%										
2011	0.5%	0.4%	2.3%	15.3%	8.0%		0.3%	1.9%	15.3%	7.8%			0.8%	6.3%	3.1%

Table 6-21 Alternative 3, Option 2b: Estimated hypothetical B season nominal gross revenue at risk, as a percent of total annual revenue, due to diverted fishing activities from historical fishing grounds by sector allocation (panels) and trigger cap levels, Option 2b, 2003-2011.

2ii (sector allocation 1) Option 2b															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003		0.1%	0.7%	3.4%	1.9%			0.2%		0.1%					
2004	2.5%	2.9%	1.1%	1.6%	2.8%	0.5%	2.9%	0.7%		1.8%		2.9%	0.3%		1.5%
2005		0.3%	1.1%	11.8%	5.7%		0.3%	1.1%	8.2%	4.1%		0.0%	1.0%	6.1%	3.1%
2006		0.6%		9.0%	4.0%		0.5%		9.0%	4.0%				5.2%	2.2%
2007			0.0%	0.6%	0.2%			0.0%		0.0%					
2008															
2009		0.0%	0.4%	2.4%	1.2%				0.4%	0.2%					
2010			0.8%		0.4%										
2011	0.3%	0.2%	1.3%	8.8%	4.6%	0.2%	0.2%	1.3%	5.6%	3.2%		0.2%	1.1%	1.5%	1.3%
4ii (sector allocation 2) Option 2b															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			0.7%	4.7%	2.4%										
2004	1.7%	2.9%	1.1%	4.3%	3.9%		2.9%	0.7%		1.7%		2.2%			1.0%
2005		0.3%	1.1%	11.8%	5.7%		0.0%	1.1%	8.6%	4.2%			0.6%	6.2%	2.9%
2006		0.5%		9.8%	4.3%		0.1%		9.0%	3.8%				7.2%	3.0%
2007			0.0%	1.0%	0.4%										
2008				0.2%	0.1%										
2009			0.2%	2.4%	1.1%				0.4%	0.2%					
2010			0.3%	1.1%	0.6%										
2011	0.2%	0.2%	1.3%	8.8%	4.6%		0.2%	1.3%	6.2%	3.4%			1.1%	1.7%	1.3%
6 (sector allocation 3) Option 2b															
Cap:	25,000					75,000					200,000				
	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet	CDQ	CP	M	CV	All fleet
2003			0.7%	6.5%	3.2%				1.9%	0.8%					
2004	0.5%	2.9%	0.9%	6.0%	4.3%		2.9%	0.6%	0.6%	1.9%		0.7%			0.3%
2005		0.3%	1.1%	13.4%	6.3%			1.0%	10.5%	5.0%				6.4%	2.7%
2006		0.5%		9.8%	4.3%				9.0%	3.7%				9.0%	3.7%
2007			0.0%	1.6%	0.6%				0.3%	0.1%					
2008				1.2%	0.5%										
2009			0.2%	4.7%	2.1%				0.6%	0.3%					
2010				2.3%	1.0%										
2011	0.2%	0.2%	1.3%	8.8%	4.6%		0.2%	1.1%	8.8%	4.5%			0.4%	3.6%	1.8%

6.8 Implications of Sector Transfers and Rollovers

Alternative 2 contains provisions for transfers and rollovers via component 3, while Alternative 3 provides for transfers and rollovers in component 5. These options would only apply if the sector level PSC caps under Component 2 and the inshore CV sector level cap is further allocated among the inshore cooperatives and the inshore open access fishery (if the inshore open access fishery existed in a particular year) under Component 4. Option 1 or Option 2 or both could be selected.

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

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

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

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

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

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

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

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

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

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

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

As noted in methods, the analysis assumes between cooperative transferability. Between sector transferability is evaluated here for Alternative 2, option 1a for illustrative purposes. This option assumes "perfect" transferability in that sectors would exchange allocated chum salmon PSC freely. By year, comparing with and without transferability shows that adding transferability generally increases the amount of forgone pollock and reduces the effectiveness of saving chum salmon. (Table 5-80).

The fundamental purpose of allowing transfers and rollovers of PSC cap amounts that remain unharvested is to allow other sectors that may have attained their PSC caps to utilize remaining PSC cap amounts, under the aggregate cap, to harvest either all, or a portion of the remainder of their pollock allocation. In this way, transferability and rollovers of unused PSC caps are intended to maximize the economic yield from the pollock resouces while meeting the aggregate cap level deemed practicable by the Council. Clearly, increasing pollock harvest has economic benefits, in terms of revenue, to pollock harvesters while at the same time potentially reducing salmon savings that may occur if a sector hits its allocation of a cap and must stop fishing, either altogether (Alt. 2) or in a specific area (Alt. 3) and has no option to obtain (transfer) or receive (rollover) additional PSC allowances. The level of the salmon savings that may be deemed practicable with rollovers and tranfers can be set using the suboption which limit transfers and rollovers to either 50 percent, 70 percent, or 90 percent of available PSC cap.

Actual transferability options would be initially from sector specific allocations (the analysis above was as if there were no sector allocations) and then in a given year, a "clean" sector could transfer their chum salmon PSC to a sector that requires more. Logically this poses challenges for analysis because the conditions for a transfer would have to be that the "clean" sector would know in advance that they have salmon to transfer to a sector needing more PSC salmon to extend their pollock fishing. Alternatively the clean sector could finish their pollock fishing earlier than the sector needing more PSC salmon and transfer at that time. Simulating either condition would require apriori knowledge about the interaction between sectors which are unknown. Additionally, such a system will add complexity to management and enforcement, and will obviously result in higher salmon PSC (within a cap) and less foregone pollock.

To provide some evaluation of this option one scenario to for Alternative 2, option 1a) with a cap of 50,000 and sector allocation 6. In 2005 had this scenario been in place all sectors would have come up against their cap so there would be no transfers (with motherships and shorebased CV sectors hitting their cap on the 2nd and 4th of July, respectively). In 2006, shorebased boats would have hit their cap on June 14th, and remarkably all other sectors stay below their cap. Assuming somehow that the other sectors would know how much salmon they would catch at the end of the year, then the difference between the remaining salmon and the sum of their caps is 7,645 chum. That amount would not be enough for the shorebased sector to fish even one more day (their initial allocation is 22,385 salmon; on June 13th they went from 13,838 salmon to 30,390). In summary, the idea of transfers would be beneficial in principle; however, "what ifs" evaluations from historical data are limited to illustrate performance benefits.

Table 6-22 showing the pollock foregone by year and sector between the Alternative 2 1a) without transferability (default) and with transferability A subset of estimated sum of chum salmon saved (AEQ) by region and year under 3 different allocation schemes and hard caps for Alternative 2, component 2 **option 1a)**, 2004-2011 with and without transferabilit. The shaded column represents the sum of annual estimated AEQ impact that occurred due to pollock fishing whereas the other values represent the amount (in numbers of fish) that would have been saved had the measures been in place.

		Sector							
		CDQ Transferability?		CP Transferability?		M Transferability?		S Transferability?	
Cap	Year	No	Yes	No	Yes	No	Yes	No	Yes
	2003	33,787	61,451	32,926	67,320	28,469	42,436	220,230	191,720
	2004	51,765	77,704	289,711	132,913	50,902	51,002	204,602	231,894
	2005	22,469	65,580	127,176	246,828	68,474	58,303	303,437	298,886
	2006		89,774	93,943	295,256		74,320	360,034	338,987
50,000	2007	15,434	13,128	82,889	71,579	22,808	22,092	103,343	103,475
	2008								
	2009							13,558	
	2010								
	2011	2,323	43,597	151,590	186,988	60,464	51,428	215,455	209,896
	2003							28,381	
	2004		36,085	132,913	10,724	458	24,342	95,021	95,021
	2005		46,176	65,017	203,020	12,128	43,124	264,732	245,510
	2006		30,693		171,807		36,076	290,957	223,714
200,000	2007								
	2008								
	2009								
	2010								
	2011					27,827			
	2003								
	2004		21,477		3,336		20,322	67,238	57,316
	2005		34,094		156,000		32,341	238,356	196,470
	2006							201,854	
353,000	2007								
	2008								
	2009								
	2010								
	2011					7,574			

6.9 Implications of Sector and Cooperative level Quota Share Allocation of PSC Caps

Under Alternative 2, if non-Chinook salmon PSC is allocated among the sectors, and an allocation is made to the inshore sector then the cooperative provisions could allow further allocation of transferable or non-transferable salmon PSC allocations to the inshore cooperatives. Each inshore cooperative and the inshore limited access fishery (if the inshore limited access fishery existed in a particular year) would receive a salmon allocation managed at the cooperative level. If the cooperative or limited access fishery salmon cap is reached, the cooperative or limited access fishery must stop fishing for pollock. The initial allocation of salmon by cooperative within the inshore CV fleet or to the limited access fishery would be based upon the proportion of total sector pollock catch associated with the vessels in the cooperative or limited access fishery (see EA Chapter 2).

Also under Alternative 2 are options to allow transfers among inshore cooperatives, provided that sector allocations are made and further allocated among the inshore cooperatives and the inshore limited access fishery (if the inshore limited access fishery existed in a particular year). These provisions would allow intercooperative leases of non-Chinook salmon PSC allocations or industry initiated transfers with the suboptions of 50 percent, 70 percent and 90 percent as defined for sector transfers. Under these options, when a salmon cooperative cap is reached, the cooperative must stop fishing for pollock and may lease additional non-Chinook salmon PSC allocation or arrange a voluntary transfer from another inshore cooperative. These provisions would provide additional opportunity for the inshore cooperatives to mitigate effects of non-Chinook salmon PSC caps in essentially the same way that transfers provide that opportunity at the overall sector level.

Cooperative provisions under a binding hard cap have the potential to mitigate some of the potential for an induced race for fish, at least among the inshore cooperatives. Allocation of PSC to the cooperative level converts the allocation by sector into smaller allocations at the inshore cooperative level. Each inshore cooperative would then have to manage the operations of its members to stay under their specific cap, or stop fishing. As such, there are clear economic incentives to avoid PSC. At the larger sector level, those economic incentives are somewhat diminished as higher capacity operators may see an advantage in catching their pollock allocation quickly, with little regard for non-Chinook salmon PSC so long as the sector level PSC allocation is not exceeded. In such circumstances, the smallest or least capable catcher vessels may be adversely affected by the actions of the larger, more capable, vessels (i.e., the incentives to reopen the "race-for-fish," at least at the sector level. This reality, in turn, could affect the formation and membership of the inshore cooperatives themselves, resulting in "capital stuffing" within cooperatives. It is not clear at present to what extent this might become a reality; however, allocation at the inshore cooperative level may mitigate some of the risk associated with the implications of a sector level race for fish for the CV sector.

As the Council's Scientific and Statistical Committee (SSC) correctly observed (October 2008), there is a fundamental difference between a target or retainable incidental catch "*allocation*," on the one hand, and a PSC limit "*allowance*," on the other. They state, in relevant part, "*The former imparts a harvest 'use privilege', while the latter must be regarded as a "prohibition" against harvest (to the maximum extent practicable), with an absolute cap. No "use privilege" is implied by a PSC .... Instead, every practicable effort is required to be made to avoid use of this PSC, and if avoidance is not possible, to minimize its occurrence.*" In the former case, the allocation establishes a use-privilege and provides for conversion of the non-target catch to private ownership. In the case of a PSC allowance, no use-privilege authorizing removal of a specific amount of resource is conveyed and conversion of PSC to private ownership is strictly prohibited. These are crucial differences that should not be lost sight of. Indeed, this is so critical a distinction that it has been enshrined as National Standard 9 of the Magnuson-Stevens Act:

> (9) Conservation and management measures shall, to the extent practicable, (A) minimize PSC and (B) to the extent PSC cannot be avoided, minimize the mortality of such PSC.

This view of PSC limits appears to conflict with proposals that envision transfer, trading, or rolling-over of residual non-Chinook PSC amounts, between AFA pollock entities or sectors. This is so, because a "sector transfer provision" conceptually suggests that, once a PSC hard cap level is chosen, it may be acceptable for non-Chinook salmon PSC to *achieve* that level of removal. If that interpretation is adopted, then it may also be acceptable to allow sectors that do not remove all of their non-Chinook salmon PSC allowance to transfer it to other sectors, in order to facilitate continued exploitation of the available pollock resource. Redistributing residual non-Chinook salmon PSC, would, it is asserted, mitigate some portion of the forgone pollock revenues attributable to excessive PSC of non-Chinook salmon by one or another AFA element. This interpretation of what the non-Chinook salmon PSC cap constitutes seemingly reverses the SSC's referenced concept of PSC apportionment. That is, the language of Alternative 2, Component 3, option 1 would, in effect, establish non-Chinook PSC amounts as tradable incidental catch "*allocation*," with commercially negotiable use-privileges to removal (although not conversion to private ownership) of a specific quantity of non-Chinook salmon. This clearly changes the relationship of non-Chinook salmon PSC within the pollock industry, making it just another economic input to production that can be traded, sold, bartered, or withheld in the competitive prosecution of the Bering Sea pollock fishery.

Alternatively, it may be preferable to define a hard cap amount as an upper bound on non-Chinook salmon PSC with the intent to promote actions that minimize non-Chinook salmon PSC under that cap. Such an action might be deemed appropriate in order to promote greater non-Chinook salmon conservation, than afforded under full transferability, up to the overall cap, while still affording some opportunity mitigate impact to the pollock fleet. Under Alternative 2, the suboption to Option 1 of Component 3 provides an opportunity for such measures. The suboption would limit transfers to a) 50 percent, b) 70 percent or c) 90 percent of the non-Chinook salmon that is available to the transferring entity at the time of transfer. Clearly, more non-Chinook salmon would be conserved with the 50 percent transferability than with 70 percent or 90 percent, although far fewer than without transferable allocations, and the reverse is true of mitigation of adverse impacts on pollock fleet gross revenue. Unlike Alternative 2, Alternative 4 does not contain a provision to limit the amount an allocation that can be transferred.

Interestingly, if no transfer provision were recommended under Alternative 2, the CDQ non-Chinook salmon sector level cap would continue to be managed as it is under status quo, with further allocation of the CDQ cap among the six CDQ groups, transferable allocations within the CDQ Program, and a prohibition against a CDQ group exceeding its non-Chinook salmon PSC allocation. In other words, the CDQ groups already have transferable non-Chinook salmon PSC caps and would continue to enjoy that flexibility in the absence of inclusion of transferability options for all sectors.

An important distinction should be made between voluntary transfers and rollovers. Voluntary transfers are industry initiated and fully voluntary. Meaning, the entity that represents a sector that has unused non-Chinook salmon PSC must request the transfer. If that entity does not feel compelled to make a voluntary transfer, or an entity cannot be created or cannot reach consensus among members to make the transfer, then some non-Chinook salmon PSC allocation could be unused and, potentially, some pollock that could otherwise have been harvested if the transfer hade been made would remain unharvested. In contrast, a rollover managed by NMFS is a somewhat automatic reapportionment that is not voluntary and, thus, does not suffer from the risks associated with voluntary transfers.

While this discussion has used terminology more appropriate to hard caps, it is also applicable to the triggered closures of Alternative 3, but in a slightly different way. Under the triggered closure, NMFS would not issue fishery closures once the trigger cap was reached for each sector. Rather, the trigger closures would be managed similar to current management of the trigger closures under the CDQ Program. Each sector would receive a transferable trigger cap allocation, and vessels participating in that sector would be prohibited from fishing inside an area after the sector's trigger cap is reached.

6.10 Managing and Monitoring the Alternatives

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

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

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

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

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

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

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

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

6.11 Assessment of Potential Impact of the Alternatives on Shoreside Value Added Processing

This assessment provides a breakout of the shoreside processing sector revenue (processing value added) by port group. **It is important to recognize that the dollar values in this assessment must not be**

added to the estimated effects on potentially forgone first wholesale gross revenue provided in the RIR for the aggregated shoreside (S) sector. The potential impact values shown here are a subset of the values provided in the RIR and are intended to highlight the potential effects on value added processing by port group.

Confidentiality of data regulations necessitates the creation of two port groups. The two port groups that have been created are the Akutan and Dutch Harbor (AKU/DUT) group, and the "All Others" group. The AKU/DUT group denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors. The All Others group includes King Cove, Kodiak, Sand Point, and several floating processors. These combinations account for all shoreside processing of Bering Sea pollock.

Shown in the tables below are the breakout of ex-vessel and shoreside processing values, as well as their total, and the percent each group-season-year- category represents of the annual total value. These percentages are used to estimate the potential effects on each port group, in each year and season, by multiplying that percentage by estimated effects on the shoreside sector. This method "allocates" effects on each group-season-year, relative to their observed proportion of total first wholesale value. Thus, this is not an accounting of actual effects, but rather is a proportionality-based estimate of where the potential effects may accrue. This has been done, at least in part, to enhance the presentation of economic impact information, while maintaining confidentiality constraints.

Table 6-23 Bering Sea pollock nominal ex-vessel value by season and port group ($millions), 2003-2011.

Season	Port Group	2003	2004	2005	2006	2007	2008	2009	2010	2011
A Season	AKU/DUT	$68	$73	$85	$85	$78	$90	$59	$48	$62
	Others	$4	$5	$7	$6	$6	$5	$3	$3	$4
	Total	**$72**	**$78**	**$91**	**$91**	**$84**	**$95**	**$62**	**$51**	**$66**
B season	AKU/DUT	$82	$75	$88	$92	$78	$99	$75	$64	$94
	Others	$5	$6	$7	$7	$6	$6	$3	$3	$5
	Total	**$87**	**$80**	**$95**	**$98**	**$84**	**$105**	**$78**	**$67**	**$99**
	Grand Total	**$158**	**$159**	**$186**	**$190**	**$168**	**$200**	**$140**	**$118**	**$165**

Sources: Terry Hiatt: Alaska Fisheries Science Center, from data compiled for the Economic Status and Fishery Evaluation Report, 2007.

Table 6-24 Bering Sea pollock shoreside processing nominal value added by season and port group ($millions), 2003-2011.

Season	Port Group	2003	2004	2005	2006	2007	2008	2009	2010	2011
A Season	AKU/DUT	$132	$141	$167	$154	$160	$160	$133	$138	$192
	Others	$3	$2	$4	$4	$4	$2	$2	$0	$1
	Total	**$135**	**$142**	**$171**	**$157**	**$165**	**$161**	**$135**	**$138**	**$193**
B season	AKU/DUT	$160	$144	$175	$166	$161	$176	$168	$181	$253
	Others	$3	$2	$4	$4	$5	$2	$3	$1	$1
	Total	**$163**	**$145**	**$179**	**$169**	**$166**	**$178**	**$171**	**$182**	**$254**
	Grand Total	**$297**	**$288**	**$350**	**$326**	**$330**	**$340**	**$306**	**$320**	**$447**

Sources: Terry Hiatt: Alaska Fisheries Science Center, from data compiled for the Economic Status and Fishery Evaluation Report, 2007.

Table 6-25 Bering Sea pollock total shoreside sector nominal value (ex-vessel value plus shoreside processing value added ($millions)) by season and port group, 2003-2011

Season	Port Group	2003	2004	2005	2006	2007	2008	2009	2010	2011
A Season	AKU/DUT	$200	$214	$252	$239	$238	$249	$192	$186	$255
	Others	$7	$7	$10	$10	$10	$7	$5	$3	$4
	Total	**$206**	**$221**	**$262**	**$248**	**$249**	**$256**	**$197**	**$189**	**$259**
B season	AKU/DUT	$241	$218	$263	$257	$239	$275	$243	$245	$347
	Others	$8	$7	$11	$10	$10	$8	$6	$4	$6
	Total	**$249**	**$225**	**$274**	**$268**	**$250**	**$283**	**$249**	**$249**	**$353**
	Grand Total	**$456**	**$446**	**$536**	**$516**	**$498**	**$539**	**$446**	**$438**	**$612**

Sources: Terry Hiatt: Alaska Fisheries Science Center, from data compiled for the Economic Status and Fishery Evaluation Report, 2007.

Table 6-26 B Season Bering Sea pollock processing nominal value, by port group, as a percent of total B season first wholesale gross revenue, 2003-2011.

Port Group	Season	2003	2004	2005	2006	2007	2008	2009	2010	2011
AKU/DUT	B	96.8%	96.8%	96.1%	96.1%	95.9%	97.3%	97.6%	98.4%	98.4%
All Others	B	3.2%	3.2%	3.9%	3.9%	4.1%	2.7%	2.4%	1.6%	1.6%

Sources: Terry Hiatt: Alaska Fisheries Science Center, from data compiled for the Economic Status and Fishery Evaluation Report, 2007.

As shown in Table 6-27 through
Table 6-29, the effect of hard cap allocation scenarios and cap levels on shoreside value added in dollars, percent of B season total gross revenue, and in percent of annual total gross revenue, repectively. The estimates are provided for the port groupings of Akutan/Dutch Harbor and for all others combined. Recall that these values are a subset of the shoreside total potential forgone pollock revenue from the CV sector. In the worst cases, potentially forgone shoreside value added revenue exceeds $161 million, or approximately 97 percent of B season total gross revenue and approximately 48 percent of total annual goross revenue. The vast majority of the potential impact is attributable to the Akutan and Dutch Harbor area. As these numbers are a subset of the CV impact numbers presented previously under the impact anlsysis of Alternative 2, they vary similarly with decreasing impact as the cap is increased, but greater effect on the CV, and thus shoreside, sector under allocation scenario 3.

Table 6-27 Hypothetical potentially forgone ex-vessel nominal revenue and shoreside nominal value added pollock first wholesale revenue by year, season, and aggregated port group under Alternative 2, Option 1a ($ Millions) 2003-2011.

2II (sector allocation 1)

Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$40.48	$78.97	$2.43	$1.54	2003					2003				
2004	$39.38	$75.91	$2.92	$0.86	2004	$17.66	$34.05	$1.31	$0.39	2004	$7.16	$13.80	$0.53	$0.16
2005	$67.47	$133.62	$5.19	$3.03	2005	$57.60	$114.09	$4.43	$2.59	2005	$45.31	$89.74	$3.49	$2.04
2006	$86.21	$155.54	$6.17	$3.57	2006	$57.54	$103.82	$4.12	$2.38	2006				
2007	$19.32	$39.75	$1.44	$1.11	2007					2007				
2008					2008					2008				
2009					2009					2009				
2010					2010					2010				
2011	$59.15	$159.19	$3.03	$0.55	2011					2011				

4II (sector allocation 2)

Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$45.72	$89.19	$2.75	$1.74	2003	$5.89	$11.49	$0.35	$0.22	2003				
2004	$40.33	$77.73	$2.99	$0.88	2004	$18.73	$36.10	$1.39	$0.41	2004	$13.25	$25.55	$0.98	$0.29
2005	$68.49	$135.66	$5.27	$3.08	2005	$59.76	$118.35	$4.60	$2.69	2005	$53.80	$106.56	$4.14	$2.42
2006	$86.21	$155.54	$6.17	$3.57	2006	$69.67	$125.70	$4.99	$2.89	2006	$48.34	$87.20	$3.46	$2.00
2007	$24.72	$50.86	$1.84	$1.42	2007					2007				
2008					2008					2008				
2009	$4.86	$10.88	$0.21	$0.17	2009					2009				
2010					2010					2010				
2011	$67.63	$182.02	$3.47	$0.63	2011					2011				

6 (sector allocation 3)

Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$51.60	$100.67	$3.10	$1.97	2003	$14.41	$28.12	$0.87	$0.55	2003				
2004	$44.59	$85.95	$3.30	$0.98	2004	$30.08	$57.98	$2.23	$0.66	2004	$17.66	$34.05	$1.31	$0.39
2005	$72.43	$143.46	$5.58	$3.26	2005	$65.83	$130.38	$5.07	$2.96	2005	$57.69	$114.27	$4.44	$2.59
2006	$89.47	$161.41	$6.40	$3.71	2006	$78.64	$141.88	$5.63	$3.26	2006	$58.36	$105.29	$4.18	$2.42
2007	$28.64	$58.92	$2.13	$1.65	2007					2007				
2008					2008					2008				
2009	$23.17	$51.88	$1.01	$0.82	2009					2009				
2010					2010					2010				
2011	$76.15	$204.95	$3.90	$0.71	2011	$19.25	$51.82	$0.99	$0.18	2011				

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.

All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-28 Hypothetical potentially forgone ex-vessel nominal revenue and shoreside nominal value added pollock first wholesale processing revenue by year, season, and aggregated port group under Alternative 2, Option 1a, in percent of B season sector revenue, 2003-2011.

2ii (sector allocation 1)

Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	46.7%	48.6%	2.8%	0.9%	2003					2003				
2004	49.2%	52.2%	3.6%	0.6%	2004	22.1%	23.4%	1.6%	0.3%	2004	8.9%	9.5%	0.7%	0.1%
2005	71.1%	74.8%	5.5%	1.7%	2005	60.7%	63.9%	4.7%	1.5%	2005	47.7%	50.2%	3.7%	1.1%
2006	87.6%	91.8%	6.3%	2.1%	2006	58.5%	61.3%	4.2%	1.4%	2006				
2007	23.0%	24.0%	1.7%	0.7%	2007					2007				
2008					2008					2008				
2009					2009					2009				
2010					2010					2010				
2011	59.9%	62.7%	3.1%	0.2%	2011					2011				

4ii (sector allocation 2)

Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	52.7%	54.8%	3.2%	1.1%	2003	6.8%	7.1%	0.4%	0.1%	2003				
2004	50.4%	53.5%	3.7%	0.6%	2004	23.4%	24.8%	1.7%	0.3%	2004	16.6%	17.6%	1.2%	0.2%
2005	72.1%	76.0%	5.6%	1.7%	2005	62.9%	66.3%	4.8%	1.5%	2005	56.7%	59.7%	4.4%	1.4%
2006	87.6%	91.8%	6.3%	2.1%	2006	70.8%	74.2%	5.1%	1.7%	2006	49.1%	51.5%	3.5%	1.2%
2007	29.4%	30.7%	2.2%	0.9%	2007					2007				
2008					2008					2008				
2009	6.2%	6.4%	0.3%	0.1%	2009					2009				
2010					2010					2010				
2011	68.5%	71.7%	3.5%	0.2%	2011					2011				

6 (sector allocation 3)

Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	59.5%	61.9%	3.6%	1.2%	2003	16.6%	17.3%	1.0%	0.3%	2003				
2004	55.7%	59.1%	4.1%	0.7%	2004	37.6%	39.9%	2.8%	0.5%	2004	22.1%	23.4%	1.6%	0.3%
2005	76.3%	80.3%	5.9%	1.8%	2005	69.3%	73.0%	5.3%	1.7%	2005	60.8%	64.0%	4.7%	1.5%
2006	90.8%	95.2%	6.5%	2.2%	2006	79.8%	83.6%	5.7%	1.9%	2006	59.3%	62.1%	4.2%	1.4%
2007	34.0%	35.6%	2.5%	1.0%	2007					2007				
2008					2008					2008				
2009	29.6%	30.4%	1.3%	0.5%	2009					2009				
2010					2010					2010				
2011	77.1%	80.8%	4.0%	0.3%	2011	19.5%	20.4%	1.0%	0.1%	2011				

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.

All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-29 Hypothetical potentially forgone ex-vessel nominal revenue and shoreside nominal value added pollock first wholesale processing revenue by year, season, and aggregated port group under Alternative 2, Option 1a, in percent of total annual sector revenue, 2003-2011.\

2ii (sector allocation 1)														
Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	25.5%	26.6%	0.8%	0.5%	2003					2003				
2004	24.8%	26.4%	1.0%	0.3%	2004	11.1%	11.8%	0.8%	0.1%	2004	4.5%	4.8%	0.3%	0.1%
2005	36.3%	38.2%	1.5%	0.9%	2005	31.0%	32.6%	2.4%	0.7%	2005	24.4%	25.6%	1.9%	0.6%
2006	45.4%	47.6%	1.9%	1.1%	2006	30.3%	31.8%	2.2%	0.7%	2006				
2007	11.5%	12.0%	0.4%	0.3%	2007					2007				
2008					2008					2008				
2009					2009					2009				
2010					2010					2010				
2011	35.9%	35.6%	0.7%	0.1%	2011					2011				
4ii (sector allocation 2)														
Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	28.9%	30.0%	1.7%	0.6%	2003	3.7%	3.9%	0.2%	0.1%	2003				
2004	25.4%	27.0%	1.9%	0.3%	2004	11.8%	12.5%	0.9%	0.1%	2004	8.4%	8.9%	0.6%	0.1%
2005	36.8%	38.8%	2.8%	0.9%	2005	32.1%	33.8%	2.5%	0.8%	2005	28.9%	30.5%	2.2%	0.7%
2006	45.4%	47.6%	3.3%	1.1%	2006	36.7%	38.5%	2.6%	0.9%	2006	25.5%	26.7%	1.8%	0.6%
2007	14.7%	15.4%	1.1%	0.4%	2007					2007				
2008					2008					2008				
2009	3.5%	3.6%	0.2%	0.1%	2009					2009				
2010					2010					2010				
2011	41.0%	40.8%	2.1%	0.1%	2011					2011				
6 (sector allocation 3)														
Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	32.6%	33.9%	2.0%	0.7%	2003	9.1%	9.5%	0.5%	0.2%	2003				
2004	28.1%	29.9%	2.1%	0.3%	2004	19.0%	20.2%	1.4%	0.2%	2004	11.1%	11.8%	0.8%	0.1%
2005	38.9%	41.0%	3.0%	0.9%	2005	35.4%	37.3%	2.7%	0.8%	2005	31.0%	32.7%	2.4%	0.7%
2006	47.1%	49.4%	3.4%	1.1%	2006	41.4%	43.4%	3.0%	1.0%	2006	30.7%	32.2%	2.2%	0.7%
2007	17.1%	17.8%	1.3%	0.5%	2007					2007				
2008					2008					2008				
2009	16.5%	17.0%	0.7%	0.3%	2009					2009				
2010					2010					2010				
2011	46.2%	45.9%	2.4%	0.2%	2011	11.7%	11.6%	0.6%	0.0%	2011				

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.

All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-30 Hypothetical potentially forgone ex-vessel nominal revenue and shoreside nominal value added pollock first wholesale revenue by year, season, and aggregated port group under Alternative 2, Option 1b ($ Millions) 2003-2011.

2ii (sector allocation 1)

Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$40.48	$78.97	$2.43	$1.54	2003					2003				
2004					2004					2004				
2005	$26.73	$52.94	$2.06	$1.20	2005	$18.87	$37.38	$1.45	$0.85	2005	$17.47	$34.59	$1.34	$0.79
2006	$35.85	$64.68	$2.57	$1.49	2006	$27.57	$49.73	$1.97	$1.14	2006	$25.04	$45.17	$1.79	$1.04
2007					2007					2007				
2008					2008					2008				
2009	$1.34	$3.01	$0.06	$0.05	2009					2009				
2010					2010					2010				
2011	$43.35	$116.67	$2.22	$0.40	2011	$12.86	$34.60	$0.66	$0.12	2011				

4ii (sector allocation 2)

Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$4.90	$9.56	$0.29	$0.19	2003					2003				
2004	$1.11	$2.15	$0.08	$0.02	2004					2004				
2005	$30.11	$59.64	$2.32	$1.35	2005	$19.10	$37.83	$1.47	$0.86	2005	$17.47	$34.59	$1.34	$0.79
2006	$35.85	$64.68	$2.57	$1.49	2006	$32.60	$58.82	$2.33	$1.35	2006	$25.04	$45.17	$1.79	$1.04
2007	$1.81	$3.72	$0.13	$0.10	2007					2007				
2008					2008					2008				
2009	$8.09	$18.11	$0.35	$0.29	2009					2009				
2010					2010					2010				
2011	$86.86	$233.77	$4.45	$0.81	2011	$60.18	$161.98	$3.09	$0.56	2011	$31.71	$85.35	$1.63	$0.30

6 (sector allocation 3)

Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$10.32	$20.14	$0.62	$0.39	2003					2003				
2004	$3.57	$6.87	$0.26	$0.08	2004					2004				
2005	$32.46	$64.29	$2.50	$1.46	2005	$21.80	$43.18	$1.68	$0.98	2005	$18.87	$37.38	$1.45	$0.85
2006	$35.85	$64.68	$2.57	$1.49	2006	$35.85	$64.68	$2.57	$1.49	2006	$27.57	$49.73	$1.97	$1.14
2007	$5.50	$11.32	$0.41	$0.32	2007					2007				
2008					2008					2008				
2009	$20.08	$44.96	$0.88	$0.71	2009					2009				
2010					2010					2010				
2011	$88.67	$238.65	$4.55	$0.83	2011	$70.16	$188.84	$3.60	$0.65	2011	$54.36	$146.29	$2.79	$0.51

Table 6-31 Hypothetical potentially forgone ex-vessel nominal revenue and shoreside value added pollock first wholesale revenue by year, season, and aggregated port group under Alternative 2, Option 1b, in percent of B season sector revenue, 2003-2011.

2ii (sector allocation 1)												
Cap:	50,000				200,000				353,000			
	AKU/DUT		All Others		AKU/DUT		All Others		AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	CV-ExV	SVA	CV-ExV	SVA	CV-ExV	SVA	CV-ExV	SVA
2003	46.7%	48.6%	2.8%	0.9%								
2004												
2005	28.2%	29.6%	2.2%	0.7%	19.9%	20.9%	1.5%	0.5%	18.4%	19.4%	1.4%	0.4%
2006	36.4%	38.2%	2.6%	0.9%	28.0%	29.4%	2.0%	0.7%	25.5%	26.7%	1.8%	0.6%
2007												
2008												
2009	1.7%	1.8%	0.1%	0.0%								
2010												
2011	43.9%	46.0%	2.3%	0.2%	13.0%	13.6%	0.7%	0.0%				
4ii (sector allocation 2)												
Cap:	50,000				200,000				353,000			
	AKU/DUT		All Others		AKU/DUT		All Others		AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	CV-ExV	SVA	CV-ExV	SVA	CV-ExV	SVA	CV-ExV	SVA
2003	5.7%	5.9%	0.3%	0.1%								
2004	1.4%	1.5%	0.1%	0.0%								
2005	31.7%	33.4%	2.4%	0.8%	20.1%	21.2%	1.5%	0.5%	18.4%	19.4%	1.4%	0.4%
2006	36.4%	38.2%	2.6%	0.9%	33.1%	34.7%	2.4%	0.8%	25.5%	26.7%	1.8%	0.6%
2007	2.1%	2.2%	0.2%	0.1%								
2008												
2009	10.3%	10.6%	0.5%	0.2%								
2010												
2011	87.9%	92.1%	4.5%	0.3%	60.9%	63.8%	3.1%	0.2%	32.1%	33.6%	1.6%	0.1%
6 (sector allocation 3)												
Cap:	50,000				200,000				353,000			
	AKU/DUT		All Others		AKU/DUT		All Others		AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	CV-ExV	SVA	CV-ExV	SVA	CV-ExV	SVA	CV-ExV	SVA
2003	11.9%	12.4%	0.7%	0.2%								
2004	4.5%	4.7%	0.3%	0.1%								
2005	34.2%	36.0%	2.6%	0.8%	23.0%	24.2%	1.8%	0.5%	19.9%	20.9%	1.5%	0.5%
2006	36.4%	38.2%	2.6%	0.9%	36.4%	38.2%	2.6%	0.9%	28.0%	29.4%	2.0%	0.7%
2007	6.5%	6.8%	0.5%	0.2%								
2008												
2009	25.6%	26.3%	1.1%	0.4%								
2010												
2011	89.8%	94.1%	4.6%	0.3%	71.0%	74.4%	3.6%	0.3%	55.0%	57.7%	2.8%	0.2%

Table 6-32 Hypothetical potentially forgone ex-vessel revenue and shoreside nominal value added pollock first wholesale revenue by year, season, and aggregated port group under Alternative 2, Option 1b, in percent of total annual sector revenue, 2003-2011.

2ii (sector allocation 1)														
Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	25.5%	26.6%	0.8%	0.5%	2003					2003				
2004					2003					2004				
2005	14.4%	15.1%	0.6%	0.3%	2003	10.1%	10.7%	0.8%	0.2%	2005	9.4%	9.9%	0.7%	0.2%
2006	18.9%	19.8%	0.8%	0.5%	2003	14.5%	15.2%	1.0%	0.3%	2006	13.2%	13.8%	0.9%	0.3%
2007					2003					2007				
2008					2003					2008				
2009	1.0%	1.0%	0.0%	0.0%	2003					2009				
2010					2003					2010				
2011	26.3%	26.1%	0.5%	0.1%	2003	7.8%	7.7%	0.4%	0.0%	2011				
4ii (sector allocation 2)														
Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	3.1%	3.2%	0.2%	0.1%	2003					2003				
2004	0.7%	0.7%	0.1%	0.0%	2004					2004				
2005	16.2%	17.0%	1.2%	0.4%	2005	10.3%	10.8%	0.8%	0.2%	2005	9.4%	9.9%	0.7%	0.2%
2006	18.9%	19.8%	1.4%	0.5%	2006	17.2%	18.0%	1.2%	0.4%	2006	13.2%	13.8%	0.9%	0.3%
2007	1.1%	1.1%	0.1%	0.0%	2007					2007				
2008					2008					2008				
2009	5.8%	5.9%	0.3%	0.1%	2009					2009				
2010					2010					2010				
2011	52.7%	52.3%	2.7%	0.2%	2011	36.5%	36.3%	1.9%	0.1%	2011	19.2%	19.1%	1.0%	0.1%
6 (sector allocation 3)														
Cap:	50,000				Cap:	200,000				Cap:	353,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	6.5%	6.8%	0.4%	0.1%	2003					2003				
2004	2.2%	2.4%	0.2%	0.0%	2004					2004				
2005	17.4%	18.4%	1.3%	0.4%	2005	11.7%	12.3%	0.9%	0.3%	2005	10.1%	10.7%	0.8%	0.2%
2006	18.9%	19.8%	1.4%	0.5%	2006	18.9%	19.8%	1.4%	0.5%	2006	14.5%	15.2%	1.0%	0.3%
2007	3.3%	3.4%	0.2%	0.1%	2007					2007				
2008					2008					2008				
2009	14.3%	14.7%	0.6%	0.2%	2009					2009				
2010					2010					2010				
2011	53.8%	53.4%	2.8%	0.2%	2011	42.5%	42.3%	2.2%	0.1%	2011	33.0%	32.8%	1.7%	0.1%

Table 6-33 through Table 6-44 shoreside value added under Alternative 3 in dollars, percent of B season total gross revenue, and in percent of annual total gross revenue, for each of the Altematgive 3 options. The estimates are provided for the port groupings of Akutan/Dutch Harbor and for all others combined. Recall that these values are a subset of the shoreside total potential forgone pollock revenue from the CV sector. In the worst cases, potentially forgone shoreside value added revenue exceeds $119 million, or approximately 67 percent of B season total gross revenue and approximately 34 percent of total annual goross revenue. The vast majority of the potential impact is attributable to the Akutan and Dutch Harbor area. As these numbers are a subset of the CV impact numbers presented previously under the impacta anlsysis of Alternative 3, they vary similarly with decreasing impact as the trigger cap is increased, but greater effect on the CV, and thus shoreside, sector under allocation scenario 3. In the tables that follow, estimates are provided for each of options of Alternative 3.

Table 6-33 Hypothetical "at risk" ex-vessel nominal revenue and and shoreside nominal value added pollock first wholesale revenue by year, season, and aggregated port group under Alternative 3, Option 1a ($ Millions), 2003-2011.

2ii (sector allocation 1) Option 1a.

Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$47.39	$92.45	$2.85	$1.81	2003	$21.66	$42.26	$1.30	$0.83	2003				
2004	$40.24	$77.56	$2.98	$0.88	2004	$30.18	$58.17	$2.24	$0.66	2004	$13.83	$26.66	$1.03	$0.30
2005	$54.11	$107.16	$4.16	$2.43	2005	$48.26	$95.58	$3.71	$2.17	2005	$40.95	$81.10	$3.15	$1.84
2006	$47.92	$86.46	$3.43	$1.99	2006	$38.65	$69.73	$2.77	$1.60	2006	$26.28	$47.42	$1.88	$1.09
2007	$20.55	$42.28	$1.53	$1.18	2007					2007				
2008					2008					2008				
2009	$8.79	$19.68	$0.38	$0.31	2009					2009				
2010					2010					2010				
2011	$52.14	$140.34	$2.67	$0.49	2011	$30.96	$83.32	$1.59	$0.29	2011				

4ii (sector allocation 2) Option 1a.

Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$47.39	$92.45	$2.85	$1.81	2003	$32.49	$63.40	$1.95	$1.24	2003	$5.42	$10.57	$0.33	$0.21
2004	$40.24	$77.56	$2.98	$0.88	2004	$31.44	$60.59	$2.33	$0.69	2004	$15.09	$29.09	$1.12	$0.33
2005	$55.57	$110.06	$4.28	$2.50	2005	$49.72	$98.47	$3.83	$2.24	2005	$42.41	$83.99	$3.26	$1.91
2006	$47.92	$86.46	$3.43	$1.99	2006	$40.20	$72.52	$2.88	$1.67	2006	$30.92	$55.78	$2.21	$1.28
2007	$21.92	$45.10	$1.63	$1.26	2007	$13.70	$28.19	$1.02	$0.79	2007				
2008					2008					2008				
2009	$8.79	$19.68	$0.38	$0.31	2009					2009				
2010					2010					2010				
2011	$57.03	$153.49	$2.92	$0.53	2011	$42.37	$114.02	$2.17	$0.39	2011				

6 (sector allocation 3) Option 1a.

Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$51.45	$100.38	$3.09	$1.96	2003	$41.97	$81.89	$2.52	$1.60	2003	$12.19	$23.77	$0.73	$0.46
2004	$40.24	$77.56	$2.98	$0.88	2004	$35.21	$67.87	$2.61	$0.77	2004	$26.41	$50.90	$1.96	$0.58
2005	$59.96	$118.75	$4.62	$2.70	2005	$49.72	$98.47	$3.83	$2.24	2005	$48.26	$95.58	$3.71	$2.17
2006	$47.92	$86.46	$3.43	$1.99	2006	$44.83	$80.89	$3.21	$1.86	2006	$38.65	$69.73	$2.77	$1.60
2007	$23.29	$47.92	$1.73	$1.34	2007	$17.81	$36.65	$1.32	$1.03	2007				
2008	$5.01	$8.90	$0.28	$0.10	2008					2008				
2009	$8.79	$19.68	$0.38	$0.31	2009	$3.77	$8.43	$0.16	$0.13	2009				
2010					2010					2010				
2011	$58.66	$157.88	$3.01	$0.55	2011	$45.63	$122.79	$2.34	$0.42	2011	$17.92	$48.24	$0.92	$0.17

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.
All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-34 Hypothetical "at risk"ex-vessel nominal revenue and shoreside nominal value added pollock first wholesale revenue by year, season, and aggregated port group under Alternative 3, Option 1a, in percent of B season sector revenue, 2003-2009).

2ii (sector allocation 1) Option 1a.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	54.7%	56.8%	3.3%	1.1%	2003	25.0%	26.0%	1.5%	0.5%	2003				
2004	50.3%	53.4%	3.7%	0.6%	2004	37.7%	40.0%	2.8%	0.5%	2004	17.3%	18.3%	1.3%	0.2%
2005	57.0%	60.0%	4.4%	1.4%	2005	50.8%	53.5%	3.9%	1.2%	2005	43.1%	45.4%	3.3%	1.0%
2006	48.7%	51.0%	3.5%	1.2%	2006	39.3%	41.2%	2.8%	0.9%	2006	26.7%	28.0%	1.9%	0.6%
2007	24.4%	25.5%	1.8%	0.7%	2007					2007				
2008					2008					2008				
2009	11.2%	11.5%	0.5%	0.2%	2009					2009				
2010					2010					2010				
2011	52.8%	55.3%	2.7%	0.2%	2011	31.3%	32.8%	1.6%	0.1%	2011				
4ii (sector allocation 2) Option 1a.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	54.7%	56.8%	3.3%	1.1%	2003	37.5%	39.0%	2.3%	0.8%	2003	6.2%	6.5%	0.4%	0.1%
2004	50.3%	53.4%	3.7%	0.6%	2004	39.3%	41.7%	2.9%	0.5%	2004	18.8%	20.0%	1.4%	0.2%
2005	58.5%	61.6%	4.5%	1.4%	2005	52.4%	55.1%	4.0%	1.3%	2005	44.7%	47.0%	3.4%	1.1%
2006	48.7%	51.0%	3.5%	1.2%	2006	40.9%	42.8%	2.9%	1.0%	2006	31.4%	32.9%	2.2%	0.8%
2007	26.1%	27.2%	1.9%	0.8%	2007	16.3%	17.0%	1.2%	0.5%	2007				
2008					2008					2008				
2009	11.2%	11.5%	0.5%	0.2%	2009					2009				
2010					2010					2010				
2011	57.7%	60.5%	3.0%	0.2%	2011	42.9%	44.9%	2.2%	0.2%	2011				
6 (sector allocation 3) Option 1a.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	59.4%	61.7%	3.6%	1.2%	2003	48.4%	50.4%	2.9%	1.0%	2003	14.1%	14.6%	0.8%	0.3%
2004	50.3%	53.4%	3.7%	0.6%	2004	44.0%	46.7%	3.3%	0.5%	2004	33.0%	35.0%	2.4%	0.4%
2005	63.1%	66.5%	4.9%	1.5%	2005	52.4%	55.1%	4.0%	1.3%	2005	50.8%	53.5%	3.9%	1.2%
2006	48.7%	51.0%	3.5%	1.2%	2006	45.6%	47.7%	3.3%	1.1%	2006	39.3%	41.2%	2.8%	0.9%
2007	27.7%	29.0%	2.1%	0.8%	2007	21.2%	22.1%	1.6%	0.6%	2007				
2008	4.8%	5.0%	0.3%	0.1%	2008					2008				
2009	11.2%	11.5%	0.5%	0.2%	2009	4.8%	4.9%	0.2%	0.1%	2009				
2010					2010					2010				
2011	59.4%	62.2%	3.0%	0.2%	2011	46.2%	48.4%	2.4%	0.2%	2011	18.1%	19.0%	0.9%	0.1%

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.
All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-35 Hypothetical "at risk" ex-vessel nominal revenue and shoreside nominal value added pollock first wholesale processing revenue by year, season, and aggregated port group under Alternative 3, Option 1a, in percent of total annual sector revenue, 2003-2011.

2ii (sector allocation 1) Option 1a.

Cap: 25,000

	AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA
2003	29.9%	31.1%	1.0%	0.6%
2004	25.4%	27.0%	1.0%	0.3%
2005	29.1%	30.6%	1.2%	0.7%
2006	25.3%	26.5%	1.1%	0.6%
2007	12.2%	12.8%	0.5%	0.4%
2008				
2009	6.3%	6.4%	0.1%	0.1%
2010				
2011	31.6%	31.4%	0.6%	0.1%

Cap: 75,000

	AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA
2003	13.7%	14.2%	0.8%	0.3%
2003	19.0%	20.2%	1.4%	0.2%
2003	25.9%	27.3%	2.0%	0.6%
2003	20.4%	21.4%	1.5%	0.5%
2003				
2003				
2003				
2003				
2003	18.8%	18.7%	1.0%	0.1%

Cap: 200,000

	AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA
2003				
2004	8.7%	9.3%	0.6%	0.1%
2005	22.0%	23.2%	1.7%	0.5%
2006	13.9%	14.5%	1.0%	0.3%
2007				
2008				
2009				
2010				
2011				

4ii (sector allocation 2) Option 1a.

Cap: 25,000

	AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA
2003	29.9%	31.1%	1.8%	0.6%
2004	25.4%	27.0%	1.9%	0.3%
2005	29.9%	31.5%	2.3%	0.7%
2006	25.3%	26.5%	1.8%	0.6%
2007	13.1%	13.7%	1.0%	0.4%
2008				
2009	6.3%	6.4%	0.3%	0.1%
2010				
2011	34.6%	34.4%	1.8%	0.1%

Cap: 75,000

	AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA
2003	20.5%	21.3%	1.2%	0.4%
2004	19.8%	21.1%	1.5%	0.2%
2005	26.7%	28.1%	2.1%	0.6%
2006	21.2%	22.2%	1.5%	0.5%
2007	8.2%	8.5%	0.6%	0.2%
2008				
2009				
2010				
2011	25.7%	25.5%	1.3%	0.1%

Cap: 200,000

	AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA
2003	3.4%	3.6%	0.2%	0.1%
2004	9.5%	10.1%	0.7%	0.1%
2005	22.8%	24.0%	1.8%	0.5%
2006	16.3%	17.1%	1.2%	0.4%
2007				
2008				
2009				
2010				
2011				

6 (sector allocation 3) Option 1a.

Cap: 25,000

	AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA
2003	32.5%	33.8%	2.0%	0.7%
2004	25.4%	27.0%	1.9%	0.3%
2005	32.2%	33.9%	2.5%	0.8%
2006	25.3%	26.5%	1.8%	0.6%
2007	13.9%	14.5%	1.0%	0.4%
2008	2.5%	2.6%	0.1%	0.0%
2009	6.3%	6.4%	0.3%	0.1%
2010				
2011	35.6%	35.4%	1.8%	0.1%

Cap: 75,000

	AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA
2003	26.5%	27.5%	1.6%	0.5%
2004	22.2%	23.6%	1.6%	0.3%
2005	26.7%	28.1%	2.1%	0.6%
2006	23.7%	24.8%	1.7%	0.6%
2007	10.6%	11.1%	0.8%	0.3%
2008				
2009	2.7%	2.8%	0.1%	0.0%
2010				
2011	27.7%	27.5%	1.4%	0.1%

Cap: 200,000

	AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA
2003	7.7%	8.0%	0.5%	0.2%
2004	16.7%	17.7%	1.2%	0.2%
2005	25.9%	27.3%	2.0%	0.6%
2006	20.4%	21.4%	1.5%	0.5%
2007				
2008				
2009				
2010				
2011	10.9%	10.8%	0.6%	0.0%

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.
All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-36 Hypothetical "at risk" ex-vessel nominal reveue and shoreside nominal value added pollock first wholesale processing revenue by year, season, and aggregated port group under Alternative 3, Option 1b ($ Millions), 2003-2011.

2ii (sector allocation 1) Option 1b.

Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$5.14	$10.03	$0.31	$0.20	2003					2003				
2004	$2.32	$4.48	$0.17	$0.05	2004					2004				
2005	$27.57	$54.60	$2.12	$1.24	2005	$20.29	$40.18	$1.56	$0.91	2005	$15.49	$30.68	$1.19	$0.70
2006	$21.62	$39.01	$1.55	$0.90	2006	$21.62	$39.01	$1.55	$0.90	2006	$14.61	$26.36	$1.05	$0.61
2007	$1.71	$3.52	$0.13	$0.10	2007					2007				
2008					2008					2008				
2009	$4.47	$10.00	$0.19	$0.16	2009	$0.47	$1.06	$0.02	$0.02	2009				
2010					2010					2010				
2011	$27.00	$72.67	$1.38	$0.25	2011	$19.83	$53.36	$1.02	$0.18	2011	$6.08	$16.36	$0.31	$0.06

4ii (sector allocation 2) Option 1b.

Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$7.41	$14.45	$0.45	$0.28	2003					2003				
2004	$6.49	$12.50	$0.48	$0.14	2004					2004				
2005	$27.57	$54.60	$2.12	$1.24	2005	$21.84	$43.26	$1.68	$0.98	2005	$15.64	$30.98	$1.20	$0.70
2006	$23.03	$41.55	$1.65	$0.95	2006	$21.62	$39.01	$1.55	$0.90	2006	$18.37	$33.14	$1.31	$0.76
2007	$2.83	$5.83	$0.21	$0.16	2007					2007				
2008	$0.59	$1.04	$0.03	$0.01	2008					2008				
2009	$4.77	$10.67	$0.21	$0.17	2009	$0.63	$1.40	$0.03	$0.02	2009				
2010	$1.59	$4.53	$0.09	$0.02	2010					2010				
2011	$27.00	$72.67	$1.38	$0.25	2011	$20.90	$56.25	$1.07	$0.19	2011	$8.91	$23.97	$0.46	$0.08

6 (sector allocation 3) Option 1b.

Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$10.10	$19.71	$0.61	$0.38	2003	$2.87	$5.60	$0.17	$0.11	2003				
2004	$9.80	$18.88	$0.73	$0.21	2004	$0.95	$1.83	$0.07	$0.02	2004				
2005	$30.50	$60.42	$2.35	$1.37	2005	$25.22	$49.95	$1.94	$1.13	2005	$16.99	$33.65	$1.31	$0.76
2006	$23.03	$41.55	$1.65	$0.95	2006	$21.62	$39.01	$1.55	$0.90	2006	$21.62	$39.01	$1.55	$0.90
2007	$4.68	$9.63	$0.35	$0.27	2007	$0.40	$0.83	$0.03	$0.02	2007				
2008	$3.75	$6.65	$0.21	$0.08	2008					2008				
2009	$7.90	$17.69	$0.34	$0.28	2009	$1.55	$3.47	$0.07	$0.06	2009				
2010	$3.81	$10.85	$0.21	$0.04	2010					2010				
2011	$27.00	$72.67	$1.38	$0.25	2011	$25.19	$67.79	$1.29	$0.23	2011	$13.07	$35.18	$0.67	$0.12

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.

All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-37 Hypothetical "at risk" ex-vessel nominal revenue and shoreside nominal value added pollock first wholesale processing revenue by year, season, and aggregated port group under Alternative 3 Option 1b, in percent of B season sector revenue, 2003-2011.

2ii (sector allocation 1) Option 1b.

Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	5.9%	6.2%	0.4%	0.1%	2003					2003				
2004	2.9%	3.1%	0.2%	0.0%	2004					2004				
2005	29.0%	30.6%	2.2%	0.7%	2005	21.4%	22.5%	1.6%	0.5%	2005	16.3%	17.2%	1.3%	0.4%
2006	22.0%	23.0%	1.6%	0.5%	2006	22.0%	23.0%	1.6%	0.5%	2006	14.9%	15.6%	1.1%	0.4%
2007	2.0%	2.1%	0.2%	0.1%	2007					2007				
2008					2008					2008				
2009	5.7%	5.9%	0.2%	0.1%	2009	0.6%	0.6%	0.0%	0.0%	2009				
2010					2010					2010				
2011	27.3%	28.6%	1.4%	0.1%	2011	20.1%	21.0%	1.0%	0.1%	2011	6.2%	6.4%	0.3%	0.0%

4ii (sector allocation 2) Option 1b.

Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	8.5%	8.9%	0.5%	0.2%	2003					2003				
2004	8.1%	8.6%	0.6%	0.1%	2004					2004				
2005	29.0%	30.6%	2.2%	0.7%	2005	23.0%	24.2%	1.8%	0.5%	2005	16.5%	17.3%	1.3%	0.4%
2006	23.4%	24.5%	1.7%	0.6%	2006	22.0%	23.0%	1.6%	0.5%	2006	18.7%	19.6%	1.3%	0.4%
2007	3.4%	3.5%	0.3%	0.1%	2007					2007				
2008	0.6%	0.6%	0.0%	0.0%	2008					2008				
2009	6.1%	6.3%	0.3%	0.1%	2009	0.8%	0.8%	0.0%	0.0%	2009				
2010	2.4%	2.5%	0.1%	0.0%	2010					2010				
2011	27.3%	28.6%	1.4%	0.1%	2011	21.2%	22.2%	1.1%	0.1%	2011	9.0%	9.4%	0.5%	0.0%

6 (sector allocation 3) Option 1b.

Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	11.7%	12.1%	0.7%	0.2%	2003	3.3%	3.4%	0.2%	0.1%	2003				
2004	12.2%	13.0%	0.9%	0.1%	2004	1.2%	1.3%	0.1%	0.0%	2004				
2005	32.1%	33.8%	2.5%	0.8%	2005	26.6%	28.0%	2.0%	0.6%	2005	17.9%	18.8%	1.4%	0.4%
2006	23.4%	24.5%	1.7%	0.6%	2006	22.0%	23.0%	1.6%	0.5%	2006	22.0%	23.0%	1.6%	0.5%
2007	5.6%	5.8%	0.4%	0.2%	2007	0.5%	0.5%	0.0%	0.0%	2007				
2008	3.6%	3.7%	0.2%	0.0%	2008					2008				
2009	10.1%	10.4%	0.4%	0.2%	2009	2.0%	2.0%	0.1%	0.0%	2009				
2010	5.7%	6.0%	0.3%	0.0%	2010					2010				
2011	27.3%	28.6%	1.4%	0.1%	2011	25.5%	26.7%	1.3%	0.1%	2011	13.2%	13.9%	0.7%	0.0%

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.

All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-38 Hypothetical "at risk" ex-vessel nominal revenue and shoreside nominal value added pollock first wholesale processing revenue by year, season, and aggregated port group under Alternative 3 Option 1b, in percent of total annual sector revenue, 2003-2011.

2ii (sector allocation 1) Option 1b.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	3.2%	3.4%	0.1%	0.1%	2003					2003				
2004	1.5%	1.6%	0.1%	0.0%	2003					2004				
2005	14.8%	15.6%	0.6%	0.4%	2003	10.9%	11.5%	0.8%	0.3%	2005	8.3%	8.8%	0.6%	0.2%
2006	11.4%	11.9%	0.5%	0.3%	2003	11.4%	11.9%	0.8%	0.3%	2006	7.7%	8.1%	0.6%	0.2%
2007	1.0%	1.1%	0.0%	0.0%	2003					2007				
2008					2003					2008				
2009	3.2%	3.3%	0.1%	0.1%	2003	0.3%	0.3%	0.0%	0.0%	2009				
2010					2003					2010				
2011	16.4%	16.3%	0.3%	0.1%	2003	12.0%	11.9%	0.6%	0.0%	2011	3.7%	3.7%	0.2%	0.0%
4ii (sector allocation 2) Option 1b.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	4.7%	4.9%	0.3%	0.1%	2003					2003				
2004	4.1%	4.3%	0.3%	0.0%	2004					2004				
2005	14.8%	15.6%	1.1%	0.4%	2005	11.7%	12.4%	0.9%	0.3%	2005	8.4%	8.9%	0.6%	0.2%
2006	12.1%	12.7%	0.9%	0.3%	2006	11.4%	11.9%	0.8%	0.3%	2006	9.7%	10.2%	0.7%	0.2%
2007	1.7%	1.8%	0.1%	0.0%	2007					2007				
2008	0.3%	0.3%	0.0%	0.0%	2008					2008				
2009	3.4%	3.5%	0.1%	0.1%	2009	0.4%	0.5%	0.0%	0.0%	2009				
2010	1.3%	1.4%	0.1%	0.0%	2010					2010				
2011	16.4%	16.3%	0.8%	0.1%	2011	12.7%	12.6%	0.6%	0.0%	2011	5.4%	5.4%	0.3%	0.0%
6 (sector allocation 3) Option 1b.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	6.4%	6.6%	0.4%	0.1%	2003	1.8%	1.9%	0.1%	0.0%	2003				
2004	6.2%	6.6%	0.5%	0.1%	2004	0.6%	0.6%	0.0%	0.0%	2004				
2005	16.4%	17.3%	1.3%	0.4%	2005	13.6%	14.3%	1.0%	0.3%	2005	9.1%	9.6%	0.7%	0.2%
2006	12.1%	12.7%	0.9%	0.3%	2006	11.4%	11.9%	0.8%	0.3%	2006	11.4%	11.9%	0.8%	0.3%
2007	2.8%	2.9%	0.2%	0.1%	2007	0.2%	0.3%	0.0%	0.0%	2007				
2008	1.9%	2.0%	0.1%	0.0%	2008					2008				
2009	5.6%	5.8%	0.2%	0.1%	2009	1.1%	1.1%	0.0%	0.0%	2009				
2010	3.2%	3.4%	0.2%	0.0%	2010					2010				
2011	16.4%	16.3%	0.8%	0.1%	2011	15.3%	15.2%	0.8%	0.1%	2011	7.9%	7.9%	0.4%	0.0%

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.

All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-39 Hypothetical "at risk" ex-vesel nominal revenue and shoreside nominal value added pollock first wholesale processing revenue by year, season, and aggregated port group under Alternative 3 Option 2a ($ Millions), 2003-2011.

2ii (sector allocation 1) Option 2a.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$31.14	$60.75	$1.87	$1.19	2003	$10.83	$21.13	$0.65	$0.41	2003				
2004	$23.89	$46.05	$1.77	$0.52	2004	$17.60	$33.93	$1.30	$0.38	2004	$10.06	$19.39	$0.75	$0.22
2005	$39.48	$78.20	$3.04	$1.78	2005	$36.56	$72.41	$2.81	$1.64	2005	$29.25	$57.93	$2.25	$1.32
2006	$37.10	$66.94	$2.66	$1.54	2006	$29.37	$52.99	$2.10	$1.22	2006	$20.10	$36.26	$1.44	$0.83
2007	$16.44	$33.83	$1.22	$0.95	2007					2007				
2008					2008					2008				
2009	$5.02	$11.25	$0.22	$0.18	2009					2009				
2010					2010					2010				
2011	$32.59	$87.71	$1.67	$0.30	2011	$17.92	$48.24	$0.92	$0.17	2011				
4ii (sector allocation 2) Option 2a.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$31.14	$60.75	$1.87	$1.19	2003	$17.60	$34.34	$1.06	$0.67	2003	$4.06	$7.92	$0.24	$0.15
2004	$23.89	$46.05	$1.77	$0.52	2004	$17.60	$33.93	$1.30	$0.38	2004	$11.32	$21.81	$0.84	$0.25
2005	$40.95	$81.10	$3.15	$1.84	2005	$36.56	$72.41	$2.81	$1.64	2005	$32.17	$63.72	$2.48	$1.45
2006	$37.10	$66.94	$2.66	$1.54	2006	$30.92	$55.78	$2.21	$1.28	2006	$24.74	$44.63	$1.77	$1.02
2007	$16.44	$33.83	$1.22	$0.95	2007	$12.33	$25.37	$0.92	$0.71	2007				
2008					2008					2008				
2009	$5.02	$11.25	$0.22	$0.18	2009					2009				
2010					2010					2010				
2011	$32.59	$87.71	$1.67	$0.30	2011	$24.44	$65.78	$1.25	$0.23	2011				
6 (sector allocation 3) Option 2a.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$32.49	$63.40	$1.95	$1.24	2003	$25.72	$50.19	$1.55	$0.98	2003	$8.12	$15.85	$0.49	$0.31
2004	$23.89	$46.05	$1.77	$0.52	2004	$21.38	$41.20	$1.58	$0.47	2004	$15.09	$29.09	$1.12	$0.33
2005	$43.87	$86.89	$3.38	$1.97	2005	$36.56	$72.41	$2.81	$1.64	2005	$36.56	$72.41	$2.81	$1.64
2006	$37.10	$66.94	$2.66	$1.54	2006	$34.01	$61.36	$2.43	$1.41	2006	$29.37	$52.99	$2.10	$1.22
2007	$16.44	$33.83	$1.22	$0.95	2007	$15.07	$31.01	$1.12	$0.87	2007				
2008	$3.34	$5.93	$0.19	$0.07	2008					2008				
2009	$5.02	$11.25	$0.22	$0.18	2009	$1.26	$2.81	$0.05	$0.04	2009				
2010					2010					2010				
2011	$35.85	$96.48	$1.84	$0.33	2011	$27.70	$74.55	$1.42	$0.26	2011	$13.04	$35.08	$0.67	$0.12

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.
All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-40 Hypothetical "at risk" ex-vesssel nominal revenue and shoreside nominal value added pollock first wholesale processing revenue by year, season, and aggregated port group under Alternative 3 Option 2a, in percent of B season sector revenue, 2003-2011.

2ii (sector allocation 1) Option 2a.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	35.9%	37.4%	2.2%	0.7%	2003	12.5%	13.0%	0.8%	0.3%	2003				
2004	29.8%	31.7%	2.2%	0.4%	2004	22.0%	23.4%	1.6%	0.3%	2004	12.6%	13.3%	0.9%	0.2%
2005	41.6%	43.8%	3.2%	1.0%	2005	38.5%	40.5%	3.0%	0.9%	2005	30.8%	32.4%	2.4%	0.7%
2006	37.7%	39.5%	2.7%	0.9%	2006	29.9%	31.3%	2.1%	0.7%	2006	20.4%	21.4%	1.5%	0.5%
2007	19.6%	20.4%	1.5%	0.6%	2007					2007				
2008					2008					2008				
2009	6.4%	6.6%	0.3%	0.1%	2009					2009				
2010					2010					2010				
2011	33.0%	34.6%	1.7%	0.1%	2011	18.1%	19.0%	0.9%	0.1%	2011				
4ii (sector allocation 2) Option 2a.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	35.9%	37.4%	2.2%	0.7%	2003	20.3%	21.1%	1.2%	0.4%	2003	4.7%	4.9%	0.3%	0.1%
2004	29.8%	31.7%	2.2%	0.4%	2004	22.0%	23.4%	1.6%	0.3%	2004	14.1%	15.0%	1.0%	0.2%
2005	43.1%	45.4%	3.3%	1.0%	2005	38.5%	40.5%	3.0%	0.9%	2005	33.9%	35.7%	2.6%	0.8%
2006	37.7%	39.5%	2.7%	0.9%	2006	31.4%	32.9%	2.2%	0.8%	2006	25.1%	26.3%	1.8%	0.6%
2007	19.6%	20.4%	1.5%	0.6%	2007	14.7%	15.3%	1.1%	0.4%	2007				
2008					2008					2008				
2009	6.4%	6.6%	0.3%	0.1%	2009					2009				
2010					2010					2010				
2011	33.0%	34.6%	1.7%	0.1%	2011	24.7%	25.9%	1.3%	0.1%	2011				
6 (sector allocation 3) Option 2a.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	37.5%	39.0%	2.3%	0.8%	2003	29.7%	30.9%	1.8%	0.6%	2003	9.4%	9.7%	0.6%	0.2%
2004	29.8%	31.7%	2.2%	0.4%	2004	26.7%	28.4%	2.0%	0.3%	2004	18.8%	20.0%	1.4%	0.2%
2005	46.2%	48.7%	3.6%	1.1%	2005	38.5%	40.5%	3.0%	0.9%	2005	38.5%	40.5%	3.0%	0.9%
2006	37.7%	39.5%	2.7%	0.9%	2006	34.6%	36.2%	2.5%	0.8%	2006	29.9%	31.3%	2.1%	0.7%
2007	19.6%	20.4%	1.5%	0.6%	2007	17.9%	18.7%	1.3%	0.5%	2007				
2008	3.2%	3.3%	0.2%	0.0%	2008					2008				
2009	6.4%	6.6%	0.3%	0.1%	2009	1.6%	1.6%	0.1%	0.0%	2009				
2010					2010					2010				
2011	36.3%	38.0%	1.9%	0.1%	2011	28.0%	29.4%	1.4%	0.1%	2011	13.2%	13.8%	0.7%	0.0%

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.
All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-41 Hypothetical "at risk" nominal revenue at risk and shoreside nominal value added pollock first wholesale processing revenue by year, season, and aggregated port group under Alternative 3 Option 2a in percent of total annual sector revenue, 2003-2011.

2ii (sector allocation 1) Option 2a.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	19.7%	20.4%	0.6%	0.4%	2003	6.8%	7.1%	0.4%	0.1%	2003				
2004	15.1%	16.0%	0.6%	0.2%	2003	11.1%	11.8%	0.8%	0.1%	2004	6.3%	6.7%	0.5%	0.1%
2005	21.2%	22.4%	0.9%	0.5%	2003	19.7%	20.7%	1.5%	0.5%	2005	15.7%	16.6%	1.2%	0.4%
2006	19.6%	20.5%	0.8%	0.5%	2003	15.5%	16.2%	1.1%	0.4%	2006	10.6%	11.1%	0.8%	0.3%
2007	9.8%	10.2%	0.4%	0.3%	2003					2007				
2008					2003					2008				
2009	3.6%	3.7%	0.1%	0.1%	2003					2009				
2010					2003					2010				
2011	19.8%	19.6%	0.4%	0.1%	2003	10.9%	10.8%	0.6%	0.0%	2011				
4ii (sector allocation 2) Option 2a.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	19.7%	20.4%	1.2%	0.4%	2003	11.1%	11.6%	0.7%	0.2%	2003	2.6%	2.7%	0.2%	0.1%
2004	15.1%	16.0%	1.1%	0.2%	2004	11.1%	11.8%	0.8%	0.1%	2004	7.1%	7.6%	0.5%	0.1%
2005	22.0%	23.2%	1.7%	0.5%	2005	19.7%	20.7%	1.5%	0.5%	2005	17.3%	18.2%	1.3%	0.4%
2006	19.6%	20.5%	1.4%	0.5%	2006	16.3%	17.1%	1.2%	0.4%	2006	13.0%	13.7%	0.9%	0.3%
2007	9.8%	10.2%	0.7%	0.3%	2007	7.3%	7.7%	0.5%	0.2%	2007				
2008					2008					2008				
2009	3.6%	3.7%	0.2%	0.1%	2009					2009				
2010					2010					2010				
2011	19.8%	19.6%	1.0%	0.1%	2011	14.8%	14.7%	0.8%	0.1%	2011				
6 (sector allocation 3) Option 2a.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	20.5%	21.3%	1.2%	0.4%	2003	16.2%	16.9%	1.0%	0.3%	2003	5.1%	5.3%	0.3%	0.1%
2004	15.1%	16.0%	1.1%	0.2%	2004	13.5%	14.3%	1.0%	0.2%	2004	9.5%	10.1%	0.7%	0.1%
2005	23.6%	24.8%	1.8%	0.6%	2005	19.7%	20.7%	1.5%	0.5%	2005	19.7%	20.7%	1.5%	0.5%
2006	19.6%	20.5%	1.4%	0.5%	2006	17.9%	18.8%	1.3%	0.4%	2006	15.5%	16.2%	1.1%	0.4%
2007	9.8%	10.2%	0.7%	0.3%	2007	9.0%	9.4%	0.7%	0.3%	2007				
2008	1.7%	1.7%	0.1%	0.0%	2008					2008				
2009	3.6%	3.7%	0.2%	0.1%	2009	0.9%	0.9%	0.0%	0.0%	2009				
2010					2010					2010				
2011	21.7%	21.6%	1.1%	0.1%	2011	16.8%	16.7%	0.9%	0.1%	2011	7.9%	7.9%	0.4%	0.0%

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.
All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-42 Hypothetical "at risk" ex-vessel nominal revenue and shoreside nominal value added pollock first wholesale processing revenue by year, season, and aggregated port group under Alternative 3, Option 2b ($ Millions), 2003-2011.

2ii (sector allocation 1) Option 2b.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$5.06	$9.87	$0.30	$0.19	2003					2003				
2004	$2.31	$4.45	$0.17	$0.05	2004					2004				
2005	$20.46	$40.51	$1.57	$0.92	2005	$14.25	$28.23	$1.10	$0.64	2005	$10.47	$20.73	$0.81	$0.47
2006	$15.97	$28.81	$1.14	$0.66	2006	$15.97	$28.81	$1.14	$0.66	2006	$9.23	$16.65	$0.66	$0.38
2007	$0.91	$1.87	$0.07	$0.05	2007					2007				
2008					2008					2008				
2009	$3.22	$7.20	$0.14	$0.11	2009	$0.48	$1.07	$0.02	$0.02	2009				
2010					2010					2010				
2011	$14.40	$38.74	$0.74	$0.13	2011	$9.10	$24.48	$0.47	$0.08	2011	$2.48	$6.68	$0.13	$0.02
4ii (sector allocation 2) Option 2b.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$7.07	$13.80	$0.43	$0.27	2003					2003				
2004	$6.34	$12.21	$0.47	$0.14	2004					2004				
2005	$20.46	$40.51	$1.57	$0.92	2005	$14.82	$29.36	$1.14	$0.67	2005	$10.70	$21.18	$0.82	$0.48
2006	$17.31	$31.22	$1.24	$0.72	2006	$15.97	$28.81	$1.14	$0.66	2006	$12.72	$22.95	$0.91	$0.53
2007	$1.57	$3.23	$0.12	$0.09	2007					2007				
2008	$0.37	$0.65	$0.02	$0.01	2008					2008				
2009	$3.25	$7.28	$0.14	$0.12	2009	$0.48	$1.07	$0.02	$0.02	2009				
2010	$1.27	$3.63	$0.07	$0.01	2010					2010				
2011	$14.40	$38.74	$0.74	$0.13	2011	$10.17	$27.38	$0.52	$0.09	2011	$2.75	$7.41	$0.14	$0.03
6 (sector allocation 3) Option 2b.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	$9.66	$18.85	$0.58	$0.37	2003	$2.86	$5.57	$0.17	$0.11	2003				
2004	$8.81	$16.98	$0.65	$0.19	2004	$0.95	$1.83	$0.07	$0.02	2004				
2005	$23.11	$45.77	$1.78	$1.04	2005	$18.20	$36.05	$1.40	$0.82	2005	$11.05	$21.88	$0.85	$0.50
2006	$17.31	$31.22	$1.24	$0.72	2006	$15.97	$28.81	$1.14	$0.66	2006	$15.97	$28.81	$1.14	$0.66
2007	$2.46	$5.06	$0.18	$0.14	2007	$0.40	$0.83	$0.03	$0.02	2007				
2008	$2.32	$4.11	$0.13	$0.05	2008					2008				
2009	$6.27	$14.04	$0.27	$0.22	2009	$0.79	$1.76	$0.03	$0.03	2009				
2010	$2.59	$7.38	$0.14	$0.03	2010					2010				
2011	$14.40	$38.74	$0.74	$0.13	2011	$14.40	$38.74	$0.74	$0.13	2011	$5.92	$15.93	$0.30	$0.06

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.

All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-43 Hypothetical "at risk" ex-vessel nominal revenue and shoreside nominal value added pollock first wholesale processing revenue by year, season, and aggregated port group under Alternative 3 Option 2b, in percent of B season sector revenue, 2003-2011.

2ii (sector allocation 1) Option 2b.

Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	5.8%	6.1%	0.4%	0.1%	2003					2003				
2004	2.9%	3.1%	0.2%	0.0%	2004					2004				
2005	21.5%	22.7%	1.7%	0.5%	2005	15.0%	15.8%	1.2%	0.4%	2005	11.0%	11.6%	0.8%	0.3%
2006	16.2%	17.0%	1.2%	0.4%	2006	16.2%	17.0%	1.2%	0.4%	2006	9.4%	9.8%	0.7%	0.2%
2007	1.1%	1.1%	0.1%	0.0%	2007					2007				
2008					2008					2008				
2009	4.1%	4.2%	0.2%	0.1%	2009	0.6%	0.6%	0.0%	0.0%	2009				
2010					2010					2010				
2011	14.6%	15.3%	0.7%	0.1%	2011	9.2%	9.6%	0.5%	0.0%	2011	2.5%	2.6%	0.1%	0.0%

4ii (sector allocation 2) Option 2b.

Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	8.2%	8.5%	0.5%	0.2%	2003					2003				
2004	7.9%	8.4%	0.6%	0.1%	2004					2004				
2005	21.5%	22.7%	1.7%	0.5%	2005	15.6%	16.4%	1.2%	0.4%	2005	11.3%	11.9%	0.9%	0.3%
2006	17.6%	18.4%	1.3%	0.4%	2006	16.2%	17.0%	1.2%	0.4%	2006	12.9%	13.5%	0.9%	0.3%
2007	1.9%	2.0%	0.1%	0.1%	2007					2007				
2008	0.4%	0.4%	0.0%	0.0%	2008					2008				
2009	4.1%	4.3%	0.2%	0.1%	2009	0.6%	0.6%	0.0%	0.0%	2009				
2010	1.9%	2.0%	0.1%	0.0%	2010					2010				
2011	14.6%	15.3%	0.7%	0.1%	2011	10.3%	10.8%	0.5%	0.0%	2011	2.8%	2.9%	0.1%	0.0%

6 (sector allocation 3) Option 2b.

Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	11.1%	11.6%	0.7%	0.2%	2003	3.3%	3.4%	0.2%	0.1%	2003				
2004	11.0%	11.7%	0.8%	0.1%	2004	1.2%	1.3%	0.1%	0.0%	2004				
2005	24.3%	25.6%	1.9%	0.6%	2005	19.2%	20.2%	1.5%	0.5%	2005	11.6%	12.3%	0.9%	0.3%
2006	17.6%	18.4%	1.3%	0.4%	2006	16.2%	17.0%	1.2%	0.4%	2006	16.2%	17.0%	1.2%	0.4%
2007	2.9%	3.1%	0.2%	0.1%	2007	0.5%	0.5%	0.0%	0.0%	2007				
2008	2.2%	2.3%	0.1%	0.0%	2008					2008				
2009	8.0%	8.2%	0.3%	0.1%	2009	1.0%	1.0%	0.0%	0.0%	2009				
2010	3.9%	4.1%	0.2%	0.0%	2010					2010				
2011	14.6%	15.3%	0.7%	0.1%	2011	14.6%	15.3%	0.7%	0.1%	2011	6.0%	6.3%	0.3%	0.0%

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.

All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Table 6-44 Hypothetical "at risk" ex-vessel nominal revenue and shoreside nominal value added pollock first wholesale processing revenue by year, season, and aggregated port group under Alternative 3 Option 2b, in percent of total annual sector revenue, 2003-2011.

2ii (sector allocation 1) Option 2b.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	3.2%	3.3%	0.1%	0.1%	2003					2003				
2004	1.5%	1.5%	0.1%	0.0%	2003					2004				
2005	11.0%	11.6%	0.5%	0.3%	2003	7.7%	8.1%	0.6%	0.2%	2005	5.6%	5.9%	0.4%	0.1%
2006	8.4%	8.8%	0.4%	0.2%	2003	8.4%	8.8%	0.6%	0.2%	2006	4.9%	5.1%	0.3%	0.1%
2007	0.5%	0.6%	0.0%	0.0%	2003					2007				
2008					2003					2008				
2009	2.3%	2.4%	0.0%	0.0%	2003	0.3%	0.4%	0.0%	0.0%	2009				
2010					2003					2010				
2011	8.7%	8.7%	0.2%	0.0%	2003	5.5%	5.5%	0.3%	0.0%	2011	1.5%	1.5%	0.1%	0.0%
4ii (sector allocation 2) Option 2b.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	4.5%	4.6%	0.3%	0.1%	2003					2003				
2004	4.0%	4.2%	0.3%	0.0%	2004					2004				
2005	11.0%	11.6%	0.8%	0.3%	2005	8.0%	8.4%	0.6%	0.2%	2005	5.7%	6.1%	0.4%	0.1%
2006	9.1%	9.6%	0.7%	0.2%	2006	8.4%	8.8%	0.6%	0.2%	2006	6.7%	7.0%	0.5%	0.2%
2007	0.9%	1.0%	0.1%	0.0%	2007					2007				
2008	0.2%	0.2%	0.0%	0.0%	2008					2008				
2009	2.3%	2.4%	0.1%	0.0%	2009	0.3%	0.4%	0.0%	0.0%	2009				
2010	1.1%	1.1%	0.1%	0.0%	2010					2010				
2011	8.7%	8.7%	0.4%	0.0%	2011	6.2%	6.1%	0.3%	0.0%	2011	1.7%	1.7%	0.1%	0.0%
6 (sector allocation 3) Option 2b.														
Cap:	25,000				Cap:	75,000				Cap:	200,000			
	AKU/DUT		All Others			AKU/DUT		All Others			AKU/DUT		All Others	
Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA	Year	CV-ExV	SVA	CV-ExV	SVA
2003	6.1%	6.3%	0.4%	0.1%	2003	1.8%	1.9%	0.1%	0.0%	2003				
2004	5.6%	5.9%	0.4%	0.1%	2004	0.6%	0.6%	0.0%	0.0%	2004				
2005	12.4%	13.1%	1.0%	0.3%	2005	9.8%	10.3%	0.8%	0.2%	2005	5.9%	6.3%	0.5%	0.1%
2006	9.1%	9.6%	0.7%	0.2%	2006	8.4%	8.8%	0.6%	0.2%	2006	8.4%	8.8%	0.6%	0.2%
2007	1.5%	1.5%	0.1%	0.0%	2007	0.2%	0.3%	0.0%	0.0%	2007				
2008	1.2%	1.2%	0.1%	0.0%	2008					2008				
2009	4.5%	4.6%	0.2%	0.1%	2009	0.6%	0.6%	0.0%	0.0%	2009				
2010	2.2%	2.3%	0.1%	0.0%	2010					2010				
2011	8.7%	8.7%	0.4%	0.0%	2011	8.7%	8.7%	0.4%	0.0%	2011	3.6%	3.6%	0.2%	0.0%

Notes: AKU/DUT: Denotes the aggregate of all processing facilities in the Akutan and Dutch Harbor areas, including some floating processors.

All Others: May include King Cove, Kodiak, Sand Point, and several floating processors.

Modifications to the draft document from March 6, 2012 version of EA

The following corrections were made to the draft document since the version that was mailed on March 6th. The Executive Summary (ES) included in the notebooks includes the changes listed below as does the document posted on the Council's website. The RIR tables listed below will be updated for the next iteration of the analysis.

Location	Change	Other sections modified
Global	'bycatch' changed to 'PSC' where appropriate; 'hard cap' specified to indicate 'PSC limit'	
Table caption ES-3	Strike 2nd sentence 'Note that percentage allocations…'	Same change is made in caption for Table 2-3
Component 2 description	Suboptions 1a and 2a modified to reflect that this is the B-season closure while suboptions 1b and 2b modified to reflect that this is the June-July closure.	Same changes were made in Chapter 2 component 2 descriptions. *Note these changes were made March 19th in the replacement pages in the Council mailing and on the Council website.*
Component 3 description	Change 3rd sentence to read 'If suboption 1b or 2b is selected, then the June-July cap would reflect the proportion of bycatch in June and July'	Same change in Chapter 2, component 3 description (2.3.3). Note that the table in this section should also reflect this change (this was modified previously in the Executive Summary)
Table ES-6	Component 2 modified to reflect reorganization of options 1a/2a and 1b/2b as above	Same change in Table 2-8
Table ES-7	Component 2 modified to reflect reorganization of options 1a/2a and 1b/2b as above	Same change in Table 2-9
Chum salmon impacts	Bullets modified under the 'Analysis of the efficacy of the existing RHS program showed the following general conclusions"	Same change made in Chapter 5 section 5.3.1.11
Caption Figure ES-13	Added to caption "Note that for 1b options the cap considered is that proportion of the B season cap shown in the horizontal axis."	Same note added to captions for ES-14, ES-16, ES-17, ES-18, and ES-19
Figure ES-14	Revised figure included	Same change made to Chapter 5, Figure 5-101
Pollock stocks	Last sentence of 3rd paragraph modified to read "In terms of potential tons of pollock that would be diverted under Alternative 3, Options 1b) and 2b) appear to have the lowest impact on pollock fishing among the other trigger closure options given cap and sector allocation scheme. "	
Figure ES-17	Revised figure included	
Economic impacts of Alternatives	Changes made to clarify when 'revenue at risk' vs. 'potentially forgone gross revenue' is used. Potential impacts summary sections revised to reflect modifications to pollock impacts as listed below and 2011 pricing information. Additional discussion of impacts to Alternative 3 options included.	These changes will also be reflected in the RIR
Figures ES-18; ES-19; ES-20 Table ES-10	Figures and tables revised to reflect changes made to Pollock Table 4-4 and 4-13. Overview text reflecting these changes modified.	Same changes to Chapter 4 and Chapter 9 tables, figures and text. Figures 9-1; 9-2, 9-5; Tables 4-4; 4-13; 9-1; 9-2 Note changes to the RIR will be provided in presentation and modified in the next iteration of the analysis

Council motion on Bering Sea Non-Chinook Salmon Prohibited Species Catch
June 11, 2011

The Council requests staff revise the analysis as described below and bring it back for initial review.

Add the following option under Alternative 2, Component 1:

Option: Apply a hard cap (non-Chinook PSC limit) to vessels participating in the directed pollock fishery during June and July, in aggregate. This hard cap, if exceeded, would require all vessels affected by the cap to stop fishing until August 1.

The components under Alternative 2 for cap level, sector allocation, sector transfer, cooperative allocation, and cooperative transfer options would apply (see June 2011 EA pages 28-35). A hard cap applicable only to June and July will be derived from the range of options for B-season hard cap levels, adjusted to reflect the average proportion of non-Chinook salmon PSC in June and July relative to the B-season total.

Remove current Alternative 3 as a stand-alone alternative, and incorporate elements in the alternative as described below.

1. Revise Alternative 4 to read:

(new) Alternative 3:

Rolling Hot Spot (RHS) system – with RHS in regulation, participants in a vessel-level (platform level for Mothership fleet) RHS would be exempt from:

a large area trigger closure encompassing 80% of historical non-Chinook prohibited species catch with the trigger cap level options under what was formerly Alternative 3 (see June 2011 EA pages 35-36). This closure would apply to vessels that are not in an RHS system when total non-Chinook salmon PSC from all vessels (those in an RHS system and those not in an RHS system) reaches the trigger cap level, and would not be subject to sector or cooperative level allocations.

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

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

Suboption 1: the June and July pollock fishery, in aggregate. This trigger closure would only apply in June and July.

Suboption 2: the B season pollock fishery. This trigger closure would apply for the full B season.

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

Suboption 1: the June and July pollock fishery, in aggregate. This trigger closure would only apply in June and July.
Suboption 2: the B season pollock fishery. This trigger closure would apply for the full B season.

Apply the components under what was formerly Alternative 3 for trigger cap levels, sector allocations, and cooperative provisions (see June 2011 EA pages 35-43). Trigger closures that are applicable only to June and July will be derived from the range of options for B-season trigger cap levels, adjusted to reflect the average proportion of non-Chinook salmon PSC in June and July relative to the B-season total.

Alternatives 2 and 3 are not mutually exclusive.

2. Analyze parameters of the RHS program under Alternative 3 that could be adjusted by the council including:
    - Modification of RHS to operate at a vessel level, instead of at the cooperative level;
    - Faster reaction/closure time (shorter delay between announcement and closure);
    - Amount of closure area;
    - Adjustments that would address timing and location of bycatch of Western Alaska chum stocks;
    - Base rates;
    - Possibilities by which the tier system may be amended to provide further incentives to reduce chum bycatch.

3. Make the following revisions to the Draft EA:
    - Add caveats to all sections describing the impacts to specific stocks describing the limitations of the stock identification and AEQ information;
    - Where run size impacts are presented for aggregated stocks (i.e. Western Alaska, coastal Western Alaska), clarify that these aggregations may mask impacts on smaller runs (i.e. Norton Sound);
    - Revise the analysis of pollock fishery impacts and potential foregone revenue for trigger area closures to present actual numbers for each year;
    - Include the discussion previously requested by the Council ~~of~~ for "a discussion of the meaningfulness of fines, including histograms of number and magnitude of fines over time as well as a comparison of penalties under the RHS program to agency penalties and enforcement actions for violating area closures."
    - Include a qualitative discussion of the impacts on salmon fisheries, i.e. impacts of fishing restrictions on drying fish, lower CPUEs, gas costs, increased travel time, fish camps and culture;
    - Include an expanded discussion of Norton Sound salmon fisheries by district including escapement and harvest information for an expanded time period and a full discussion of the tier II fishery.
    - Expand discussion of cumulative effects of the Area M commercial fishery on other western Alaska stocks.

Supplement to Section 5.3.1.1-Status Quo Rolling Hotspot (RHS) System Analysis: Examination and discussion of salmon PSC closures for the 2011 B Season

Chapter 5 of the Initial Review Draft of the Chum PSC EA contains an analysis of the effectiveness of chum PSC closures from 2003-2010, as well as an historical simulation of how a system of similar closures would likely have reduced PSC in the years prior to the actual development of the RHS program (1993-2000). This document is a supplement to that analysis. Here summary information and discussion are provided on the following topics from the 2011 B-Season:

- Chum rolling hotspot (RHS) closures
- Maps of Chinook RHS closures (which are now part of sector-specific Chinook incentive plan agreements (IPAs)
- Monthly effort compared to other years.

In 2011, there were several notable differences in the rules that apply to the Bering Sea pollock fishery compared to previous years:

- Amendment 91 and sector-specific incentive plan agreements (IPAs) were in place, so there was a hard cap for Chinook PSC, which was allocated to cooperative and the vessel level. IPAs provided additional incentives for Chinook PSC reduction, and therefore gave strong incentives for the fleet to prioritize Chinook PSC avoidance.
- Chinook RHS closures were more limited than in previous years and were distinct for each sector under their IPAs.
- All vessels, including all catcher vessels, had 100-percent observer coverage.
- Chum RHS closures were implemented throughout the B-Season, even in periods of high Chinook PSC.
- Because of changes to the inter-cooperative agreement (ICA), chum RHS closures could be larger and the base rate adjusted more slowly than in previous years, which allowed a larger number of areas to be considered for closures.

Chum Rolling Hotspot Closures, 2011 B-Season

In 2011, RHS closures were in place throughout the B Season, as in recent years, with a total of 36 chum closures implemented. Unlike in other recent years, however, the late season closures did not prioritize Chinook closures when hotspots were identified for both Chinook and chum. Between 2007 and 2010, only one chum closure was in place in October, versus four this year. Figure 1 displays all of the chum RHS closures that were in place during the 2011 B-Season.

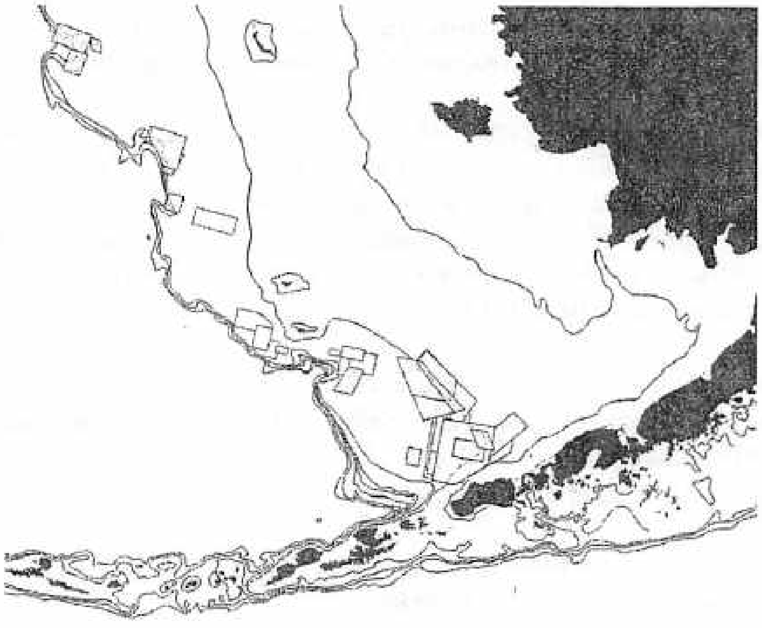


Figure 1: Chum Rolling Hotspot (RHS) Closures, 2011 B Season

The chum RHS closures were adjusted and/or extended twice per week via notice from Sea State to the fleet. Recent changes in the ICA permitted greater area to be closed and for a slower base rate adjustment, which provided more opportunities to close areas (pers. comm. J. Gruver). Figure 2 shows chum PSC by day-of-the-year for the 2011 B-Season (comparable panels for previous years are available in Figure 5-87).

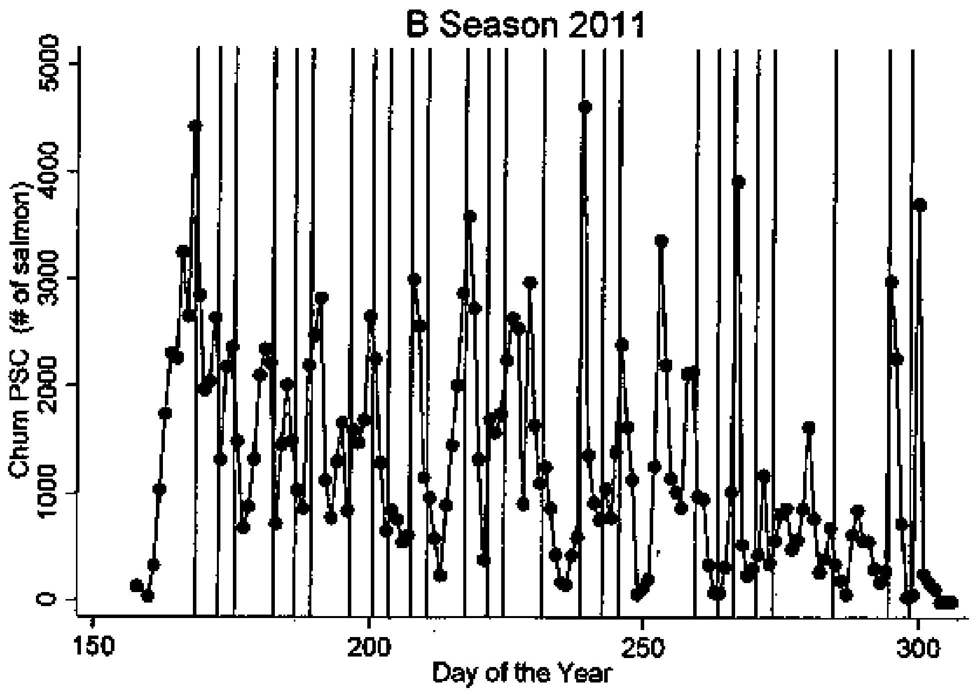


Figure 2: Chum PSC by day of year, 2011. Vertical lines represent when closures were implemented. (Comparable to Figure 5-87)

One noticeable aspect of variation in chum PSC in 2011 was its daily volatility. The days with the highest total chum PSC occurred at the beginning, middle, and end of the year and chum PSC rates quickly fell from spikes. This pattern indicates the consistency of chum PSC encounters throughout the season. The lack of prolonged high-PSC periods also suggests that vessels were not returning immediately to high-PSC areas.

Table 1 (an update to Table 5-58) displays the amount of pollock catch and Chinook and chum PSC that occurred in the location of closure areas in the 5 days before they were implemented. For all fishing sectors in 2011, the largest amount of pollock and chum to date occurring in the soon-to-be-closed areas, which would suggest that the chum RHS closures potentially had a larger impact on vessel behavior than in previous years. Those vessels that were fishing in the areas in the period immediately prior to the closures had on average about the same share of their pollock catch in the areas to be closed.

Table 1: Average percent of total Chum, Chinook, and Pollock caught in RHS closures during the 5 days before each closure, 2003-2011 (comparable to Figure 5-58)

	Catcher Vessels			CPs/MS		
Year	% Chum	% Chin	% Poll	% Chum	% Chin	% Poll
2003	27%	10%	21%	28%	4%	4%
2004	33%	9%	8%	23%	4%	3%
2005	21%	21%	12%	19%	3%	4%
2006	19%	28%	9%	15%	0.7%	0.5%
2007	11%	19%	7%	30%	22%	5%
2008	29%	52%	11%	2%	6%	0.3%
2009	33%	18%	13%	9%	18%	2%
2010	33%	47%	9%	13%	35%	2%
2011	36%	7%	17%	32%	6%	6%

As noted in the status quo hotspot analysis, a repeated examination of chum PSC rates before and after closure implementation provides evidence of whether or not the RHS closures are effective. An examination of Table 2 displays that in general, while chum PSC rates were slightly lower in the days following closures than, in 2011 they were higher. However, a few important caveats should be noted:

- It is more difficult to assess whether an individual closure, or even a year worth of closures, is effective, as daily chum PSC rates are very volatile. This is particularly true when chum are spatially dispersed, as was the case in 2011.
- This the first year that chum RHS system was operating under Amendment 91.
- For catcher vessels, the percentage of trips where vessels encountered zero chum was lower than in any previous year (including 2005), yet the total chum PSC for the sector was considerably lower than in the highest PSC years. This could be due to changes in observer coverage leading to more chum being counted when very few chum appear in a deliver and/or to avoidance of particularly high-PSC areas.
- In general, 2011 involves an observer census of salmon rather than a sample.
- As always, this method of analysis does not account for a number of RHS benefits noted in the status quo analysis, including whatever savings might result from closures that are left in place for several weeks in high-PSC areas.

Table 2: Change in Chum PSC in days before and after closure implementation. 2003-2011

Day Relative to Closure	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
-3	0.239	0.486	0.862	0.497	0.141	0.03	0.103	0.058	0.41	0.411
-2	0.253	0.386	0.782	0.529	0.128	0.059	0.095	0.056	0.331	0.371
-1	0.285	0.465	0.841	0.544	0.176	0.053	0.127	0.054	0.352	0.411
1	0.39	0.311	0.712	0.35	0.147	0.066	0.192	0.095	0.435	0.371
2	0.227	0.385	0.753	0.423	0.133	0.027	0.204	0.119	0.493	0.398
3	0.242	0.418	0.821	0.473	0.199	0.033	0.142	0.033	0.396	0.395
Total	0.273	0.408	0.795	0.467	0.154	0.045	0.144	0.059	0.404	0.393

Chinook Rolling Hotspot Closures, 2011 B-Season

With Amendment 91, the Chinook RHS program was taken out regulation. However, as part of the IPAs that have been implemented in all three sectors (with 100% of vessels), a Chinook RHS system is in place. These closures applied to different vessels depending on their PSC performance compared to the "base rate" for the sector. The mothership closures that were implemented applied to one platform, the CP closures were closed to one vessel, and the shoreside closure applied to 12 vessels. Additional "advisory areas" were also distributed to the fleets. Figure 3 displays the Chinook RHS closures that were in place for the different sectors during 2011, which are in addition to the hard cap and other IPA components that are discussed in Chapter 2 of the EA.

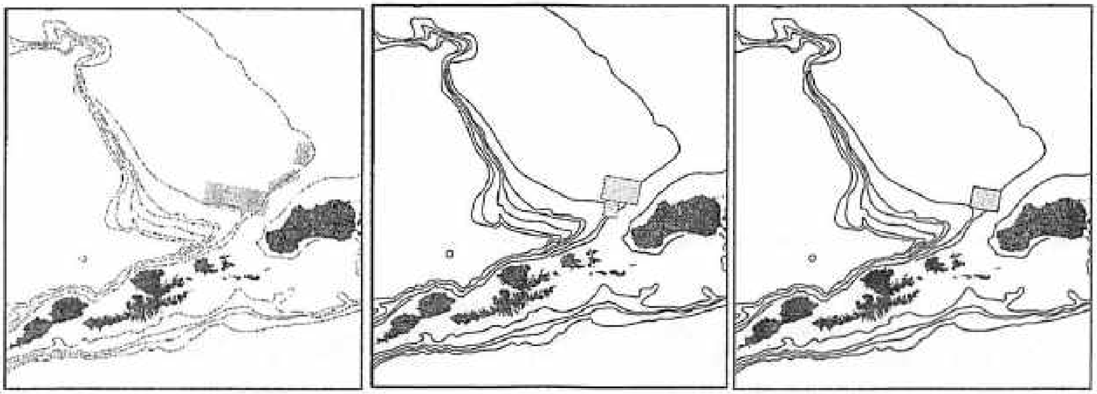


Figure 3: Chinook Rolling Hotspot Closures, 2011 B-Season for the Mothership Sector (Left Panel), Catcher Processor sector (Middle) and Catcher vessel sector (Right). Additional high-Chinook advisory areas were also communicated to the fleet.

Further analysis of the effectiveness of these closures will be conducted following the availability of IPA reports.

Monthly Effort Distribution

This section of the document provides some additional information about how fishing effort in 2011 compares to previous years. Fishing effort in all sectors began relatively intensely in June, although variation in TAC and the implementation of 100-percent coverage makes comparing 2011 more complex than comparing other years.

In August 2011, there was an unusually steep decline in pollock catch per unit effort (CPUE), which fell abruptly. Table 3 displays the count and percentage of hauls by month for the catcher processor and mothership sectors, indicating a larger than average amount of fishing in October, driven apparently by poor pollock fishing conditions in the middle of the summer. Table 4 displays the number and percentage of hauls by the shoreside catcher-vessel sector. There was much less effort in October from 2008-2010 than in previous years, which was impacted by low TAC and by the greater number and proportion of hauls that have occurred by CVs in June since 2007.

Table 3: Count and Percentage of CP and MS Hauls per Month, B-Season 2003-2011[1]

	Hauls per month by year, CP, MS, and CDQ Sectors								
month	2003	2004	2005	2006	2007	2008	2009	2010	2011
June	648	679	658	510	417	309	401	578	609
July	1,416	1,519	1,435	1,374	1,375	1,135	1,012	948	1,156
Aug	1,347	1,369	1,353	1,475	1,376	1,038	809	749	924
Sept	944	864	848	895	784	852	461	161	862
Oct	143	56	42	360	579	237	16	18	754
	% of total Hauls by year, CP, MS, and CDQ Sectors								
month	2003	2004	2005	2006	2007	2008	2009	2010	2011
June	14%	15%	15%	11%	9%	9%	15%	24%	14%
July	31%	34%	33%	30%	30%	32%	37%	39%	27%
Aug	30%	31%	31%	32%	30%	29%	30%	31%	21%
Sept	21%	19%	20%	19%	17%	24%	17%	7%	20%
Oct	3%	1%	1%	8%	13%	7%	1%	1%	17%

Table 4: Percentage of CV Hauls per Month, B-Season, 2003-2011[2]

	Hauls per month CV Sectors								
month	2003	2004	2005	2006	2007	2008	2009	2010	2011
June	190	232	419	432	469	575	542	428	923
July	653	694	839	707	728	805	753	691	1,429
Aug	923	938	833	907	763	816	456	500	1,417
Sept	724	802	604	827	756	618	236	247	893
Oct	395	495	586	722	861	233	94	169	724
	% of total Hauls by CV Sector								
mon	2003	2004	2005	2006	2007	2008	2009	2010	2011
June	7%	7%	13%	12%	13%	19%	26%	21%	17%
July	23%	22%	26%	20%	20%	26%	36%	34%	27%
Aug	32%	30%	25%	25%	21%	27%	22%	25%	26%
Sept	25%	25%	18%	23%	21%	20%	11%	12%	17%
Oct	14%	16%	18%	20%	24%	8%	5%	8%	13%

[1] The total number of hauls changes based on TAC and catch rates, but the numbers indicate that there was relatively intense effort early in the season.

[2] Because of the implementation of 100-percent observer coverage in 2011, shoreside delivery counts for 2011 are not comparable to previous years. Percentages adjust with the total TAC as a shorter period is typically required to catch a lower TAC.

7.2.2.5 Cook Inlet Beluga Whale

In a memorandum dated March 26, 2010, the NMFS Alaska Region Protected Resources Division (PRD) concurred with the Alaska Region Sustainable Fisheries Division (SFD) determination that federal and State of Alaska parallel groundfish fisheries were not likely to adversely affect Cook Inlet beluga whales (Brix 2010). This consultation included Amendment 91 to the BSAI FMP to limit Chinook salmon PSC in the pollock fishery and determined the effects of the action on Cook Inlet beluga whales directly through vessel interaction and indirectly through potential prey competition were discountable and insignificant.

No chum salmon with Coded Wire Tags (CWT) from Cook Inlet have ever been recorded in the BSAI groundfish fisheries, although the numbers of Cook Inlet CWT salmon are low, and none have been released since 1991. Genetic analyses indicate that a significant portion of the chum salmon PSC in BSAI groundfish fisheries are of Asian origin, although genetic baseline data from BSAI groundfish fisheries do not represent Cook Inlet populations well. Therefore, no definitive conclusions can be drawn regarding the percentage of chum salmon caught in the Bering Sea with Cook Inlet origins. However, data available for salmon PSC in the GOA and BSAI fisheries indicates that the potential amount of Cook Inlet chum salmon harvested in the BSAI is small, and there is not likely to be a measurable direct effect to prey otherwise available to Cook Inlet beluga whales. Therefore, effects from the Alaska groundfish fisheries and Amendment 93 were considered insignificant.

In April, 2011 critical habitat for Cook Inlet beluga whales was designated which necessitated reinitiation of consultation on the effects of Alaska groundfish fisheries on Cook Inlet beluga whale critical habitat. In January, 2012 SFD requested consultation on the effects of Alaska groundfish fisheries and Amendment 93 to the GOA FMP on Cook Inlet beluga whales. In a memo dated February 15, 2012, PRD concurred with SFD that the two actions may affect, but are not likely to adversely affect, the Cook Inlet beluga whale or its critical habitat (Rivera 2012).

Table 7-5. Marine Mammals taken in the pollock fishery in 2007, 2008, 2009, 2010, and 2011. Locations correspond to the areas depicted in Figure 7-5 (Source: National Marine Mammal Laboratory 3-07-12)

Species	Date of Interaction	NMFS Management Area
Steller sea lion	2007-03-13	517
Northern fur seal	2007-08-07	513
Northern fur seal	2007-08-21	517
Bearded seal	2007-09-11	521
Northern fur seal	2007-09-26	521
Steller sea lion	2007-10-09	521
Steller sea lion	2008-01-21	509
Steller sea lion	2008-01-30	509
Steller sea lion	2008-01-30	509
Harbor Seal	2008-01-31	517
Steller sea lion	2008-03-02	517
Steller sea lion	2008-03-03	517
Steller sea lion	2008-07-04	521
Steller sea lion	2008-07-06	521
Bearded seal	2008-07-08	517
Ringed seal	2008-07-16	521
Ribbon seal	2008-08-04	521
Bearded seal	2008-08-17	521
Steller sea lion	2008-08-25	521
Ribbon seal	2008-09-05	517
Bearded seal	2008-09-05	524
Northern fur seal	2008-09-09	521
Bearded seal	2008-09-21	524
Steller sea lion	2009-01-27	509
Steller sea lion	2009-02-14	513
Steller sea lion	2009-02-16	509
Steller sea lion	2009-02-16	509
Steller sea lion	2009-02-17	509
Dall's Porpoise	2009-02-23	509
Steller sea lion	2009-03-18	513
Ribbon seal	2009-07-19	521
Bearded seal	2009-07-30	509
Ringed seal	2009-08-06	521
Steller sea lion	2010-02-23	509
Steller sea lion	2010-03-03	521
Steller sea lion	2010-03-06	521
Spotted Seal (Larga Seal)	2010-03-20	521
Steller sea lion	2010-04-05	521
Bearded seal	2010-07-06	509
Humpback Whale	2010-07-19	517
Northern fur seal	2010-08-04	517
Northern fur seal	2010-08-10	521
Steller sea lion	2010-08-12	517
Steller sea lion	2011-01-30	509
Steller sea lion	2011-02-24	509
Steller sea lion	2011-02-26	513

Species	Date of Interaction	NMFS Management Area
Ringed seal	2011-04-01	521
Steller sea lion	2011-06-24	517
Steller sea lion	2011-06-27	521
Steller sea lion	2011-08-04	519
Ringed seal	2011-08-07	521
Ringed seal	2011-08-11	524
Steller sea lion	2011-08-23	517
Steller sea lion	2011-08-31	519

7.2.6 Prey Availability Effects

Table 7-6 shows the Bering Sea marine mammals that may be impacted by the pollock fishery and their prey species. Pollock and salmon prey are in **bold**.

Table 7-6 Bering Sea Marine Mammal that are known to feed on pollock or salmon.

Species	Prey
Fin whale	Zooplankton, squid, fish (herring, cod, capelin, and **pollock**), and cephalopods
Humpback whale	Zooplankton, schooling fish (**pollock**, herring, capelin, saffron cod, sand lance, Arctic cod, and **salmon** species)
Minke whale	Pelagic schooling fish (herring and **pollock**)
Beluga whale	Wide variety invertebrates and fish including **salmon and pollock**
Killer whale	(transient) Marine mammals and (resident) fish (including herring, halibut, **salmon**, and cod)
Dall's porpoise	hake, squid, lanternfish, anchovy, sardines, and small schooling fish.
Bearded seal	Primarily crab, shrimp, and mollusks; some fish (Arctic cod, saffron cod, sculpin, and **pollock**)
Spotted seal	Primarily pelagic and nearshore fish (**pollock and salmon**), occasionally cephalopods and crustaceans
Ribbon seal	Arctic and saffron cods, **pollock**, capelin, eelpouts, sculpin and flatfish, crustaceans and cephalopods
Northern fur seal	**Pollock**, squid, and bathylagid fish (northern smoothtongue), herring, **salmon**, and capelin. (Females at Bogoslof eat primarily squid and bathylagid fish and less pollock than in the Pribilofs, and salmon irregularly.)
Harbor seal	crustaceans, squid, fish, and mollusks
Steller sea lion	**pollock**, Atka mackerel, Pacific herring, Capelin, Pacific sand lance, Pacific cod, and **salmon**

Sources: NOAA 1988; NMFS 2004; NMFS 2007b; Nemoto 1959; Tomilin 1957; Lowry et al. 1980; Kawamura 1980; http://www.afsc.noaa.gov/nmml/education/cetaceans/sperm.php; Rolf Ream, NMML personal communication, September 26, 2008; and http://www.adfg.state.ak.us/pubs/notebook/marine/orca.php

Nine of the species listed in Table 7-7 are documented to eat pollock, and six of the marine mammals listed eat salmon. Salmon is primarily a summer prey species for Steller sea lions (NMFS 2001), resident killer whales (NMFS 2004), spotted seals (CBD 2008a), beluga whales (NMFS 2008), and northern fur seals (NMFS 2007b). Steller sea lions, ribbon seals, and northern fur seals depend on pollock as a principal prey species (NMFS 2007a, 2007b and http://www.adfg.state.ak.us/pubs/notebook/marine/rib-seal.php). Spotted seals eat pollock mainly in the winter and spring, and salmon in the summer (CBD 2008). Prohibited Species Catch (PSC) of chum salmon in the BSAI pollock fishery may have some impacts on species that feed on chum salmon. Previous consultations (Brix 2010, Rivera 2012) have determined that Chinook and chum salmon PSC in the Bering Sea groundfish fisheries is unlikely to affect Cook Inlet belugas because Cook Inlet beluga whales do not normally transit outside of Cook Inlet, and therefore are unlily to encounter vessels fishing in the federal groundfish fisheries, and the small proportion of Cook Inlet salmon that are caught incidentally in BSAI groundfish fisheries. Based on the results of previous informal consultations on the effects of the Alaska groundfish fisheries on Cook Inlet beluga whales and their designated critical habitat, further restrictions on chum salmon PSC in the BSAI pollock fishery may affect, but are unlikely to adversely affect, Cook Inlet belugas or their designated critical habitat. Any effects on Cook Inlet belugas are likely to be incremental and insignificant.

Several marine mammals do not depend primarily on pollock or salmon but may be impacted indirectly by effects that the pelagic trawl gear may have on benthic habitats where marine mammals are dependent on benthic prey. The EFH EIS provides a description of the effects of pollock fishing on bottom habitat in Appendix B (NMFS 2005a). Although pollock trawl gear is considered pelagic, pollock trawl gear is known to contact the bottom and may impact benthic habitat. The fisheries effects analysis in the EFH EIS determined that the long term effects indices for pollock fishing on sand/mud and slope biostructure in the Bering Sea were much larger than the effects from other fisheries conducted in the Bering Sea, especially on the slope (Table 8.2-10 in NMFS 2005a)

Table 7-7 shows the marine mammals that feed on benthic prey and the known depths of diving and Bering Sea locations. Most pollock fishing is conducted in waters between 50 m and 200 m (Figure 4-2).

Table 7-7. Name, location and dive characteristics of benthic feeding marine mammals that may be affected by the pollock fishery.

Species	Location and dive characteristics
Bearded seal	Occur in waters < 200 m, at least 20 nm from shore during spring and summer (Figure 7-4)
Ringed seal	Usually shallow but can dive up to 500 m. Throughout pack ice.
Ribbon seal	Mostly dive < 150 m on shelf, deeper off shore. Shelf and slope areas
Spotted seal	Up to 300 m. Coastal habitats in summer and fall and ice edge in winter
Harbor seal	Up to 183 m. Generally coastal
Pacific walrus	Usually in waters < 100 m. Shelf area, concentrated SW of St. Lawrence Island and in Nunivak Island/Bristol Bay area
Gray whale	< 60 m waters, coastal and shelf area.
Beluga whale	6-30 m, shelf area and nearshore estuaries and river mouths

Sources: http://www.adfg.state.ak.us/pubs/notebook/marine/harseal.php, http://www.afsc.noaa.gov/nmml/species/species_ribbon.php, http://www.adfg.state.ak.us/pubs/notebook/marine/rib-seal.php, Burns et al. 1981, Angliss and Outlaw 2008, Angliss and Outlaw 2007, http://www.adfg.state.ak.us/pubs/notebook/marine/gray.php, http://alaska.fws.gov/fisheries/mmm/walrus/nhistory.htm, and http://www.adfg.state.ak.us/pubs/notebook/marine/beluga.php

Sperm whales, beluga whales, and harbor seals are unlikely to be affected by the Bering Sea pollock fishery because they occur in areas outside of pollock trawling concentration. The pollock fishery in the SE Bering Sea occurs between 100 m and 50 m deep, and may overlap with a portion of the gray whale feeding area. However, pollock fishing is not likely to impact gray whales considering the extensive area of the Bering Sea under 60 m depth that is not fished for pollock and the areas of pollock fishing compared to the areas of gray whale migration and feeding.

Ice seals occur seasonally in areas where the pollock fishery operates during the ice-free season, and may, therefore, be affected by benthic disturbance by the pollock fishery. Bearded seals have been taken incidentally in area 524 by the pollock fishery (Table 7-7) and may use benthic habitat for feeding in locations where pollock fishing has occurred. Ribbon and spotted seals are probably less likely to be affected by any benthic prey disturbance compared to the other ice seals due to pollock being their primary prey.

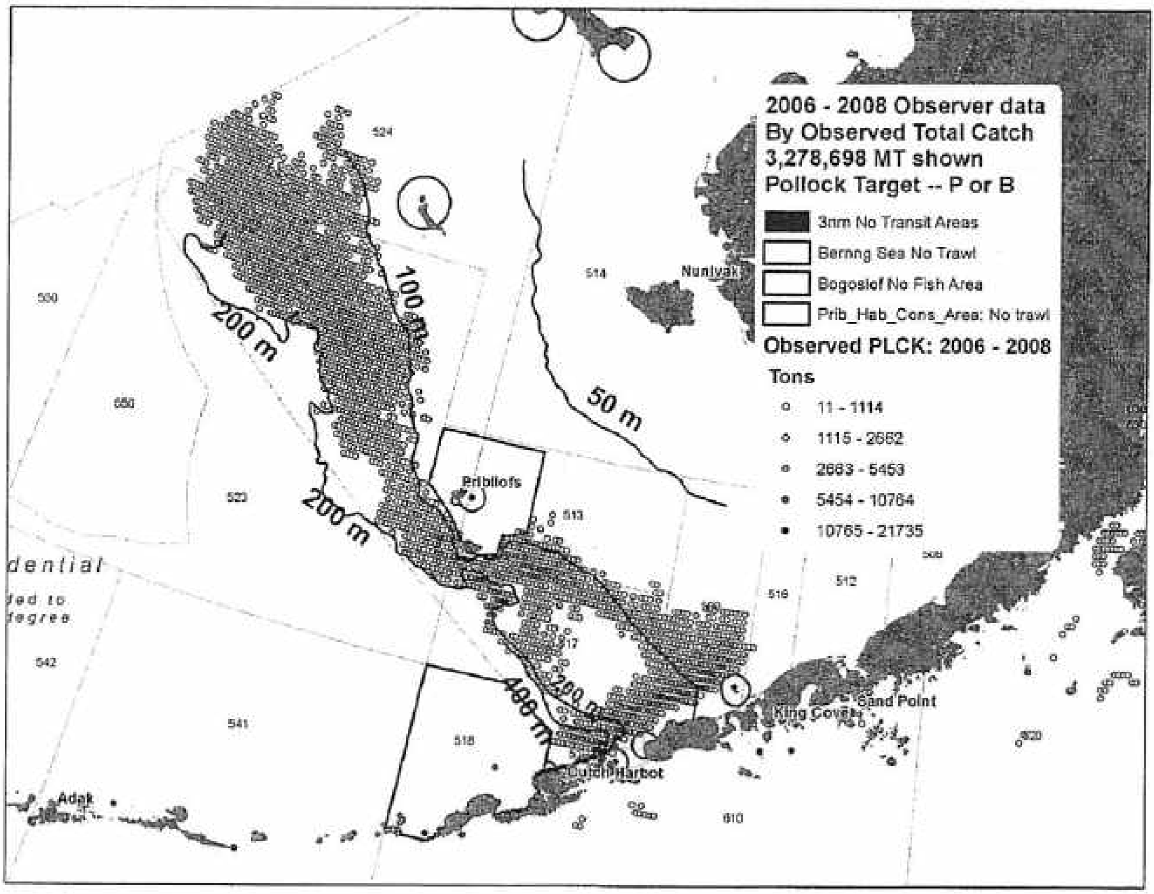


Figure 7-6 2006-2008 Observed pollock harvest and bathymetry of the Bering Sea (Steve Lewis, NMFS Analytical Team, October 5, 2008)

The Alaska Groundfish Harvest Specifications EIS determined that competition for key prey species under the status quo fishery is not likely to constrain foraging success of marine mammal species or cause population declines (NMFS 2007a). The exceptions to this are northern fur seals and Steller sea lions which potentially compete for principal prey with the groundfish fisheries (NMFS 2001, 2007b).

Summary of statewide teleconference on proposed alternatives to limit non-Chinook (chum) salmon bycatch in the Bering Sea pollock fisheries

North Pacific Fishery Management Council
February 24, 2012

Purpose

In May 2010, North Pacific Fishery Management Council (Council) staff held a statewide teleconference to inform rural stakeholders of the alternatives that were being considered to limit non-Chinook (primarily chum) salmon bycatch in the Bering Sea pollock fisheries, and to help the public understand the Council process and ways to provide formal input to the Council. Additionally, the public was given opportunity to express concerns and ask questions of the Council analysts. A report of that call was presented at the June 2010 Council meeting in Sitka, AK.

A second statewide teleconference was held on February 24, 2012, as requested by the Rural Community Outreach Committee, and directed by the Council. The purpose of this second call was again to inform the public of the alternatives under consideration to reduce non-Chinook salmon bycatch in the Bering Sea pollock trawl fisheries, to help the public understand the Council process and ways to provide formal input to the Council, and provide opportunity for the public to express concerns and ask questions of the Council analyst. Any comments and questions that resulted from this call are intended to become part of the official public record for the non-Chinook salmon bycatch action taken by the Council. Comments are incorporated into this report, which will also be provided to the Council as part of the overall outreach report at a future Council meeting.

Logistics and participation

Notice of the teleconference was announced in several ways, including email notices, postings on the Council website, direct mailings to stakeholders, and announcement on Alaska Public Radio Network community calendars and public service announcements. The mailing was sent to over 150 individuals and entities, including community governments, regional and village Alaska Native corporations, regional non-profit Alaska Native organizations, tribal entities, Federal Subsistence Regional Advisory Council coordinators, Community Development Quota corporations, ADF&G Regional Coordinators, and other community and Alaska Native entities.

An announcement that contained a brief summary of the alternatives and provided call details was emailed to the Alaska Public Radio Network and news or station managers of several public radio stations including:

KSKA	Anchorage
KNBA	Anchorage
KYUK	Bethel
KOTZ	Kotzebue
KNOM	Nome
KSDP	Sand Point
KUHB	St. Paul Island
KUCB	Unalaska
KMXT	Kodiak
KDLG	Dillingham

The teleconference was open to the public, and hosted by the Council. The call was moderated and recorded by EventBuilder.[1] A toll-free number was provided, and an unlimited number of lines could be accommodated.

The call took place from 9 am – 11 am on February 24, 2012. Council analyst, Dr. Diana Stram, provided a 30 minute presentation on the proposed action and Council process, with 90 minutes remaining for questions and comments from the public. Callers provided their name and location. The presentation was posted on the Council website two weeks prior to the teleconference, and is attached as **Appendix 1**.

The call log, which indicates the number of callers, their location, and the amount of time they participated, is provided as **Appendix 2**. A total of 49 unique lines called in, which effectively means a minimum of 49 people participated, as there were several sites with more than one person on the line. Note that the call log lists a total of 67 calls, but several of those were from the same number, resulting in a total number of 49 individual lines (e.g., a person called in for a portion of the call, hung up, then called back in later). Individual phone numbers of participants are not provided in the call log to protect confidentiality. Nineteen different communities were represented, including 12 small Alaskan communities, and Whitehorse, Yukon Territory.

Summary of questions and comments

The following provides a brief summary of participants' questions and comments, and a summary of staff response, where appropriate.

Emmonak – Nick Tucker

Caller questioned whether outreach meetings such as the statewide call contributed more to affected communities than regular meetings. Does the Council believe that they are helping more than hindering affected communities?

Staff responded that public participation is an important part of the Council process and that the Council hopes that the calls and other outreach efforts provide an opportunity for more effective two way communication.

Caller noted that the declines seen in Chinook salmon in the river are starting to be seen in chum salmon. Villagers currently have no control over in-river fisheries and intense in-river conservation measures are pitting one region against another for fish (upriver vs. downriver). He noted that preventative measures against chum salmon bycatch are needed now, although he has not yet formed an opinion on the alternatives for Council action.

Nome – Roy Ashfelter, Kawerak

Caller questioned which alternative of the three being considered called for the greatest reduction in chum bycatch.

Staff responded that Alternative two contained the most restrictive hard cap, 50,000.

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[1] EventBuilder is a provider of online event technology and conferencing services that provides event management, online registration and web and audio conferencing. www.eventbuilder.com.

Caller noted that there has not been a commercial fishery for chum salmon for the last 20 years, and noted that the chum fishery is a tier 2[2] fishery, meaning that mandatory escapement numbers must be reached before a commercial fishery occurs. He also noted that recent escapement numbers are up. However, there is still concern for chum salmon escapement for three rivers in the Nome area. Caller stated that balanced decisions must consider the needs of people in Norton Sound, and recommended that the Council implement a hard cap for chum salmon bycatch.

Caller also requested clarification on the Council's role in tribal consultation.

Staff responded that the Council's understanding is that NMFS is the executive agency responsible for tribal consultation under EO 13175, but that the Council supports the consultation process through providing data, presentations, and/or staff. The Council has also made a motion to request tribal consultation reports, when available, from NMFS as early as possible in the Council's decision-making process. In June 2011, the Council also requested clarification from NOAA General Counsel as to whether the current understanding regarding the Council's role in tribal consultation is correct.

Fairbanks – Orville Huntington, Tanana Chiefs Conference

Caller asked when there are opportunities for public comment in the Council process.

Staff suggested written or oral testimony prior to or during Council meetings, and noted that there are fax, letter, or new email options for submitting public testimony up to a week before the Council meeting.

Hooper Bay – David ______, Native Village of Hooper Bay

Caller asked if Area M fishery was open.

Staff responded that the area fishery was open, and that there was concern over a higher proportion of chum salmon bycatch from Western Alaska in the June fishery.

Emmonak – Dora Moore, Tribal Council

Caller recognized that chum salmon bycatch is a sensitive issue and different stakeholder groups have different concerns and views. Caller asked how the alternatives being considered affect the escapement agreement between Canada and the U.S.

Staff responded that it is difficult to predict how alternatives will affect upper Yukon River chum salmon escapement, but Council staff has regularly met with the Yukon River Panel to keep them involved and engaged on the issue of chum-salmon bycatch. Staff noted that it is possible to review alternatives for their effects on upper Yukon (fall) chum salmon, but those estimates should not be considered an estimate or prediction for meeting treaty goals.

[2] The Norton Sound chum salmon fishery has not been a Tier 2 fishery since 2005.

Nome – Rose Fosdick, Kawerak

Caller noted the high chum salmon bycatch years in 2004 – 2006 were likely connected to low escapement years in 2008 – 2009. Caller also commented that there are little data to review the effects of the alternatives on subsistence. Caller asked who is doing the research, and what information they are using. Caller also stated disappointment that the WASSIP genetic studies aggregated western Alaska chum salmon, and feels that the analysis fails to recognize the importance of Norton Sound chum salmon.

Staff responded that limitations in genetic resolution preclude analysis of genetic data at scales finer than current aggregations. Staff also responded that subsistence data come primarily from published reports from the Division of Subsistence division at ADF&G. A literature review was also conducted, and the information provided cites research from Wolfe, Magdanz, Moncrieff, and others.

Nome – Tim Smith

Caller noted that local groups from Norton Sound have recommended that the Council consider lower hard caps than are currently in the alternatives, and asked whether the Council can consider other alternatives.

Staff responded that the Council can modify alternatives for analysis and reiterated that the caller should send formal comments to the Council with that suggestion.

St. Mary's – Michael James

Caller stated that he would like to see more salmon escapement devices for chum salmon in use in the Bering Sea pollock fishery, more fishery observers in place fleet-wide, more stand-down periods, and suggests a hard cap lower than 50,000 to allow better escapement for chum salmon in western Alaska rivers and to meet treaty obligations.

Emmonak – Michael ________, Tribal Council

Caller expressed concern about the Northern Bering Sea Research Area and its important habitat for marine mammals, migratory species of mammals and birds, anadromous fish (including whitefish, eels, smelts, tomcod), and suggested that the NBSRA should be considered for permanent protection.

Staff responded that the Northern Bering Sea Research Area is currently closed to all non-pelagic trawling, and Council plans are to keep the closure in place at least until sufficient knowledge exists to understand and mitigate impacts from trawling on benthic habitats of the northern Bering Sea.

Nome – Roy Ashfelter

Caller asked whether alternatives being considered by the Council could be combined, for instance combining a hard cap with other measures to reduce bycatch.

Staff responded that the alternatives for analysis can be combined by the Council and encouraged the caller to send formal comment to the Council with specific suggestions. The Council would need to identify the combination of alternatives in order for an analysis of combined alternatives to be provided

Caller asked whether the Council could consider different measures for different years because of differential chum salmon returns in even and odd years.

Staff responded that the current alternatives do not consider transfer of bycatch or other measures to address even/odd year differences. The Council could consider such measures, but a mechanism to identify appropriate measures would be necessary.

Hooper Bay – David ____

Caller asked whether there were current concerns about herring bycatch.

Staff responded that a herring cap already exists on the groundfish fisheries in the Bering Sea, but that herring bycatch was not a focus of the current analysis.

Appendix 1: NPFMC staff powerpoint presentation during teleconference.

The powerpoint presentation is available on the Council website at:
http://www.fakr.noaa.gov/npfmc/PDFdocuments/bycatch/chumPPT212.pdf

Appendix 2: Audio log: Statewide Chum Salmon PSC Teleconference

Location	Duration
Seattle, WA	12
Seattle, WA	7
Seattle, WA	1
Seattle, WA	1
Seattle, WA	2
Whitehorse, YT	13
Seattle, WA	0
Emmonak, AK	4
Emmonak, AK	0
Whitehorse, YT	19
Seattle, WA	10
Wenatchee, WA	20
Fairbanks, AK	9
Anchorage, AK	36
Anchorage, AK	48
Nome, AK	25
Hooper Bay, AK	58
Hooper Bay, AK	0
Hooper Bay, AK	0
Seattle, WA	47
Fairbanks, AK	38
Seattle, WA	12
Seattle, WA	59
Fairbanks, AK	8
Kotzebue, AK	81
Anchorage, AK	83
Anchorage, AK	78
Anchorage, AK	8
Nome, AK	87
Juneau, AK	84
Fairbanks, AK	71
Seattle, WA	80
Seattle, WA	82
Deming, WA	85

Nome, AK	30
Juneau, AK	85
Seattle, WA	84
Seattle, WA	86
Anchorage, AK	83
Wasilla, AK	56
St Marys, AK	83
Nome, AK	85
Nome, AK	88
Bethel, AK	16
Anchorage, AK	87
Nome, AK	71
Anchorage, AK	32
Petersburg, AK	88
Unalaska, AK	78
Juneau, AK	86
Hooper Bay, AK	26
Fairbanks, AK	88
Anchorage, AK	35
Fairbanks, AK	87
Fairbanks, AK	62
Teller, AK	92
Fairbanks, AK	9
St Marys, AK	84
Seattle, WA	75
Anchorage, AK	87
Anchorage, AK	59
Emmonak, AK	87
Anchorage, AK	89
Kodiak, AK	90
Dillingham, AK	93

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

March 15, 2012

Eric Olson, Chairman
North Pacific Fishery Management Council
605 W. 4th Avenue, Suite 306
Anchorage, Alaska 99501-2817

Dear Chairman Olson:

Enclosed are the following documents related to two tribal consultation meetings in 2011 between the National Marine Fisheries Service (NMFS) and Alaska Native tribes from the Norton Sound region about chum salmon bycatch:

1. A report of the June 1, 2011, tribal consultation meeting, including a copy of one of the resolutions we received from the tribes about chum salmon bycatch.
2. NMFS's June 6, 2011, letter summarizing the consultation meeting.
3. A report from the October 6, 2011, follow-up teleconference with tribal representatives at which staff provided an update on the analysis and more information about the prohibited species donation program.

NMFS staff will be available at the upcoming North Pacific Fishery Management Council meeting to answer any questions the Council may have about the tribal consultation meetings or these documents.

Sincerely,

James W. Balsiger, Ph.D.
Administrator, Alaska Region

Enclosures

Summary of
Tribal Consultation Teleconference on
Chum Salmon Bycatch in the Bering Sea Pollock Fishery
June 1, 2011

In Attendance

Attending via telephone:

Native Village of Elim/Elim IRA Council
Robert Keith, President
Sheldon Naguruk, Council member
e-mail: jmurray@kawerak.org (Janelle Murray, Tribal Coordinator)

Native Village of Gambell
Iver Campbell, IRA Council President
e-mail: ivercampbell@yahoo.com

Native Village of Savoonga
Ronnie Toolie, President (stoolie@kawerak.org)
Peggy Akeya (peggyakeya@yahoo.com)
Verna Immingan

Native Village of Shishmaref/Shishmaref IRA Council
Donna Barr, Vice-President
Howard Weyiouanna, Sr.
e-mail: knayokpuk@kawerak.org; tc.shh@kawerek.org (tribal coordinators)

Native Village of Teller/Teller Traditional Council
Wesley Okbaok, President
Joe Garnie
e-mail: cisabell@kawerak.org

Mary's Igloo Traditional Council
Albert W. Oquilluk
e-mail: cablowaluk@kawerak.org

Kawerak, Inc.
Julie Raymond-Yakoubian
e-mail: JRaymond-Yakoubian@kawerak.org

Attending in person, NMFS Alaska Regional Office:
Doug Mecum, Deputy Regional Administrator, NMFS Alaska Region
Glenn Merrill, Assistant Regional Administrator, NMFS, Sustainable Fisheries Division
Sally Bibb, NMFS, Sustainable Fisheries Division (907-586-7389)
Melanie Brown, NMFS Sustainable Fisheries Division
Mary Grady, NMFS Sustainable Fisheries Division
Sarah Ellgen, NMFS Sustainable Fisheries Division
Gabrielle Aberle, NMFS Sustainable Fisheries Division (907-586-7356)
Scott Miller, NMFS, Analytical Team and co-author on chum salmon bycatch analysis
John Lepore, NOAA General Counsel
Demian Schane, NOAA General Counsel

Summary

The six Norton Sound and Bering Strait tribes listed above requested a consultation on chum salmon bycatch in the Bering Sea pollock fishery. Each tribe had submitted to the National Marine Fisheries Service (NMFS) a written resolution stating its position on chum salmon bycatch and a separate resolution requesting a permanent ban of all bottom trawling in the Northern Bering Sea Research Area. The consultation between the NMFS and representatives of the six tribes was conducted under Presidential Executive Order 13175. Julie Raymond-Yakoubian also participated in the consultation.

Sally Bibb opened the meeting by introducing those present at the NMFS Alaska Regional Office, then asked for an introduction from each tribal representative. Sally Bibb asked if any of the representatives had questions, but none did at that time. She then presented an overview of the chum salmon bycatch issue and asked the representatives to share their concerns and questions. The following issues were raised by the tribal representatives.

- All six of the tribes requested the North Pacific Fishery Management Council (Council) adopt a hard cap of 30,000 chum salmon for the Bering Sea pollock fishery. On reaching the hardcap, the pollock fishery should be closed and no sector allocations, sector transfers, or cooperative provisions allowed. This request is in response to the continuing decline of regional salmon stocks, which has severely impacted the tribes' subsistence practices and traditions.

    - Response: In a letter dated June 6, 2011, NMFS provided the Council with a preliminary summary of the issues discussed at the consultation. NMFS requested the Council address the recommendation for a 30,000 hard cap by either including it in the alternatives analyzed or providing an explanation why this suggested cap does not meet the purpose and need for the action, and therefore, will not be included in the alternatives analyzed. A copy of this letter is enclosed with this report.

      The Council discussed the tribes' resolutions at its June 2011 meeting and asked for additional information about the reasons that the tribes recommended a 30,000 hard cap. NMFS will schedule a teleconference with interested Norton Sound and Bering Strait tribes in September 2011, or as soon as all interested parties are available to further discuss the tribes' recommendations on chum salmon bycatch.

      A summary of the Council's June 2011 action on chum salmon bycatch is enclosed with this report.

      A copy of the Council's revised set of alternatives and schedule for future analysis and discussion of chum salmon bycatch will be provided to the tribes as soon as it is available from the Council.

- An agenda for the June Council meeting in Nome was requested.

    - Response: After the consultation, the link to the Council meeting agenda was emailed to representatives of the tribes who participated in the consultation.

- Several representatives requested information about the prohibited species donation program (PSD) program and expressed interest in participation in the program by western Alaska communities.

- Response: The PSD program allows for the distribution of salmon and halibut caught accidently in the groundfish trawl fisheries to hunger relief organizations. NMFS will provide additional information about the PSD program at its next teleconference with interested Norton Sound and Bering Strait tribes. We can discuss at that time whether any tribes are interested in further follow-up on this program.

- Several representatives noted that salmon have cultural value, not just economic value, and tribes would rather catch fish than acquire them from a food bank. Salmon are nutritionally very important to tribal members. The idea of wasting food is offensive to Alaska Natives. A food bank should not be used to justify salmon bycatch.

  - Response: NMFS appreciates the comments about the cultural significance of salmon. Salmon are prohibited species and are required to be avoided. The purpose of the PSD program is to try to use salmon, which has already been caught and killed, for human consumption, if that salmon has been maintained in the appropriate condition. A relatively small proportion of the salmon bycatch is of the size or quality appropriate for human consumption. Therefore, few salmon are donated to the PSD program. Most salmon are discarded after they have been counted and biological samples have been taken from them.

- Several representatives described environmental changes they have observed in recent years. These include larger fish, more king crabs washing ashore, fish moving north, and a decline in the salinity of some river waters.

  - Response: NMFS notes these observations. We have limited data on the effects of environmental change on salmon and bycatch. Current salmon bycatch data collection and research focuses on using genetics to identify geographic origin of salmon caught as bycatch.

- One representative asked about the effects of radioactive water from Japan's Fukushima Daiichi nuclear power plant on fish off northwest Alaska.

  - Response: Some information from the U.S. Food and Drug Administration is enclosed with this report. This information is available on the internet at: http://www.fda.gov/NewsEvents/PublicHealthFocus/ucm247403.htm.

- Red salmon returns in Salmon Lake have been insufficient in recent years to provide food for the people.

  - Response: Bering Sea bycatch includes only a small amount of red salmon, pink salmon, and coho salmon. Therefore, it is unlikely that salmon bycatch in the Bering Sea trawl fisheries are impacting red salmon returns to western Alaska. However, NMFS will forward a copy of this report to the Alaska Department of Fish and Game so that they are aware that this issue came up in this tribal consultation.

- One representative asked if hatchery eggs can cause cancer.

  - Response: Doug Mecum responded that he is not aware of cancer resulting from hatchery fish. Hatchery practices are stringent about the use of chemicals. Fish live at the hatchery about a year and spend most of their life in the ocean.

- Multiple factors can lower salmon returns, and some cannot be controlled. Consequences of some industries (e.g., shipping, mining) are not clear, but bycatch can be controlled.

  - Response: The Magnuson-Stevens Fishery Conservation and Management Act requires that bycatch be minimized to the extent practicable. The Council's objective for its Chinook salmon bycatch management measures was to provide incentives to minimize Chinook salmon bycatch while still allowing the pollock fishery to continue. The Council's program does not set as a goal allowing the pollock fishery to harvest up to the hard cap of Chinook salmon.

    Thus far in 2011, the first year of the new Chinook salmon bycatch management program, Chinook salmon bycatch is about 7,400 fish. If the Council's chum salmon bycatch management program involves a hard cap, the focus also will be to minimize bycatch rather than establish the hard cap as an acceptable level of bycatch.

- Representatives commented on science and research needs in the area and an interest in collaborative research and funding for the tribes and non-profit corporations. Questions were asked on the cumulative impact of salmon interception in the False Pass salmon fisheries, what information do we get from Russia, and the percent of fisheries taxes that is used for science. Tribes and non-profit corporations should have access to fisheries taxes for their science and research needs.

  - Response: Some of these issues may be addressed in the analysis being prepared by Council and NMFS analysts about chum salmon bycatch in the Bering Sea pollock fishery. NMFS will provide these questions to those analysts and follow-up with the tribes with any further information we obtain.

- Representatives asked how the Council and NMFS are working together to address tribal concerns and what steps NMFS is taking to provide information and education to the tribes on fisheries issues, the Council process, and the agency process.

  - Response: The Council created its Rural Community Outreach Committee to improve communication and outreach to residents of rural Alaska about fisheries conservation and management issues under consideration by the Council. The Council also has conducted extensive outreach efforts over the last three years on salmon bycatch in the Bering Sea pollock fishery. The outreach plans, which include meetings in rural communities, attending regional conferences, and mailings to all villages, tribes, and local government officials, have been developed by and vetted through the committee and several rural stakeholder groups. The outreach plans are presented to the Council and public at multiple meetings, and the results of the outreach are part of the analytical document on which the Council bases its decision. NMFS staff participates in the Council's committee meetings and outreach efforts.

    The University of Alaska's Sea Grant College Program has provided short courses in Nome, Kotzebue, and Togiak about the National Environmental Policy Act (NEPA) with particular focus on fisheries management issues and process. These courses were offered, in part, due to the requests from people in rural communities for education and training about NEPA and the fisheries management process. NMFS staff participated in the Nome and Kotzebue courses.

NMFS contacts by letter all tribes, Alaska Native corporations, and local government officials about fisheries management issues and proposed rule that may be of interest to rural Alaskans. These letters specifically notify the tribes of their opportunities to consult under E.O. 13175. When requested to conduct a consultation, NMFS organizes and participates in the tribal consultations and follow-up meetings. NMFS staff also participate in meetings and regional conferences when requested to do so and when time and budget resources allow that participation.

- NMFS should hire a tribal liaison.
  - Response: NMFS acknowledged the tribes request that it hire a tribal liaison. However, at this time, funding for such a position cannot be prioritized over other responsibilities of the Alaska Regional Office.

Other Issues

In mid-June 2011, NMFS received letters and resolutions from:

Darin Douglas, President, Native Village of Koyuk
Shirley Martin, President, Native Village of St. Michael

They requested a tribal consultation on chum salmon bycatch and provided copies of resolutions on bycatch and trawling in the northern Bering Sea.

- Response: NMFS responded by phone and in writing to Mr. Douglas and Ms. Martin to let them know about the June 1 consultation, that we would provide them a copy of the consultation report, and include them in future meetings or consultations on chum salmon bycatch.

NMFS also will identify contact names and e-mail addresses for the following tribes so that they can be sent a copy of the final consultation report and notified of future discussions with Norton Sound or Bering Strait tribes about chum salmon bycatch:

Brevig Mission	Shaktoolik
Council	Stebbins
Diomede	Unalakleet
Golovin	Wales
King Island	White Mountain
Nome Eskimo Community	

Senator Donny Olson wrote to the Secretary of Commerce (June 10, 2011) and requested to be informed of NMFS's future consultations with Native villages in his district and to be kept apprised of the Department of Commerce's actions and recommendations under E.O. 13175.

- Response: NMFS Alaska Region staff contacted Senator Olson's aide Loren Peterson on June 10, 2011, and provided a verbal overview of the June 1 tribal consultation. NMFS will discuss with the tribes what additional information to send to Senator Olson's office in the future and whether to also send copies of tribal consultation information to others in the Alaska Legislature.

Native Village of Elim
Elim IRA Council
P.O. Box 70
Elim, Alaska 99739
Tel # 907-890-3737 Fax 3738

RESOLUTION 11-15

POSTION ON CHUM BYCATCH MANAGEMENT BY THE NORTH PACIFIC FISHERY MANAGEMENT COUNCIL

WHEREAS: The Native Village of Elim is a federally recognized tribe; AND

WHEREAS: Subsistence users throughout the Norton Sound and Bering Strait Region are gravely concerned with the continuing decline of regional salmon stocks; AND

WHEREAS: Norton Sound is not making escapement goals therefore there has not been a large commercial fishing for chum in Norton Sound since 1985; AND

WHEREAS: Elim, white Mountain, Golovin, Nome rivers have stocks of concern and chum closures; AND

WHEREAS: While our subsistence users face severe restrictions regarding harvest of chum salmon, federal and state managed commercial fisheries continue to harvest huge numbers of chum salmon bound for our region's rivers; AND

WHEREAS: the Board of Fish (BOF) and North Pacific Fishery Management Council (NPFMC)both are responsible for regulations which affect Western Alaska salmon sticks and those fisheries which intercept salmon bound for our rivers; AND

WHEREAS: regulations developed by these two bodies have placed the future of our declining salmon runs in severe jeopardy, while perpetuating wasteful practices by some commercial fisheries that intercept our salmon with impunity and disregard; AND

WHEREAS: the National Marine Fisheries Service (NMFS) noted in the Bering Sea Salmon Bycatch Environmental Impact Statement (EIS) prepared in 2008, *"The first priority for management is to meet spawning escapement goals to sustain salmon resources for future generations. Highest priority use is for subsistence under both State and Federal law. Surplus fish beyond escapement needs and subsistence use are made available for other uses."* AND

WHEREAS: while subsistence needs are listed as the first priority under both state and federal management systems, our regions subsistence fisheries have been given the lowest priority by fisheries

Native Village of Elim
Elim IRA Council
P.O. Box 70
Elim, Alaska 99739
Ph # 907-890-3737 Fax 3738

managers in direct conflict with mandated subsistence priority. Commercial fishing interests have been consistently favored by government fisheries managers at both state and federal levels; AND

WHEREAS: Federal actions are supposed to keenly describe and critique cumulative impacts (via Area M interception and Polluck bycatch) and the public is due that information; AND

WHEREAS: once salmon become "bycatch" in other fisheries, they will never reach our streams to spawn or be available to the families who depend upon them for basic subsistence needs; AND

WHEREAS: our Inupiat, Yupik and St. Lawrence Yupik cultures and traditions are based on hunting, fishing and living off the land, sea and air; we want to maintain our subsistence practices and traditions and we prefer our subsistence foods over store bought food; AND

WHEREAS: our culture is not disposable or replaceable, our subsistence needs are no less important than offshore commercial fisheries. Existing management regimes refuse to recognize this and their neglect, lack of protection and mismanagement of our fisheries stocks has severely impacted our ability to carry on our subsistence practices.

NOW THEREFORE BE IT RESOLVED: the Native Village of Elim does hereby request that the North Pacific Fishery Management Council institute a hard cap of 30,000 chum bycatch and that the Polluck fishery is closed upon reaching the hard cap with no sectors allocations, no sector transfers, no cooperative provisions.

By: [signature]

CERTIFICATION

I, the undersigned Secretary of the Native Village of Elim, hereby certify that the foregoing resolution was adopted by majority vote of the during a duly called meeting on this 15th day of May, 2001.

By: [signature]

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

June 6, 2011

Eric Olson, Chairman
North Pacific Fishery Management Council
605 W. Fourth Avenue, Suite 306
Anchorage, Alaska 99501

Dear Chairman Olson:

This letter provides a preliminary summary of the issues discussed at a tribal consultation on June 1, 2011, about chum salmon bycatch in the Bering Sea pollock fishery. The consultation between the National Marine Fisheries Service (NMFS) and representatives of six Norton Sound and Bering Strait area tribes was conducted under Presidential Executive Order (E.O.) 13175. The following tribes participated in the consultation: Native Village of Teller, Native Village of Shishmaref, Native Village of Savoonga, Mary's Igloo Traditional Council, Native Village of Gambell, and the Native Village of Elim. Julie Raymond-Yakoubian with Kawerak, Inc., also participated in the consultation.

Each of these tribes submitted to NMFS a written resolution stating its position on chum salmon bycatch. The North Pacific Fishery Management Council (Council) has received a copy of these resolutions, and they are part of the information you are considering at your June 2011 meeting. The tribes emphasized the cultural and nutritional significance of salmon, the importance of the subsistence use of salmon, and concerns with the status of some chum salmon stocks.

All six of the tribes we consulted with requested that the Council adopt a hard cap for the Bering Sea pollock fishery of 30,000 chum salmon. This cap currently is not within the range of the hard caps that the Council is considering. NMFS is required under E.O. 13175 to prepare a tribal summary impact statement to accompany rulemakings that summarizes the nature of concerns identified by the tribes and extent to which these concerns have been met. In addition, regulations governing the National Environment Policy Act process require NMFS to identify alternatives that were eliminated from detailed study and briefly discuss the reasons why these were eliminated (40 CFR 1502.14(a)). It would greatly help NMFS fulfill these responsibilities if the Council would address the tribes' recommendation for a 30,000 chum salmon cap by either including this recommendation in the alternatives analyzed or providing an explanation why this suggested cap does not meet the purpose and need for the action and, therefore, was not included in the alternatives analyzed.

We also discussed the prohibited species donation (PSD) program. Several tribal representatives requested additional information about this program and expressed interest in participation in the program by western Alaska communities. We will provide additional information to the tribal representatives, and we will organize a follow-up meeting between interested tribal representatives and people knowledgeable about the PSD program.

In addition to these two issues, we also discussed environmental changes tribal members have observed in recent years, science and research needs in the area, interest in collaborative research and funding for tribes and regional non-profit corporations to conduct research activities, and the cumulative impact of salmon interception in the False Pass salmon fisheries and salmon bycatch in the pollock fisheries. We also received questions about how NMFS and the Council are working together to ensure that tribal concerns are addressed, what steps NMFS is taking to provide information and education about fisheries issues to the tribes, and the status of the tribes' request that NMFS hire a tribal liaison.

A more detailed report of the consultation is being prepared by NMFS staff and will be sent to the Council when it is completed.

Sincerely,

James W. Balsiger, Ph.D.
Administrator, Alaska Region

cc: Representatives of the tribes that
participated in the June 1, 2011, consultation

Julie Raymond-Yakoubian

Summary of Follow-up Teleconference
for the June 1, 2011, Tribal Consultation
on Chum Salmon Bycatch in the Bering Sea Pollock Fishery

October 6, 2011

<u>In Attendance</u>

Attending via telephone:

Native Village of Brevig Mission
Stuart Tocktoo, President
Leonard Adams
Floyd Olanna
Walter Seetot
Inez Tocktoo

Native Village of Savoonga
Mitchell Kiyuklook, President
Peggy Akeya
Merton Miklahook, Sr.
Ronnie Toolie
Gregory Toolie

Native Village of St. Michael
Charlie Fitka

Nome Eskimo Community
Mike Sloan

Kawerak, Inc.
Rose Fosdick
Julie Raymond-Yakoubian

North Pacific Fishery Management Council
Nicole Kimball
Diana Stram (<u>diana.stram@noaa.gov</u>), co-author of non-Chinook (chum) salmon bycatch analysis

Office of Senator Donald Olson
Laura Lawrence
Loren Peterson
David Scott

Office of Representative Neal Foster
Paul LaBolle

Attending in person, NMFS Alaska Regional Office:

Sally Bibb, NMFS, Sustainable Fisheries Division (<u>sally.bibb@noaa.gov</u>; 907-586-7389)
Melanie Brown, NMFS Sustainable Fisheries Division
Mary Grady, NMFS Sustainable Fisheries Division
Sarah Ellgen, NMFS Sustainable Fisheries Division
Gabrielle Aberle, NMFS Sustainable Fisheries Division (<u>gabrielle.aberle@noaa.gov</u>; 907-586-7356)
Scott Miller, NMFS, Analytical Team and co-author of non-Chinook (chum) salmon bycatch analysis
Demian Schane, NOAA General Counsel

Summary

This teleconference responded to issues raised during a tribal consultation conducted on June 1, 2011, between the National Marine Fisheries Service (NMFS) and six Norton Sound and Bering Strait tribes. Each tribe had submitted to NMFS a written resolution stating its position on chum salmon bycatch and a separate resolution requesting a permanent ban of all bottom trawling in the Northern Bering Sea Research Area. The tribes requested the North Pacific Fishery Management Council (Council) adopt a hard cap of 30,000 chum salmon for the Bering Sea pollock fishery. The tribes emphasized the cultural and nutritional significance of salmon, the importance of subsistence use of salmon, and concerns with the status of some chum salmon stocks.

Representatives from the Native Village of Elim/Elim IRA Council, Native Village of Gambell, Native Village of Savoonga, Native Village of Shishmaref/Shishmaref IRA Council, Native Village of Teller/Teller Traditional Council, Mary's Igloo Traditional Council, and Kawerak, Inc., participated in the consultation, which was conducted under Presidential Executive Order 13175. NMFS did not receive the resolutions submitted by the Native Village of Koyuk IRA Council and the Native Village of St. Michael until after June 1; therefore, these tribes were not notified of the consultation until after it occurred. The Native Village of Koyuk IRA Council and the Native Village of St. Michael, as well as other tribes in the Norton Sound and Bering Strait area, the June 1 participants, and staff from the offices of Senator Donald Olson and Representative Neal Foster were invited to attend the teleconference held on October 6, 2011. The purpose of the teleconference was to update the tribes on the analysis and to follow-up on questions from the June 1, 2011, consultation about the prohibited species donation program.

Sally Bibb opened the meeting by introducing those present at the NMFS Alaska Regional Office, then asked for an introduction from each participant that called in to the meeting. She then summarized the final report from the June 1 tribal consultation.

Next, Sarah Ellgen provided an overview of the prohibited species donation program (PSD program), which is administered by the organization SeaShare. During the June 1 consultation, several tribal representatives requested information about the PSD program and expressed interest in participation in the program by western Alaska communities. The PSD program allows salmon and halibut caught accidently in the groundfish trawl fisheries to be distributed to hunger relief organizations. Starting in the fall of 2011, participation in the PSD program increased beyond the Bering Sea and Aleutian Islands to include Gulf of Alaska processors and vessels. SeaShare has begun distributing salmon to food banks in the Kodiak area. Sarah offered to provide the appropriate contact information for those interested in learning more about the program. None of the teleconference participants had questions on the PSD program at this time.

Diana Stram and Nicole Smith summarized the status of the Council's review of the analysis evaluating proposed management measures to minimize non-Chinook (chum) salmon bycatch in the Bering Sea pollock fishery. The Council conducted an initial review of the analysis at its June 2011 meeting in Nome. The Council revised and restructured the alternatives and options, and requested that additional information be included in the analysis. The Council is scheduled to review the revised analysis at its meeting in Anchorage in April 2012. The analysis will be available for public review in mid-March and will be posted on the Council's website at http://www.alaskafisheries.noaa.gov/npfmc/. Nicole informed the participants that a public, statewide teleconference on the non-Chinook salmon bycatch management measures would be held in the spring of 20112. The Council held this teleconference on February 24, 2012, and a report will be posted on the Council's website.

The participants were then asked to share their concerns and questions. The following issues and responses from NMFS were discussed.

- What is the location of the Council's April meeting?
    - Response: The Council will hold its April meeting at the Hilton Hotel in Anchorage.

- Clarification was requested on a sentence for a Response on page 4 of the June 1 tribal consultation report. The sentence responded to a concern on how bycatch can be controlled and reads as follows: "The Council's program does not set as a goal allowing the pollock fishery to harvest up to the hard cap of Chinook salmon."
    - Response: The Council authorizes and approves the amount of Chinook salmon bycatch that can be caught by the Bering Sea pollock fishery. The pollock fishery will close if that number, the hard cap, is reached. The goal is not for the pollock fishery to reach that number, but for the pollock fishery to minimize its Chinook salmon bycatch and keep the amount of bycatch as low as possible.

- When does the pollock fishery close?
    - Response: The pollock fishery will close when sectors reach their seasonal pollock allocations, when the seasons end on June 10 or November 1, or when the hard cap for Chinook salmon bycatch is reached.

- We would rather catch salmon than acquire it through food banks. Subsistence catch of salmon is shared and contributes to our food supplies. Important knowledge, skills, and values are associated with the way we harvest, preserve, and share salmon.
    - Response: NMFS appreciates the comments that subsistence salmon have considerable significance to individuals, their families, and their communities. The PSD program is not intended to replace locally harvested salmon with commercial bycatch. The purpose of the PSD program is to try to use salmon bycatch, which has already been caught and killed, for human consumption if that salmon has been maintained in the appropriate condition.

- Are the salmon distributed through the PSD program edible?
    - Response: Yes, the same processing and quality guidelines exist for the salmon as the other fish that the fishermen process. The food banks where the salmon are distributed are subject to the State of Alaska's food safety regulations.

- A representative of Savoonga requested more information on receiving donated salmon through the PSD program.
    - Response: After the teleconference, Sarah Ellgen and Sally Bibb called and talked to Ronnie Toolie of Savoonga about the PSD program. The contact information for the representative of SeaShare, which distributes salmon donated to the program, was emailed to Mr. Toolie.

- During the June 1 tribal consultation, tribal representatives commented on research needs and asked questions on the cumulative impact of salmon interception in the False Pass salmon fisheries, the information we get from Russia about chum salmon, and the percent of Alaska fisheries taxes used for research.

- **Response**: The analysis will include escapement and harvest information for the Area M fisheries, which are also known as the False Pass fisheries, and information on the stock of origin of chum salmon caught in Area M. The analysis also will include what is known about chum salmon released from Russian hatcheries and the origin of chum salmon caught in the Bering Sea pollock fishery.

  The analysis probably will not include information on fisheries taxes used for research; however, this could change as the analysis progresses. As the action is not expected to reduce landings, there is no expected impact on taxes derived from landed value and, therefore, no specific need to detail the various State of Alaska taxes at this time. Almost all of the state fisheries tax collections are General Fund tax collections and are appropriated, including to fisheries research, during the annual budget process. The collections and how they are shared with municipalities depend on the type of tax in question. Information on the fisheries tax collections is provided in the Alaska Tax Division 2011 Annual Report: http://www.tax.alaska.gov//programs/documentviewer/viewer.aspx?2470f.

  The Fisheries Resource Landings Tax, which is a tax on the pollock fishery authorized by the American Fisheries Act and most applicable to the discussion of chum bycatch, and the State Fisheries Business Tax are shared with municipalities. The remainder of these tax collections is retained by the State of Alaska as receipts into the General Fund. A municipality could use its portion of these taxes to fund research; however, it is more likely that it goes into the municipality's General Fund and any amount for fisheries research would be part of an appropriation in the municipal budget process. The State collection goes into the State's General Fund and could be allocated to fisheries research as part of the annual budget process. Additionally, most municipalities that have fish landing ports charge their own landing taxes as well as sales taxes, and large proportions of the annual budget for such locales can come from these taxes. Thus, municipalities receiving these revenues could allocate monies to fisheries research as part of their annual budget process.

- NMFS should review the Alaska Sustainable Salmon Fund, which could fund research in the Norton Sound and Bering Strait region.
  - **Response**: The Alaska Sustainable Salmon Fund (AKSSF) comprises Alaska's allocation of funds from the Pacific Coastal Salmon Recovery Fund (PCSRF). The PCSRF was established by Congress in fiscal year 2000 to protect, restore, and conserve Pacific salmon and steelhead populations and their habitats. Under the PCSRF, NMFS provides funding to states and tribes of the Pacific Coast region to implement habitat restoration and recovery projects that contribute to the sustainability of the species. For more information, see the AKSSF website at http://www.akssf.org/akssf_org/home.cfm# or the NMFS PCSRF website at http://www.nwr.noaa.gov/Salmon-Recovery-Planning/PCSRF/.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

AGENDA C-2
SUPPLEMENTAL
MARCH/APRIL 2012

March 15, 2012

Eric Olson, Chairman
North Pacific Fishery Management Council
605 W. 4th Avenue, Suite 306
Anchorage, Alaska 99501-2817

Dear Chairman Olson:

Enclosed are the following documents related to two tribal consultation meetings in 2011 between the National Marine Fisheries Service (NMFS) and Alaska Native tribes from the Norton Sound region about chum salmon bycatch:

1. A report of the June 1, 2011, tribal consultation meeting, including a copy of one of the resolutions we received from the tribes about chum salmon bycatch.

2. NMFS's June 6, 2011, letter summarizing the consultation meeting.

3. A report from the October 6, 2011, follow-up teleconference with tribal representatives at which staff provided an update on the analysis and more information about the prohibited species donation program.

NMFS staff will be available at the upcoming North Pacific Fishery Management Council meeting to answer any questions the Council may have about the tribal consultation meetings or these documents.

Sincerely,

James W. Balsiger, Ph.D.
Administrator, Alaska Region

Enclosures

Summary of
Tribal Consultation Teleconference on
Chum Salmon Bycatch in the Bering Sea Pollock Fishery
June 1, 2011

In Attendance

Attending via telephone:

Native Village of Elim/Elim IRA Council
Robert Keith, President
Sheldon Naguruk, Council member
e-mail: jmurray@kawerak.org (Janelle Murray, Tribal Coordinator)

Native Village of Gambell
Iver Campbell, IRA Council President
e-mail: ivercampbell@yahoo.com

Native Village of Savoonga
Ronnie Toolie, President (stoolie@kawerak.org)
Peggy Akeya (peggyakeya@yahoo.com)
Verna Immingan

Native Village of Shishmaref/Shishmaref IRA Council
Donna Barr, Vice-President
Howard Weyiouanna, Sr.
e-mail: knayokpuk@kawerak.org; tc.shh@kawerek.org (tribal coordinators)

Native Village of Teller/Teller Traditional Council
Wesley Okbaok, President
Joe Garnie
e-mail: cisabell@kawerak.org

Mary's Igloo Traditional Council
Albert W. Oquilluk
e-mail: cablowaluk@kawerak.org

Kawerak, Inc.
Julie Raymond-Yakoubian
e-mail: JRaymond-Yakoubian@kawerak.org

Attending in person, NMFS Alaska Regional Office:
Doug Mecum, Deputy Regional Administrator, NMFS Alaska Region
Glenn Merrill, Assistant Regional Administrator, NMFS, Sustainable Fisheries Division
Sally Bibb, NMFS, Sustainable Fisheries Division (907-586-7389)
Melanie Brown, NMFS Sustainable Fisheries Division
Mary Grady, NMFS Sustainable Fisheries Division
Sarah Ellgen, NMFS Sustainable Fisheries Division
Gabrielle Aberle, NMFS Sustainable Fisheries Division (907-586-7356)
Scott Miller, NMFS, Analytical Team and co-author on chum salmon bycatch analysis
John Lepore, NOAA General Counsel
Demian Schane, NOAA General Counsel

Summary

The six Norton Sound and Bering Strait tribes listed above requested a consultation on chum salmon bycatch in the Bering Sea pollock fishery. Each tribe had submitted to the National Marine Fisheries Service (NMFS) a written resolution stating its position on chum salmon bycatch and a separate resolution requesting a permanent ban of all bottom trawling in the Northern Bering Sea Research Area. The consultation between the NMFS and representatives of the six tribes was conducted under Presidential Executive Order 13175. Julie Raymond-Yakoubian also participated in the consultation.

Sally Bibb opened the meeting by introducing those present at the NMFS Alaska Regional Office, then asked for an introduction from each tribal representative. Sally Bibb asked if any of the representatives had questions, but none did at that time. She then presented an overview of the chum salmon bycatch issue and asked the representatives to share their concerns and questions. The following issues were raised by the tribal representatives.

- All six of the tribes requested the North Pacific Fishery Management Council (Council) adopt a hard cap of 30,000 chum salmon for the Bering Sea pollock fishery. On reaching the hardcap, the pollock fishery should be closed and no sector allocations, sector transfers, or cooperative provisions allowed. This request is in response to the continuing decline of regional salmon stocks, which has severely impacted the tribes' subsistence practices and traditions.
    - Response: In a letter dated June 6, 2011, NMFS provided the Council with a preliminary summary of the issues discussed at the consultation. NMFS requested the Council address the recommendation for a 30,000 hard cap by either including it in the alternatives analyzed or providing an explanation why this suggested cap does not meet the purpose and need for the action, and therefore, will not be included in the alternatives analyzed. A copy of this letter is enclosed with this report.

      The Council discussed the tribes' resolutions at its June 2011 meeting and asked for additional information about the reasons that the tribes recommended a 30,000 hard cap. NMFS will schedule a teleconference with interested Norton Sound and Bering Strait tribes in September 2011, or as soon as all interested parties are available to further discuss the tribes' recommendations on chum salmon bycatch.

      A summary of the Council's June 2011 action on chum salmon bycatch is enclosed with this report.

      A copy of the Council's revised set of alternatives and schedule for future analysis and discussion of chum salmon bycatch will be provided to the tribes as soon as it is available from the Council.
- An agenda for the June Council meeting in Nome was requested.
    - Response: After the consultation, the link to the Council meeting agenda was emailed to representatives of the tribes who participated in the consultation.
- Several representatives requested information about the prohibited species donation program (PSD) program and expressed interest in participation in the program by western Alaska communities.

- Response: The PSD program allows for the distribution of salmon and halibut caught accidently in the groundfish trawl fisheries to hunger relief organizations. NMFS will provide additional information about the PSD program at its next teleconference with interested Norton Sound and Bering Strait tribes. We can discuss at that time whether any tribes are interested in further follow-up on this program.

- Several representatives noted that salmon have cultural value, not just economic value, and tribes would rather catch fish than acquire them from a food bank. Salmon are nutritionally very important to tribal members. The idea of wasting food is offensive to Alaska Natives. A food bank should not be used to justify salmon bycatch.

  - Response: NMFS appreciates the comments about the cultural significance of salmon. Salmon are prohibited species and are required to be avoided. The purpose of the PSD program is to try to use salmon, which has already been caught and killed, for human consumption, if that salmon has been maintained in the appropriate condition. A relatively small proportion of the salmon bycatch is of the size or quality appropriate for human consumption. Therefore, few salmon are donated to the PSD program. Most salmon are discarded after they have been counted and biological samples have been taken from them.

- Several representatives described environmental changes they have observed in recent years. These include larger fish, more king crabs washing ashore, fish moving north, and a decline in the salinity of some river waters.

  - Response: NMFS notes these observations. We have limited data on the effects of environmental change on salmon and bycatch. Current salmon bycatch data collection and research focuses on using genetics to identify geographic origin of salmon caught as bycatch.

- One representative asked about the effects of radioactive water from Japan's Fukushima Daiichi nuclear power plant on fish off northwest Alaska.

  - Response: Some information from the U.S. Food and Drug Administration is enclosed with this report. This information is available on the internet at: http://www.fda.gov/NewsEvents/PublicHealthFocus/ucm247403.htm.

- Red salmon returns in Salmon Lake have been insufficient in recent years to provide food for the people.

  - Response: Bering Sea bycatch includes only a small amount of red salmon, pink salmon, and coho salmon. Therefore, it is unlikely that salmon bycatch in the Bering Sea trawl fisheries are impacting red salmon returns to western Alaska. However, NMFS will forward a copy of this report to the Alaska Department of Fish and Game so that they are aware that this issue came up in this tribal consultation.

- One representative asked if hatchery eggs can cause cancer.

  - Response: Doug Mecum responded that he is not aware of cancer resulting from hatchery fish. Hatchery practices are stringent about the use of chemicals. Fish live at the hatchery about a year and spend most of their life in the ocean.

- Multiple factors can lower salmon returns, and some cannot be controlled. Consequences of some industries (e.g., shipping, mining) are not clear, but bycatch can be controlled.

    - Response: The Magnuson-Stevens Fishery Conservation and Management Act requires that bycatch be minimized to the extent practicable. The Council's objective for its Chinook salmon bycatch management measures was to provide incentives to minimize Chinook salmon bycatch while still allowing the pollock fishery to continue. The Council's program does not set as a goal allowing the pollock fishery to harvest up to the hard cap of Chinook salmon.

      Thus far in 2011, the first year of the new Chinook salmon bycatch management program, Chinook salmon bycatch is about 7,400 fish. If the Council's chum salmon bycatch management program involves a hard cap, the focus also will be to minimize bycatch rather than establish the hard cap as an acceptable level of bycatch.

- Representatives commented on science and research needs in the area and an interest in collaborative research and funding for the tribes and non-profit corporations. Questions were asked on the cumulative impact of salmon interception in the False Pass salmon fisheries, what information do we get from Russia, and the percent of fisheries taxes that is used for science. Tribes and non-profit corporations should have access to fisheries taxes for their science and research needs.

    - Response: Some of these issues may be addressed in the analysis being prepared by Council and NMFS analysts about chum salmon bycatch in the Bering Sea pollock fishery. NMFS will provide these questions to those analysts and follow-up with the tribes with any further information we obtain.

- Representatives asked how the Council and NMFS are working together to address tribal concerns and what steps NMFS is taking to provide information and education to the tribes on fisheries issues, the Council process, and the agency process.

    - Response: The Council created its Rural Community Outreach Committee to improve communication and outreach to residents of rural Alaska about fisheries conservation and management issues under consideration by the Council. The Council also has conducted extensive outreach efforts over the last three years on salmon bycatch in the Bering Sea pollock fishery. The outreach plans, which include meetings in rural communities, attending regional conferences, and mailings to all villages, tribes, and local government officials, have been developed by and vetted through the committee and several rural stakeholder groups. The outreach plans are presented to the Council and public at multiple meetings, and the results of the outreach are part of the analytical document on which the Council bases its decision. NMFS staff participates in the Council's committee meetings and outreach efforts.

      The University of Alaska's Sea Grant College Program has provided short courses in Nome, Kotzebue, and Togiak about the National Environmental Policy Act (NEPA) with particular focus on fisheries management issues and process. These courses were offered, in part, due to the requests from people in rural communities for education and training about NEPA and the fisheries management process. NMFS staff participated in the Nome and Kotzebue courses.

NMFS contacts by letter all tribes, Alaska Native corporations, and local government officials about fisheries management issues and proposed rule that may be of interest to rural Alaskans. These letters specifically notify the tribes of their opportunities to consult under E.O. 13175. When requested to conduct a consultation, NMFS organizes and participates in the tribal consultations and follow-up meetings. NMFS staff also participate in meetings and regional conferences when requested to do so and when time and budget resources allow that participation.

- NMFS should hire a tribal liaison.
  - Response: NMFS acknowledged the tribes request that it hire a tribal liaison. However, at this time, funding for such a position cannot be prioritized over other responsibilities of the Alaska Regional Office.

Other Issues

In mid-June 2011, NMFS received letters and resolutions from:

Darin Douglas, President, Native Village of Koyuk
Shirley Martin, President, Native Village of St. Michael

They requested a tribal consultation on chum salmon bycatch and provided copies of resolutions on bycatch and trawling in the northern Bering Sea.

- Response: NMFS responded by phone and in writing to Mr. Douglas and Ms. Martin to let them know about the June 1 consultation, that we would provide them a copy of the consultation report, and include them in future meetings or consultations on chum salmon bycatch.

NMFS also will identify contact names and e-mail addresses for the following tribes so that they can be sent a copy of the final consultation report and notified of future discussions with Norton Sound or Bering Strait tribes about chum salmon bycatch:

Brevig Mission	Shaktoolik
Council	Stebbins
Diomede	Unalakleet
Golovin	Wales
King Island	White Mountain
Nome Eskimo Community	

Senator Donny Olson wrote to the Secretary of Commerce (June 10, 2011) and requested to be informed of NMFS's future consultations with Native villages in his district and to be kept apprised of the Department of Commerce's actions and recommendations under E.O. 13175.

- Response: NMFS Alaska Region staff contacted Senator Olson's aide Loren Peterson on June 10, 2011, and provided a verbal overview of the June 1 tribal consultation. NMFS will discuss with the tribes what additional information to send to Senator Olson's office in the future and whether to also send copies of tribal consultation information to others in the Alaska Legislature.

Native Village of Elim

Elim IRA Council

P.O. Box 70
Elim, Alaska 99739
PH # 907-890-3737 Fax 3738

RESOLUTION 11-15

POSTION ON CHUM BYCATCH MANAGEMENT BY THE NORTH PACIFIC FISHERY MANAGEMENT COUNCIL

WHEREAS: The Native Village of Elim is a federally recognized tribe; AND

WHEREAS: Subsistence users throughout the Norton Sound and Bering Strait Region are gravely concerned with the continuing decline of regional salmon stocks; AND

WHEREAS: Norton Sound is not making escapement goals therefore there has not been a large commercial fishing for chum in Norton Sound since 1985; AND

WHEREAS: Elim, white Mountain, Golovin, Nome rivers have stocks of concern and chum closures; AND

WHEREAS: While our subsistence users face severe restrictions regarding harvest of chum salmon, federal and state managed commercial fisheries continue to harvest huge numbers of chum salmon bound for our region's rivers; AND

WHEREAS: the Board of Fish (BOF) and North Pacific Fishery Management Council (NPFMC)both are responsible for regulations which affect Western Alaska salmon sticks and those fisheries which intercept salmon bound for our rivers; AND

WHEREAS: regulations developed by these two bodies have placed the future of our declining salmon runs in severe jeopardy, while perpetuating wasteful practices by some commercial fisheries that intercept our salmon with impunity and disregard; AND

WHEREAS: the National Marine Fisheries Service (NMFS) noted in the Bering Sea Salmon Bycatch Environmental Impact Statement (EIS) prepared in 2008, "*The first priority for management is to meet spawning escapement goals to sustain salmon resources for future generations. Highest priority use is for subsistence under both State and Federal law. Surplus fish beyond escapement needs and subsistence use are made available for other uses.*" AND

WHEREAS: while subsistence needs are listed as the first priority under both state and federal management systems, our regions subsistence fisheries have been given the lowest priority by fisheries

Native Village of Elim
Elim IRA Council
P.O. Box 70
Elim, Alaska 99739
PH # 907-890-3737 Fax 3738

managers in direct conflict with mandated subsistence priority. Commercial fishing interests have been consistently favored by government fisheries managers at both state and federal levels; AND

WHEREAS: Federal actions are supposed to keenly describe and critique cumulative impacts (via Area M Interception and Polluck bycatch) and the public is due that information; AND

WHEREAS: once salmon become "bycatch" in other fisheries, they will never reach our streams to spawn or be available to the families who depend upon them for basic subsistence needs; AND

WHEREAS: our Inupiat, Yupik and St. Lawrence Yupik cultures and traditions are based on hunting, fishing and living off the land, sea and air; we want to maintain our subsistence practices and traditions and we prefer our subsistence foods over store bought food; AND

WHEREAS: our culture is not disposable or replaceable, our subsistence needs are no less important than offshore commercial fisheries. Existing management regimes refuse to recognize this and their neglect, lack of protection and mismanagement of our fisheries stocks has severely impacted our ability to carry on our subsistence practices.

NOW THEREFORE BE IT RESOLVED: the Native Village of Elim does hereby request that the North Pacific Fishery Management Council institute a hard cap of 30,000 chum bycatch and that the Polluck fishery is closed upon reaching the hard cap with no sectors allocations, no sector transfers, no cooperative provisions.

By: [signature]

CERTIFICATION

I, the undersigned Secretary of the Native Village of Elim, hereby certify that the foregoing resolution was adopted by majority vote of the during a duly called meeting on this 18th day of May 2001.

By: [signature]

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

June 6, 2011

Eric Olson, Chairman
North Pacific Fishery Management Council
605 W. Fourth Avenue, Suite 306
Anchorage, Alaska 99501

Dear Chairman Olson:

This letter provides a preliminary summary of the issues discussed at a tribal consultation on June 1, 2011, about chum salmon bycatch in the Bering Sea pollock fishery. The consultation between the National Marine Fisheries Service (NMFS) and representatives of six Norton Sound and Bering Strait area tribes was conducted under Presidential Executive Order (E.O.) 13175. The following tribes participated in the consultation: Native Village of Teller, Native Village of Shishmaref, Native Village of Savoonga, Mary's Igloo Traditional Council, Native Village of Gambell, and the Native Village of Elim. Julie Raymond-Yakoubian with Kawerak, Inc., also participated in the consultation.

Each of these tribes submitted to NMFS a written resolution stating its position on chum salmon bycatch. The North Pacific Fishery Management Council (Council) has received a copy of these resolutions, and they are part of the information you are considering at your June 2011 meeting. The tribes emphasized the cultural and nutritional significance of salmon, the importance of the subsistence use of salmon, and concerns with the status of some chum salmon stocks.

All six of the tribes we consulted with requested that the Council adopt a hard cap for the Bering Sea pollock fishery of 30,000 chum salmon. This cap currently is not within the range of the hard caps that the Council is considering. NMFS is required under E.O. 13175 to prepare a tribal summary impact statement to accompany rulemakings that summarizes the nature of concerns identified by the tribes and extent to which these concerns have been met. In addition, regulations governing the National Environment Policy Act process require NMFS to identify alternatives that were eliminated from detailed study and briefly discuss the reasons why these were eliminated (40 CFR 1502.14(a)). It would greatly help NMFS fulfill these responsibilities if the Council would address the tribes' recommendation for a 30,000 chum salmon cap by either including this recommendation in the alternatives analyzed or providing an explanation why this suggested cap does not meet the purpose and need for the action and, therefore, was not included in the alternatives analyzed.

We also discussed the prohibited species donation (PSD) program. Several tribal representatives requested additional information about this program and expressed interest in participation in the program by western Alaska communities. We will provide additional information to the tribal representatives, and we will organize a follow-up meeting between interested tribal representatives and people knowledgeable about the PSD program.

In addition to these two issues, we also discussed environmental changes tribal members have observed in recent years, science and research needs in the area, interest in collaborative research and funding for tribes and regional non-profit corporations to conduct research activities, and the cumulative impact of salmon interception in the False Pass salmon fisheries and salmon bycatch in the pollock fisheries. We also received questions about how NMFS and the Council are working together to ensure that tribal concerns are addressed, what steps NMFS is taking to provide information and education about fisheries issues to the tribes, and the status of the tribes' request that NMFS hire a tribal liaison.

A more detailed report of the consultation is being prepared by NMFS staff and will be sent to the Council when it is completed.

Sincerely,

James W. Balsiger, Ph.D.
Administrator, Alaska Region

cc: Representatives of the tribes that
participated in the June 1, 2011, consultation

Julie Raymond-Yakoubian

Summary of Follow-up Teleconference
for the June 1, 2011, Tribal Consultation
on Chum Salmon Bycatch in the Bering Sea Pollock Fishery

October 6, 2011

In Attendance

Attending via telephone:

Native Village of Brevig Mission
- Stuart Tocktoo, President
- Leonard Adams
- Floyd Olanna
- Walter Seetot
- Inez Tocktoo

Native Village of Savoonga
- Mitchell Kiyuklook, President
- Peggy Akeya
- Merton Miklahook, Sr.
- Ronnie Toolie
- Gregory Toolie

Native Village of St. Michael
- Charlie Fitka

Nome Eskimo Community
- Mike Sloan

Kawerak, Inc.
- Rose Fosdick
- Julie Raymond-Yakoubian

North Pacific Fishery Management Council
- Nicole Kimball
- Diana Stram (diana.stram@noaa.gov), co-author of non-Chinook (chum) salmon bycatch analysis

Office of Senator Donald Olson
- Laura Lawrence
- Loren Peterson
- David Scott

Office of Representative Neal Foster
- Paul LaBolle

Attending in person, NMFS Alaska Regional Office:

Sally Bibb, NMFS, Sustainable Fisheries Division (sally.bibb@noaa.gov; 907-586-7389)
Melanie Brown, NMFS Sustainable Fisheries Division
Mary Grady, NMFS Sustainable Fisheries Division
Sarah Ellgen, NMFS Sustainable Fisheries Division
Gabrielle Aberle, NMFS Sustainable Fisheries Division (gabrielle.aberle@noaa.gov; 907-586-7356)
Scott Miller, NMFS, Analytical Team and co-author of non-Chinook (chum) salmon bycatch analysis
Demian Schane, NOAA General Counsel

Summary

This teleconference responded to issues raised during a tribal consultation conducted on June 1, 2011, between the National Marine Fisheries Service (NMFS) and six Norton Sound and Bering Strait tribes. Each tribe had submitted to NMFS a written resolution stating its position on chum salmon bycatch and a separate resolution requesting a permanent ban of all bottom trawling in the Northern Bering Sea Research Area. The tribes requested the North Pacific Fishery Management Council (Council) adopt a hard cap of 30,000 chum salmon for the Bering Sea pollock fishery. The tribes emphasized the cultural and nutritional significance of salmon, the importance of subsistence use of salmon, and concerns with the status of some chum salmon stocks.

Representatives from the Native Village of Elim/Elim IRA Council, Native Village of Gambell, Native Village of Savoonga, Native Village of Shishmaref/Shishmaref IRA Council, Native Village of Teller/Teller Traditional Council, Mary's Igloo Traditional Council, and Kawerak, Inc., participated in the consultation, which was conducted under Presidential Executive Order 13175. NMFS did not receive the resolutions submitted by the Native Village of Koyuk IRA Council and the Native Village of St. Michael until after June 1; therefore, these tribes were not notified of the consultation until after it occurred. The Native Village of Koyuk IRA Council and the Native Village of St. Michael, as well as other tribes in the Norton Sound and Bering Strait area, the June 1 participants, and staff from the offices of Senator Donald Olson and Representative Neal Foster were invited to attend the teleconference held on October 6, 2011. The purpose of the teleconference was to update the tribes on the analysis and to follow-up on questions from the June 1, 2011, consultation about the prohibited species donation program.

Sally Bibb opened the meeting by introducing those present at the NMFS Alaska Regional Office, then asked for an introduction from each participant that called in to the meeting. She then summarized the final report from the June 1 tribal consultation.

Next, Sarah Ellgen provided an overview of the prohibited species donation program (PSD program), which is administered by the organization SeaShare. During the June 1 consultation, several tribal representatives requested information about the PSD program and expressed interest in participation in the program by western Alaska communities. The PSD program allows salmon and halibut caught accidently in the groundfish trawl fisheries to be distributed to hunger relief organizations. Starting in the fall of 2011, participation in the PSD program increased beyond the Bering Sea and Aleutian Islands to include Gulf of Alaska processors and vessels. SeaShare has begun distributing salmon to food banks in the Kodiak area. Sarah offered to provide the appropriate contact information for those interested in learning more about the program. None of the teleconference participants had questions on the PSD program at this time.

Diana Stram and Nicole Smith summarized the status of the Council's review of the analysis evaluating proposed management measures to minimize non-Chinook (chum) salmon bycatch in the Bering Sea pollock fishery. The Council conducted an initial review of the analysis at its June 2011 meeting in Nome. The Council revised and restructured the alternatives and options, and requested that additional information be included in the analysis. The Council is scheduled to review the revised analysis at its meeting in Anchorage in April 2012. The analysis will be available for public review in mid-March and will be posted on the Council's website at http://www.alaskafisheries.noaa.gov/npfmc/. Nicole informed the participants that a public, statewide teleconference on the non-Chinook salmon bycatch management measures would be held in the spring of 20112. The Council held this teleconference on February 24, 2012, and a report will be posted on the Council's website.

The participants were then asked to share their concerns and questions. The following issues and responses from NMFS were discussed.

- What is the location of the Council's April meeting?
    - Response: The Council will hold its April meeting at the Hilton Hotel in Anchorage.

- Clarification was requested on a sentence for a Response on page 4 of the June 1 tribal consultation report. The sentence responded to a concern on how bycatch can be controlled and reads as follows: "The Council's program does not set as a goal allowing the pollock fishery to harvest up to the hard cap of Chinook salmon."
    - Response: The Council authorizes and approves the amount of Chinook salmon bycatch that can be caught by the Bering Sea pollock fishery. The pollock fishery will close if that number, the hard cap, is reached. The goal is not for the pollock fishery to reach that number, but for the pollock fishery to minimize its Chinook salmon bycatch and keep the amount of bycatch as low as possible.

- When does the pollock fishery close?
    - Response: The pollock fishery will close when sectors reach their seasonal pollock allocations, when the seasons end on June 10 or November 1, or when the hard cap for Chinook salmon bycatch is reached.

- We would rather catch salmon than acquire it through food banks. Subsistence catch of salmon is shared and contributes to our food supplies. Important knowledge, skills, and values are associated with the way we harvest, preserve, and share salmon.
    - Response: NMFS appreciates the comments that subsistence salmon have considerable significance to individuals, their families, and their communities. The PSD program is not intended to replace locally harvested salmon with commercial bycatch. The purpose of the PSD program is to try to use salmon bycatch, which has already been caught and killed, for human consumption if that salmon has been maintained in the appropriate condition.

- Are the salmon distributed through the PSD program edible?
    - Response: Yes, the same processing and quality guidelines exist for the salmon as the other fish that the fishermen process. The food banks where the salmon are distributed are subject to the State of Alaska's food safety regulations.

- A representative of Savoonga requested more information on receiving donated salmon through the PSD program.
    - Response: After the teleconference, Sarah Ellgen and Sally Bibb called and talked to Ronnie Toolie of Savoonga about the PSD program. The contact information for the representative of SeaShare, which distributes salmon donated to the program, was emailed to Mr. Toolie.

- During the June 1 tribal consultation, tribal representatives commented on research needs and asked questions on the cumulative impact of salmon interception in the False Pass salmon fisheries, the information we get from Russia about chum salmon, and the percent of Alaska fisheries taxes used for research.

- Response: The analysis will include escapement and harvest information for the Area M fisheries, which are also known as the False Pass fisheries, and information on the stock of origin of chum salmon caught in Area M. The analysis also will include what is known about chum salmon released from Russian hatcheries and the origin of chum salmon caught in the Bering Sea pollock fishery.

  The analysis probably will not include information on fisheries taxes used for research; however, this could change as the analysis progresses. As the action is not expected to reduce landings, there is no expected impact on taxes derived from landed value and, therefore, no specific need to detail the various State of Alaska taxes at this time. Almost all of the state fisheries tax collections are General Fund tax collections and are appropriated, including to fisheries research, during the annual budget process. The collections and how they are shared with municipalities depend on the type of tax in question. Information on the fisheries tax collections is provided in the Alaska Tax Division 2011 Annual Report: http://www.tax.alaska.gov//programs/documentviewer/viewer.aspx?2470f.

  The Fisheries Resource Landings Tax, which is a tax on the pollock fishery authorized by the American Fisheries Act and most applicable to the discussion of chum bycatch, and the State Fisheries Business Tax are shared with municipalities. The remainder of these tax collections is retained by the State of Alaska as receipts into the General Fund. A municipality could use its portion of these taxes to fund research; however, it is more likely that it goes into the municipality's General Fund and any amount for fisheries research would be part of an appropriation in the municipal budget process. The State collection goes into the State's General Fund and could be allocated to fisheries research as part of the annual budget process. Additionally, most municipalities that have fish landing ports charge their own landing taxes as well as sales taxes, and large proportions of the annual budget for such locales can come from these taxes. Thus, municipalities receiving these revenues could allocate monies to fisheries research as part of their annual budget process.

- NMFS should review the Alaska Sustainable Salmon Fund, which could fund research in the Norton Sound and Bering Strait region.
  - Response: The Alaska Sustainable Salmon Fund (AKSSF) comprises Alaska's allocation of funds from the Pacific Coastal Salmon Recovery Fund (PCSRF). The PCSRF was established by Congress in fiscal year 2000 to protect, restore, and conserve Pacific salmon and steelhead populations and their habitats. Under the PCSRF, NMFS provides funding to states and tribes of the Pacific Coast region to implement habitat restoration and recovery projects that contribute to the sustainability of the species. For more information, see the AKSSF website at http://www.akssf.org/akssf_org/home.cfm# or the NMFS PCSRF website at http://www.nwr.noaa.gov/Salmon-Recovery-Planning/PCSRF/.

U.S. FISH and WILDLIFE SERVICE
BUREAU of LAND MANAGEMENT
NATIONAL PARK SERVICE
BUREAU of INDIAN AFFAIRS

Federal Subsistence Board
1011 E. Tudor Rd., MS 121
Anchorage, Alaska 99503-6199

USDA
U.S. FOREST SERVICE

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MAY 20 [illegible]

Eric Olson, Chair
North Pacific Fishery Management Council
605 W. 4th Avenue, Suite 306
Anchorage, Alaska 99501-2252

Dear Mr. Olson:

The Federal Subsistence Board (Board) is taking this opportunity to provide its comments and recommendation on chum salmon bycatch in the Bering Sea/Aleutian Islands (BSAI) commercial pollock fishery as the North Pacific Fishery Management Council (NPFMC) prepares to select a preliminary preferred alternative at its June 2011 meeting in Nome, Alaska. The Board, comprised of the Regional Directors of the U.S. Fish and Wildlife Service, the Bureau of Indian Affairs, the National Park Service, the Bureau of Land Management and the USDA Forest Service, and a Chair appointed by the Secretaries of the Interior and Agriculture, provides subsistence fishing opportunities in Federal public waters in Alaska under Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA).

Bycatch is of concern to the Board and the affected Regional Advisory Councils because Western Alaska chum salmon stocks are important subsistence resources for Federally-qualified subsistence users in the Norton Sound, Yukon, Kuskokwim, and Bristol Bay areas. Along the Yukon and Kuskokwim rivers alone, there are 6,800 households in 80 villages. Chum salmon make a significant contribution to the way of life of western and interior Alaska's subsistence users, families and communities. The recent fall chum salmon runs in the Yukon River are of particular concern. In both 2009 and 2010, subsistence harvest was restricted due to poor, lower than average size runs and/or to ensure passage into Canada to meet escapement goals.

At its May 2011 public meeting the Board reviewed, discussed and heard public testimony on the various alternatives under consideration in the NPFMC's revised *Bering Sea non-Chinook (Chum) Salmon Bycatch Management Measures*, dated February 2011. **The Board recommends that a hard cap of 50,000, with a trigger cap of 25,000 chum salmon be adopted.** Once the trigger cap is reached, conservation measures would be implemented to assist the pollock fishery fleet to avoid reaching the hard cap. This alternative would provide a better opportunity for increased numbers of chum salmon to reach Western and Interior Alaska rivers to meet spawning escapement and provide for subsistence uses.

It also comes closest to the stipulation in the U.S./Canada Yukon River Salmon Agreement, signed in 2002, which requires the United States to increase in-river returns of Yukon River origin salmon by reducing marine catches and bycatches of Yukon River salmon. The 50,000 level represents a meaningful reduction in the 1997-2001 average of 58,000 chum salmon bycatch, just prior to the signing of the U.S./Canada Yukon River Salmon Agreement. This five-year period is also the same period utilized by the Board for its recommendation to the NPFMC on BSAI Chinook salmon bycatch in April 2009.

The Board appreciates the outreach efforts that NPFMC members and staff conducted on this issue by attending the February/March 2011 meetings of the Yukon-Kuskokwim Delta, Western Interior, Eastern Interior and Bristol Bay Subsistence Regional Advisory Councils. If the Board can be of further assistance, please contact Peter J. Probasco, Assistant Regional Director, Office of Subsistence Management, at (907) 786-3888. The Board will continue to monitor developments on this important issue and looks forward to the results of your efforts to significantly reduce chum salmon bycatch in the BSAI pollock fishery.

Sincerely,

Tim Towarak
Chair, Federal Subsistence Board

cc: Federal Subsistence Board members
Gene Virden, Acting Regional Director - Bureau of Indian Affairs
Bud Cribley, State Director - Bureau of Land Management
Sue Masica, Regional Director - National Park Service
Geoff Haskett, Regional Director - U.S. Fish and Wildlife Service
Beth Pendleton, Regional Forester - USDA Forest Service
Pat Pourchot, Department of the Interior, Alaska
Peter J. Probasco, Office of Subsistence Management
Lester Wilde, Chair, Yukon-Kuskokwim Delta Regional Advisory Council
Jack Reakoff, Chair, Western Interior Alaska Regional Advisory Council
Sue Entsminger, Chair, Eastern Interior Alaska Regional Advisory Council
Molly Chythlook, Chair, Bristol Bay Regional Advisory Council
Weaver Ivanoff, Chair, Seward Peninsula Regional Advisory Council
Cora J. Campbell, Commissioner, Alaska Department of Fish and Game
James W. Balsiger, Administrator, Alaska Region, National Marine Fisheries Service
David Balton, Deputy Assistant Secretary, Oceans and Fisheries, U.S. Department of State

Subject: High Chinook salmon bycatch by pollock fisheries
From: George Lamont <lamont.george@yahoo.com>
Date: 3/14/2012 12:06 PM
To: "npfmc.comments@noaa.gov" <npfmc.comments@noaa.gov>

RECEIVED
MAR 1 4 2012

Attention;

The Tuluksak Native Community Tribe, located in the southwest region of Alaska, is a Federally recognized tribe, and is historically a subsistence dependent tribe, and has fished for Chinook salmon as a resource for survival for centuries. The tribes position regarding the yearly bycatch of Chinook salmon by the Pollock fisheries is to find a solution to reduce Chinook salmon bycatch by the pollock industries. For over a decade, Tuluksak Native Community has participated in Subsistence and Commercial Fisheries Closures by the State and Federal Fish and Wildlife Services so as to allow escapement of salmon to spawn. Now, the Tuluksak Native Community feels that the North Pacific Management Council should also do the same during the highest recorded Chinook salmon bycatch peaks, during the month of october for 14 to 20 days for to allow escapement of the precious Chinook salmon resource and for its survival as a species for generations to come. By continually allowing the pollock fisheries to bycatch Chinook salmon, the Councils are working towards the Wild Chinook Salmons extinction and is genocidal towards the species. Therefore, Tuluksak Native Communities position is for the Councils to allow escapement of Chinook during the bycatch recorded peaks by closures of the pollock fisheries during the month of October.

Thank you,

George Lamont, Tuluksak Native Community, Tribal Administrator

Tuluksak Native Community
P.O. BOX 95
Tuluksak, Alaska 99679
Phone: (907) 695-6420
Fax: (907) 695-6932
Attn: George Lamont

enclosure; draft resolution

cc: TNC Tribal Council

— Draft Resolution.jpg ———

DRAFT COPY

TULUKSAK NATIVE COMMUNITY
P.O. BOX 95
Tuluksak, Alaska 99679
Phone: (907) 695-6420
Fax: (907) 695-6932

RESOLUTION # 12-03-02

A RESOLUTION PROPOSING A MEASURE TO REDUCE CHINOOK SALMON BYCATCH IN THE BERING SEA POLLOCK FISHERY BY SEASONAL CLOSURE OF AREAS WHERE HIGH CHINOOK SALMON BYCATCH OCCURS DURING THE MONTH OF OCTOBER.

WHEREAS; the TULUKSAK NATIVE COMMUNITY is an Alaska Native Village and Tribe that is Federally recognized; and

WHEREAS; the Village Council is the governing body for TULUKSAK NATIVE COMMUNITY; and

WHEREAS; the TULUKSAK NATIVE COMMUNITY harvests Chinook salmon for preservation as a subsistence resource seasonally; and

WHEREAS; the TULUKSAK NATIVE COMMUNITY relies on the harvest of Chinook salmon for winter consumption, and

WHEREAS; the High Seas Pollock Fishery are bycatching Chinook salmon at an alarming rate during the month of October yearly; and

WHEREAS; the yearly bycatch by the Alaska High Seas Fisheries is at its highest peak during the month of October, and

WHEREAS; to limit the Chinook salmon bycatch in the Bering Sea Pollock Fishery, the Bering Sea Pollock Fishery, and North Pacific Fishery Management Council, must allow a closure for two weeks or 20 days during the month of October, and would allow avoiding Chinook salmon bycatch; and

WHEREAS; the closure of 2 weeks to 20 days will allow Chinook salmon bycatch escapement during the highest peaks recorded, and;

NOW THEREFORE BE IT RESOLVED; that the Chinook salmon bycatch be limited by closure of the Bering Sea Pollock Fishery for 2 weeks to 20 days during highest bycatch peaks, during the month of October as recorded graphically by the National Oceanic and Atmospheric Administration's, Diana Stram.

CERTIFICATION

This will certify that the foregoing resolution was approved by action of a majority of Tuluksak Council members, during a duly constituted meeting held this ______ Day of ____________, 2012 with a quorum having been established and members present and voting in the following manner: ________ Yes, ______ no, _______ absent.

Signed by: ______________________ **Attest by:**

—Attachments:

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WWF

World Wildlife Fund
Arctic Field Program
406 G. Street, Suite 303
Anchorage, AK 99501 USA

Tel: (907) 279-5504
Fax: (907) 279-5509

www.worldwildlife.org

March 20, 2012

Mr. Eric Olson
Chair
North Pacific Fishery Management Council
605 W. 4th Street, Suite 306
Anchorage, AK 99501-2252

Dr. Jim Balsiger
Regional Administrator
NOAA Fisheries, Alaska Region
709 W. 9th Street
Juneau, AK 99802-1668

Re: Chum Salmon Bycatch Item C-2

Dear Mr. Olson and Dr. Balsiger,

On behalf of World Wildlife Fund (WWF) I submit these comments on the Bering Sea Aleutian Islands (BSAI) chum salmon bycatch reduction measures being considered by the North Pacific Fishery Management Council (Council).

Chum salmon function as critical ecosystem components and comprise a crucial food source for indigenous peoples. Chum salmon also play a vital role in the economic viability of communities on both sides of the Bering Sea, providing important commercial opportunities in fisheries they support as well as a source of protein for local user groups. WWF also acknowledges the importance of the BSAI Pollock fisheries in feeding the global marketplace, and further recognizes that the Pollock fishery must be allocated a portion of the annual chum salmon catch in order to operate. As you know, allocations of chum salmon are also needed in Alaska and Canada by directed commercial fisheries, subsistence harvesters, recreational users, and for ecosystem integrity.

WWF recommends the Council take swift action to permanently and significantly reduce the bycatch of chum salmon in the BSAI Pollock fishery. Nearly one year has passed since the Council took up initial review of this topic. WWF does not believe that the Voluntary Rolling Hot Spot (VRHS) system alone is adequate to control chum bycatch. High bycatch levels continue to be a problem even with the VRHS system in place. It is the view of WWF that at this time, we must move beyond the *status quo*. A combination and appropriate use of time/area closures, bycatch reduction devices, and trigger/hard caps on chum bycatch, in addition to the VRHS, could result in levels of bycatch that are significantly lower than those levels currently proposed in the Environmental Assessment (EA). Swift action is also needed to prevent a repeat of the chum bycatch levels of 2011. Chum salmon bycatch in 2011 was almost 200,000 fish, a nearly 1400% increase from the year before, and a total number that exceeded more than the last four years of chum bycatch combined.

WWF recommends the Council develop adaptive management measures that can regulate chum salmon bycatch in a manner that will be responsive to years of varying abundance. The use of a hard cap would have helped to reduce the exorbitant chum salmon caught in the Pollock fishery in 2011, but in other years a hard cap would have done little or nothing to reduce chum bycatch. A hard cap can be an effective tool if it is responsive to the abundance of chum, i.e., if it is set low enough to reduce impacts on those chum runs with yield concerns, and is implemented in conjunction with other management tools, such as graduated trigger levels and time and area closures.

WWF further recommends the Council develop management measures that can regulate chum salmon bycatch amounts in years when Chinook salmon levels cannot meet the needs of subsistence users.

For many years now, Western Alaska villages have been plagued by low Chinook salmon returns. Additionally, chum salmon remains a yield concern for Norton Sound, and the Yukon and Kuskokwim Rivers had yield concerns until very recently. Thus, the Council has a responsibility to address the issue of chum salmon bycatch especially during times of low Chinook returns.

At the June 2011 Council meeting in Nome on the issue of addressing non-Chinook bycatch, many people from Western Alaska expressed hardships due to lower returns of chum salmon. Their concerns were also expressed in a resolution from the Federal Subsistence Board, who urged the Council to adopt a hardcap of 50,000 salmon after numerous Federal Subsistence Regional Advisory Council's and tribes passed resolutions for a hardcap of either 50,000 or 15,000 of non-Chinook salmon. While we do not speak for the tribes, their voice must be heard on this issue. Therefore, we urge the Council to consider adding options to the analysis that reflect the desires of the subsistence community, while at the same time not delaying action.

The BSAI Pollock fishery is certified by the Marine Stewardship Council (MSC), and it is important for the industry to continue to strive towards reducing its catch of non-target species under MSC's Principle 3. The MSC logo helps consumers worldwide to identify Alaska pollock as a sustainable seafood product, and it is important for the industry to continue to commit to the reduction of bycatch and ecosystem impacts under the banner of MSC.

Given the global reach of WWF, we would like to emphasize the necessity for the Council to take an international perspective in its deliberations on solving the chum salmon bycatch problem. Current stock of origin science indicates that a large proportion of chum salmon captured in the BSAI Pollock fishery are of Japanese or Russian origin. There is speculation that a large proportion of this bycatch is fish originating from hatchery production. However, these two observations are irrelevant in the context of reducing chum salmon bycatch, because a Pollock trawler or fishery observer cannot distinguish between an Asian hatchery chum and an Alaskan wild chum. While chum bycatch may partly consist of hatchery fish, this does not mean we should wait to take steps to protect vulnerable wild stocks. Without more standardized and regularly analyzed stock of origin data, it would be inappropriate to simply pass off chum salmon bycatch as inconsequential or disposable in light of a perceived high proportion of hatchery or foreign fish. Further, while genetic stock of origin data has shown that Western Alaska chum are more prevalent in the June and July Pollock fisheries, it is important to make sure that total chum bycatch is down as this fishery is important for communities on both sides of the Bering Sea. The North Pacific Fishery Management Council should take international leadership in reducing salmon bycatch, no matter the stock of origin.

In conclusion, WWF urges the Council to take action to implement management measures that will reduce all chum salmon bycatch in the BSAI Pollock fishery during years of both low and high chum and Chinook abundance. This reduction will benefit other chum salmon user groups and help maintain marine and terrestrial ecosystem function.

Thank you for your time and consideration of these comments.

Respectfully,

Heather V. Brandon

Heather V. Brandon
Senior Fisheries Officer
Arctic Field Program
World Wildlife Fund

Association of Village Council Presidents

Bering Sea Fishermen's Association

YUKON RIVER DRAINAGE FISHERIES ASSOCIATION

March 20, 2012

Mr. Eric Olson, Chair
North Pacific Fishery Management Council
605 West 4th Avenue, Suite 306
Anchorage, AK 99501

Dr. Jim Balsiger, Regional Administrator
NOAA Fisheries, Alaska Region
PO Box 21668
Juneau, AK 99802

Re: Agenda Item C-2 Initial Review Draft BSAI Chum Salmon Bycatch EA/RIR

Dear Mr. Olson, Dr. Balsiger and Council members:

We are submitting these comments on behalf of the Association of Village Council Presidents (AVCP), Bering Sea Fishermen's Association (BSFA) and the Yukon River Drainage Fisheries Association (YRDFA). AVCP is a tribal consortium of the fifty-six tribes of the Yukon-Kuskokwim Delta region. BSFA is a non-profit extension service organization serving the needs of Western Alaska commercial and subsistence fishermen. YRDFA is an association of commercial and subsistence fishers on the Yukon River.

We are still in the process of reviewing the EA/RIR and may provide supplemental comments during the Council meeting in Anchorage. We appreciate the time and effort NMFS, Council and ADF&G staff have put into the Environmental Assessment (EA) and Regulatory Impact Review (RIR). We appreciate the changes which have been made to the analysis since the last draft was presented to the Council in June 2011.

As you are aware, the region our organizations serve is home to some of the world's most magnificent salmon resources. These salmon provide a primary source of food for humans and the dogs which are essential to the continued viability of the subsistence way of life in Western Alaska. Chum salmon are a critical component of the subsistence way of life in our communities, increasingly so in the recent years of Chinook salmon shortages. Chum salmon also represent the only resource for a directed commercial fishery in recent years in some regions, and this commercial fishing income is one of the only means of cash income available to many in our villages. Salmon represents an essential part of the culture, diet and economy in our region.

The chum salmon population is already fully allocated. Chum salmon taken in the pollock fishery subtracts from that full allocation, and impacts users who depend on this resource for their sustenance and livelihood. While returns have been good in most regions in recent years, chum fisheries (commercial and subsistence) in Western Alaska are in the process of recovering. While we do not know the exact cause of the crashes, or what may help or hinder recovery, mortality from bycatch is certainly a piece of the equation. It is critical that a management measure is put in place to ensure that the pollock fishery does not inadvertently stop the recovery of chum populations to allow their historic levels of harvests (commercial and subsistence). The purpose of a limit on bycatch is to keep chum interception from growing, and to provide the incentives to keep the interceptions at low levels. Over time, this will benefit chum salmon users.

This issue also poses significant environmental justice and social justice concerns. The users of Western Alaska chum salmon predominately are Alaska Native, poor, a minority, with cultures that will be harmed if there are fewer fish to harvest. The social justice consideration of risk swings toward favoring them over the pollock industry, which is newer, richer, and more powerful socioeconomically. This issue pits the largest commercial fishery in the United States against the economically poorest group of subsistence users.

Environmental and social justice means that when there is uncertainty of great risks, the costs of minimizing those risks should be disproportionately carried by the user that is socio-economically large, mainstream, and recent, rather than the user that is socio-economically poor, minority, and traditional. It is already established that chum salmon is a prohibited species in the pollock fishery. It is well established that the subsistence users of chum salmon are among the poorest minority populations in the United States, dependent on fragile, valuable cultural traditions and dependent on marginal commercial salmon fisheries, which can be easily disrupted by a losing few thousand fish to a local stream systems. This could occur on a high bycatch year, or even a lower bycatch year in which many chum salmon from the same stream are taken. Under Executive Order 12898, federal agencies are required to "make achieving environmental justice part of its mission by identifying **and addressing**, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions."[1] This indicates that the burden of risk to chum salmon based on a lack of certainty around the impacts should be borne by the pollock fishery, not by the chum salmon-dependent communities of Western Alaska.

In addition to our general comments about this action, we have several specific comments about the RIR/IRFA:

I. <u>Estimating impacts to Western Alaska stocks</u>

[1] Executive Order 12898 (February 11, 1994) § 1-101.

Minimizing bycatch of chum salmon is extremely important given the relatively small sizes of chum salmon escapements to key stream systems in Western Alaska. Because of small escapements, a bycatch of even several thousand fish may inadvertently take the lion's share of escapement to a stream system essential to the economic survival of villages.

The current analysis, however, continues to assess impacts on a Western Alaska-wide basis. While we understand that the current chum salmon genetic baseline does not allow for separation of Western Alaska stocks, this masks impacts on smaller, weaker stocks. For instance, Norton Sound chum salmon, which have suffered severe declines, are included in a coastal Western Alaska grouping. By assessing impacts on the regional scale suggested by the stock groupings represented in the genetics, the analysis underestimates the impacts on weaker stocks. This ignores the fact that impacts could be much greater in regions with smaller run sizes and weaker stocks, i.e. Norton Sound, particularly if bycatch is not evenly distributed by region.

We concur with the statement on page 207 of the RIR:

> ...in some instances the returns of chum salmon to a particular river system in western Alaska are also relatively small with respect to the aggregated overall run size... It is possible that even a few thousand returning fish may be critically important to one specific stream system. Even the relatively small numbers of estimated adult returning salmon predicted herein may be of a level of importance to a specific area that is in excess of what the analysis is capable of identifying. Thus, there are inherent benefits to the health of the salmon resources of western Alaska from even small numbers of returning salmon... even a few hundred fish, and a few hundred dollars from those fish, may be critically important in many villages throughout western Alaska.[2]

However, this point is superseded by the citation throughout the analysis of "impact rates" on Western Alaska stocks. For instance, on page 317, the average impact rate for Coastal West Alaska for 2004-2011 is cited as .49%.[3] Throughout the analysis the impact on Coastal Western Alaska and the middle and upper Yukon is referred to as "low." This severely underestimates the potential impacts to smaller stocks.

To illustrate this point, and provide data which should be included in the EA/RIR, Tables 1-4 illustrate the relative small sizes of chum salmon escapements within particular stream systems in Western Alaska (1990-2009).

Table 1 shows estimated chum salmon escapements in Norton Sound, an area suffering from such severe chum salmon shortages that subsistence fishing in areas like Nome has been drastically curtailed. The median returns of chum salmon in the rivers in the Nome subdistricts have been small relative to the sizes of chum salmon bycatches in the pollock fishery, such as 1,914 chum salmon (Solomon River), 4,552

[2] National Marine Fisheries Service, Initial Review Draft Regulatory Impact Review/Initial Regulatory Flexibility Analysis, March 2012 at 207 [hereinafter RIR/IRFA].

[3] North Pacific Fishery Management Council and National Marine Fisheries Service, Initial Review Draft Environmental Assessment, March 2012 at 317 [hereinafter EA].

chum salmon (Bonanza River), 6,333 chum salmon (Sinuk River), and 3,339 chum salmon (Nome River).

Table 2 shows the chum salmon escapements in the Kuskokwim Area. While the Aniak River shows a relatively large median escapement (408,830 chum salmon), most other systems are much smaller, such as 3,885 chum salmon (Upper Takotna), 28,832 (Middle Fork of the Goodnews River), or 13,658 chum salmon(Tuluksak River).

Tables 3 and 4 illustrate escapements of fall chum salmon (Table 3) and summer chum salmon (Table 4) in the Yukon drainages. Relatively modest median escapements of fall chum salmon are found in some key spawning areas, such as 18,022 chum salmon (Toklat River), 17,572 chum salmon (Delta River), and 59,781 chum salmon (Sheenjek River). Modest runs of summer chum salmon are also found in some key systems, such as 13,583 chum salmon (Kaltag Creek), 31,621 chum salmon (Gisasa River), and 49,140 chum salmon (Nulato River).

In looking at run size impacts it is also critical that subsistence harvests by villages occur in relatively small areas near communities. Small local stream systems like those illustrated in Tables 1-4 commonly provide the salmon for these villages. Relatively large bycatches that inadvertently remove salmon from these small returns can inflict substantial damage on these traditional subsistence uses, as stated in the RIR.

In conclusion, the statements in the EA/RIR that run size impacts are low are misleading, ignore critical differences in run sizes within the region, and **should be removed from the EA**.

II. Increasing demands for chum salmon as subsistence food in the AYK region

A significant area which has not been addressed in the current EA/RIR is the predictions for increasing demand of chum salmon for subsistence food throughout the Arctic-Yukon-Kuskokwim (AYK) region. As chum salmon becomes an increasingly important food source for villages the need for tighter bycatch restrictions becomes significantly greater. We have attached a letter from Robert Wolfe, PhD, one of the study authors, summarizing the results of the study as well as the full report. This is critical information and is directly relevant to the issue of chum salmon bycatch and should be included in the next draft analysis.

In closing, chum salmon are incredibly important to the AYK region, and will likely become even more important as a source of food in the future. While some chum salmon populations currently seem to be recovering, it is critical that measures are put in place now to ensure that bycatch of chum salmon is limited and that these stocks can recover and flourish in the future. We urge the Council to act now to put management measures in place which will reduce bycatch of Western Alaska chum salmon.

Thank you for your consideration of these comments. We look forward to continuing to work with you to ensure management measures are in place to consistently reduce chum salmon bycatch in the Bering Sea pollock fishery.

Sincerely,

Myron P. Naneng, Sr., President
Association of Village Council Presidents

Karen Gillis, Executive Director
Bering Sea Fishermen's Association

Rebecca Robbins Gisclair, Policy Director
Yukon River Drainage Fisheries Association

Encl.

Table 1. Norton Sound Chum Salmon Escapement Counts[1]
By Stream System, Area, and Management Subdistrict

Year	Pilgrim River Port Clarence	Solomon River Nome 1	Bonanza River Nome 1	Flambeau River Nome 1	Sinuk River Nome 1	Eldorado River Nome 1	Snake River Nome 1	Nome River Nome 1	Fish Golovin 2	Niukluk Golovin 2	Kwiniuk Moses Pt 3	Tubutulik Moses Pt 3	North River Unalakleet 6
1990											13,957	4,350	
1991									10,470		19,901	7,085	
1992									390		12,077	2,596	
1993		2,525	3,007	6,103	6,062	9,048	2,116	5,925	12,695		15,824	8,740	
1994		1,086	5,178	12,689	4,905	13,202	3,619	2,893	16,600		33,012		
1995		2,106	11,182	16,474	9,464	16,955	4,393	6,093	13,433	88,332	42,500	16,158	
1996		2,141	7,049	13,613	6,658	32,970	2,772	3,339	5,940	90,178	28,493	10,790	9,789
1997	16,619	2,111	4,140	9,456	9,212	14,302	6,164	6,147	19,516	57,305	20,119	3,105	8,904
1998		925	4,652	9,129	6,720	13,606	11,087	1,930	28,010	45,685	24,247	10,180	1,526
1999	2,817	637	2,304	637	6,370	4,218	484	1,048	50	38,239	8,763		5,800
2000	861	1,294	4,876	3,947	7,198	11,617	1,911	4,056		29,573	12,878	863	4,971
2001		1,949	4,745	10,465	10,718	11,635	2,192	2,859	3,220	30,662	16,898	180	6,516
2002	5,590	2,180	3,199	6,604	6,333	10,243	2,778	1,720		35,307	37,865	1,352	6,918
2003	15,200	806	1,664	3,390	3,482	3,691	2,201	1,967	3,200	20,018	12,123	1,117	8,659
2004	10,239	1,436	2,186	7,667	3,107	3,273	2,148	3,903	621	10,770	10,362	1,336	10,038
2005	8,695	1,914	5,534	7,692	4,710	10,428	2,967	6,564	6,876	25,598	12,063		11,884
2006	45,381	2,062	708	27,628	4,934	41,865	4,160	6,677		29,169	39,519	7,045	6,365
2007	36,334	3,469	8,491	12,008	16,481	21,312	6,147	7,084		50,994	27,756		8,151
2008	24,550	1,000	1,000	11,918	1,000	6,746	1,244	2,607		12,078	9,462	3,161	9,602
2009	6,427	918	6,744	4,075	2,232	4,843	891	1,565		16,679	8,733		9,783
Median	10,239	1,914	4,652	9,129	6,333	11,617	2,772	3,339	6,876	30,662	16,211	3,161	7,828
Mean	15,498	1,677	4,502	9,634	6,446	13,863	3,460	3,670	9,294	37,648	20,316	5,204	7,665
Min	861	637	708	637	1,000	3,273	484	1,048	50	10,770	8,733	180	1,526
Max	45,381	3,469	11,182	27,628	16,481	41,865	11,087	7,084	28,010	88,332	42,500	16,158	11,884

[1] *Sources: Menard and Bergstrom 2009a (Subdistrict 1); Menard and Bergstrom 2009b (Subdistricts 2-3).*

Table 2. Kuskokwim Area Chum Salmon Escapement Counts[1]
By Stream System, Area, and Management Subdistrict

Year	Kwethluk 1	Tuluksak 1	George Upper	Kogrukluk Upper	Tatlawiksuk Upper	Takotna Upper	Kanektok 4	Goodnews Mid Fork 5	Aniak 2
1990				26,765					246,813
1991		7,675		24,188				31,844	366,687
1992	30,596	11,183		34,106				22,023	87,467
1993		13,804		31,899				14,962	15,278
1994		15,724		46,635				34,849	474,398
1995				31,265				33,699	
1996	26,049		19,393	48,465		2,872	70,617	40,450	402,195
1997	10,659		5,907	7,858		1,779	51,180	17,369	289,654
1998				36,442				28,832	351,792
1999			11,562	13,820	9,599			19,513	214,428
2000	11,691		3,492	11,491	7,044	1,254		13,791	177,384
2001		19,321	11,601	30,569	23,718	5,414		28,820	408,830
2002	35,854	9,958	6,543	51,570	24,542	4,377	42,014	30,300	472,346
2003	41,812	11,724	33,666	23,413		3,393	40,088	21,637	477,544
2004	38,646	11,796	14,409	24,201	21,245	1,630	48,194	31,616	672,931
2005		35,696	14,828	197,723	55,720	6,467	50,881	26,680	1,151,505
2006	47,490	25,648	41,467	180,594	32,301	12,598		54,699	1,109,626
2007	57,230	17,288	55,842	49,505	83,248	8,900	133,215	49,285	699,178
2008	20,048	12,518	29,978	44,978	30,898	5,691	54,024	44,700	427,911
2009	32,028	13,658	7,941	83,711	19,975	2,484	51,647	19,713	479,499
Median	32,028	13,658	14,409	33,002	24,130	3,885	51,180	28,832	408,830
Mean	32,009	15,645	19,740	49,966	30,829	4,737	66,982	29,810	449,654
Min	10,659	7,676	3,492	7,858	7,044	1,254	40,088	13,791	15,278
Max	57,230	35,696	55,842	197,723	83,248	12,598	133,215	54,699	1,151,505

[1] *Source: Estensen et al. 2009*

Table 3. Yukon River Fall Chum Salmon Escapement Counts[1]
By Stream System, Area, and Management Subdistrict

Year	Chandalar 5D	Sheenjek 5	Toklat 6A	Kantishna 6A	Delta River 6	Bluff Cabin Slough 6	Upper Tanana 6	Canadian Spawning
1990	76,631	77,750	34,739		8,992	1,632		51,735
1991		86,496	13,347		32,905	7,198		78,461
1992		78,808	14,070		8,893	3,615		49,082
1993		42,922	27,838		19,857	5,550		29,743
1994		150,565	76,057		23,777	2,277		98,358
1995	280,999	241,855	54,513		20,587	19,460	268,173	158,092
1996	208,170	246,889	18,264		19,758	7,074	134,563	122,429
1997	199,874	80,423	14,511		7,705	5,707	71,661	85,419
1998	75,811	33,058	15,605		7,804	3,549	62,384	46,252
1999	88,662	14,229	4,551	27,199	16,534	7,037	97,843	58,552
2000	65,894	30,084	6,911	21,450	3,001	1,595	34,844	53,732
2001	110,971	53,932	6,007	22,992	8,103	1,808	96,556	33,491
2002	89,850	31,642	28,519	56,665	11,992	3,116	109,970	98,679
2003	214,416	44,047	21,492	87,359	22,582	10,600	193,418	143,133
2004	136,706	37,878	35,480	76,163	25,073	10,270	123,879	154,080
2005	496,484	561,863	17,779	107,719	28,132	11,964	337,755	437,733
2006	245,090	160,178		71,135	14,055		202,669	211,994
2007	228,056	65,435		81,843	18,610		320,811	254,649
2008	178,278	50,353			23,055	1,199		174,267
2009		54,126			13,492	2,900		93,626
Median	178,278	59,781	16,022	71,135	17,572	4,583	123,879	95,982
Mean	179,659	107,127	24,480	61,362	16,745	5,919	158,040	121,875
Min	65,894	14,229	4,551	21,450	3,001	1,199	34,844	29,743
Max	496,484	561,863	76,057	107,719	32,905	19,460	337,755	437,733

[1] *Source: Hayes et al. 2008*

Table 4. Yukon River Summer Chum Salmon Escapement Counts[1]
By Stream System, Area, and Management Subdistrict

Year	East Fork Andreafsky 2	Anvik Index 4A	Kaltag Creek	Nulato 4A	Gisasa 4A	Clear Creek	Henshaw 4A
1990		403,627					
1991		847,772					
1992		775,626					
1993		517,409					
1994	200,981	1,124,689	47,295	148,762	51,116		
1995	172,148	1,339,418	77,193	236,890	136,886	116,735	
1996	108,450	933,240	51,269	129,694	157,589	100,912	
1997	51,139	609,118	48,018	157,975	31,800	76,454	
1998	67,591	471,865	8,113	49,140	18,228	212	
1999	32,229	437,631	5,300	30,076	9,920	11,283	
2000	22,918	196,349	6,727	24,308	14,410	19,376	27,271
2001		224,058		17,936	3,674	35,031	
2002	45,019	462,101	13,583	72,232	32,943	13,150	25,249
2003	22,603	251,358	3,056	17,814	24,379	5,230	22,556
2004	62,730	368,691	5,247		37,851	15,661	65,988
2005	20,127	525,391	22,093		172,259	26,420	237,481
2006	102,260	992,376		225,225	29,166		
2007	69,642	459,038		46,257	31,442		
2008	57,259	374,929		36,758	97,281		
2009	8,770	182,966			26,893		156,201
Median	57,259	466,963	13,583	49,140	31,621	19,376	58,619
Mean	69,591	574,734	26,172	91,774	54,677	38,224	92,454
Min	8,770	182,966	3,056	17,814	3,674	212	22,556
Max	200,981	1,339,418	77,193	236,890	172,259	116,735	237,481

[1] *Source: Hayes et al. 2008; Bergstrom et al. 2009.*

Sources for Tables 1-4

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March 20, 2012

Association of Village Council Presidents, Bering Sea Fishermen's Association, and
Yukon River Drainage Fisheries Association
c/o Becca Robbins Gisclair
Yukon River Drainage Fisheries Association
725 Christensen Dr., Ste. 3-B
Anchorage, AK 99501

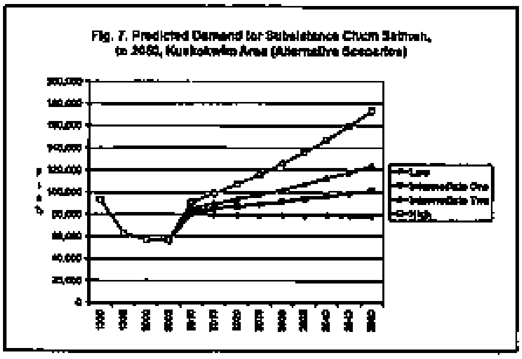
Dear Ms Gisclair,

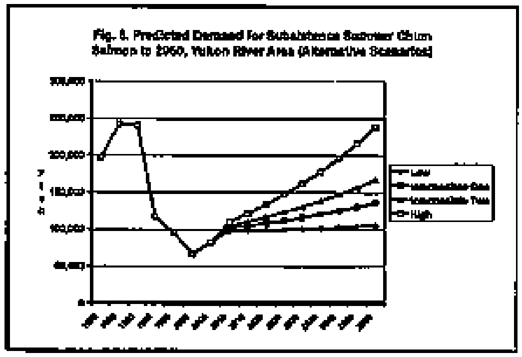
This letter is in response to your query regarding information on demand for chum salmon in the Arctic-Yukon-Kuskokwim (AYK) area of western Alaska. In particular, is subsistence demand for chum salmon projected to increase in western Alaska villages in future years?

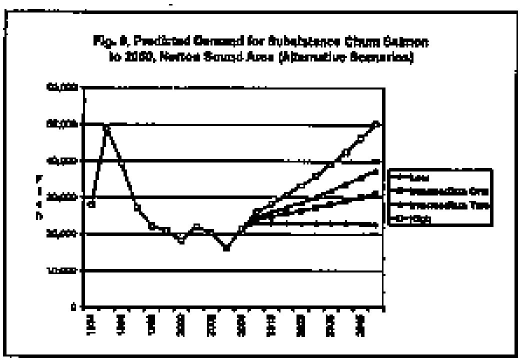
There is a recent statistical model designed to predict future subsistence demand for salmon in western Alaska, presented in "Salmon Harvests to the Year 2050: A Predictive Model for the Yukon, Kuskokwim, and Norton Sound Drainages in Alaska," by Robert J. Wolfe, Gunnar Knapp, William Bechtol, David Andersen, and Cheryl Scott, Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative, Project Final Product, June 2011. A nine-member expert panel developed the model to examine the future of salmon fisheries in western Alaska. Because it is new, the paper likely was not available to the writers of the Bering Sea Non-Chinook Salmon Bycatch Management Regulatory Impact Review. I have included a copy of the research paper with this letter.

The model of subsistence demand shows a range of potential outcomes depending upon future conditions of human populations, household incomes, community cultural composition, and other factors. According to the model, subsistence demand for chum salmon increases in western Alaska under many plausible future scenarios. That is, chum salmon becomes more important over time as a subsistence food for villages in western Alaska under these scenarios. These outcomes are illustrated in the following graphs (Figs. 7-9, 11) that show the predicted subsistence demand for chum salmon under four scenarios, called *Low, Intermediate One, Intermediate Two,* and *High* (taken from the paper). The numbers of fish are presented in Table 1.

For example, in the Intermediate Two scenario (described below), chum demand increases from 24,648 to 37,437 fish (51.9%) in Norton Sound, from 85,511 to 123,795 fish (44.8%) in the Kuskokwim Area, from 104,817 to 166,678 fish (59.0%) in the Yukon drainage of Alaska (summer chum), and from 69,011 to 82,305 fish (19.3%) in the Yukon drainage of Alaska (fall chum) (Figs. 7-9, 11; Table 1). In the Low scenario, the demand for chum appears relatively stable or in decline, but in the other scenarios, the demand for chum increases (the exception being for fall chum in the Yukon drainage, which shows mixed trends in demand). Overall, these outcomes suggest that subsistence demand for chum salmon increases under many plausible future conditions within western Alaska villages. That is, chum salmon becomes increasingly important as a food source.







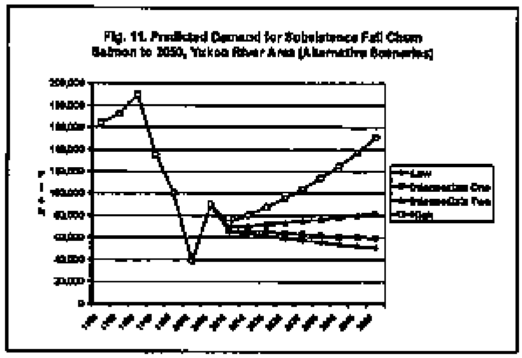


Table 1. Predicted Subsistence Demand for Chum Salmon[1]

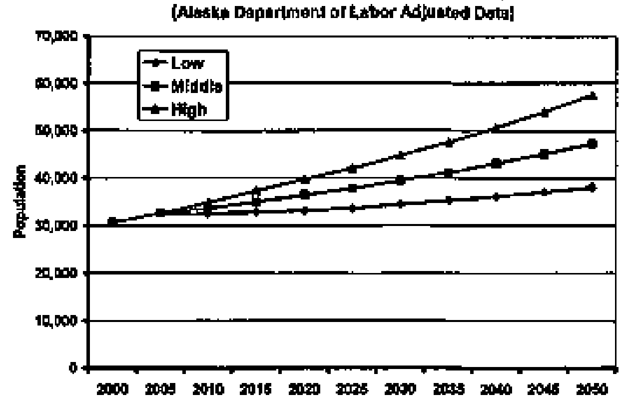
	Scenarios					Scenarios			
	Low	Intermediate One	Intermediate Two	High		Low	Intermediate One	Intermediate Two	High
Norton Sound					**Kuskokwim Area**				
2010	23,064	24,050	24,648	25,883	2010	80,188	83,059	85,511	90,702
2015	23,002	24,876	25,980	28,333	2015	79,574	85,105	89,405	98,805
2020	22,865	25,623	27,281	30,727	2020	79,053	87,221	93,511	107,152
2025	22,749	26,323	28,586	33,174	2025	78,666	89,222	97,646	115,797
2030	22,652	27,238	30,188	36,015	2030	78,774	91,632	102,388	125,437
2035	22,899	28,160	31,868	39,102	2035	78,784	94,084	107,382	135,940
2040	22,881	29,086	33,635	42,456	2040	78,675	96,569	112,583	147,385
2045	22,789	30,011	35,491	46,099	2045	78,428	99,076	118,058	159,861
2050	22,611	30,930	37,437	50,059	2050	78,021	101,593	123,795	173,482
Yukon Drainage (Alaska) Summer Chum					**Yukon Drainage (Alaska) Fall Chum**				
2010	98,487	101,660	104,817	110,243	2010	65,757	68,828	69,011	73,513
2015	98,565	104,692	110,616	121,729	2015	63,591	65,939	70,563	80,322
2020	98,983	108,542	117,034	134,128	2020	61,473	65,009	72,104	87,627
2025	99,569	112,188	123,647	147,281	2025	59,377	63,927	73,519	95,457
2030	100,672	116,322	131,008	161,868	2030	57,428	62,878	74,999	104,113
2035	101,796	120,762	138,950	178,078	2035	55,581	61,918	76,613	113,881
2040	102,921	125,514	147,513	198,089	2040	53,833	61,051	78,365	124,830
2045	104,007	130,582	156,741	216,104	2045	52,174	60,273	80,260	137,165
2050	105,024	135,971	166,678	238,338	2050	50,595	59,584	82,305	151,029

[1] *Source: Wolfe, Knapp, Bechtol, Andersen, and Scott (2011)*

The attached paper explains the basis for the model's predictions. In sum, wild food production at the village level is related to factors such as monetary income, cultural composition of consumers, size of village populations, and geography, so statistical equations can be created for estimating (that is, inferring) subsistence production based on these factors. We developed statistical relationships into a predictive model of demand for salmon, assuming that past relationships among factors continue into the future. No one can predict with surety the trends in human populations, household incomes, the relative composition of available salmon varieties, and so forth. Accordingly, the model allows for varied assumptions on potential future conditions of these factors and predicts what the future demand for salmon would be conditional on those assumptions.

The two intermediate scenarios (Intermediate One, Intermediate Two) assume that human populations would change at rates of the middle projection of the Alaska Department of Labor (shown in Fig. 2). Income (per capita) was assumed to increase by 3.0% or 5.0% for each five-year period, representing modest gains by households in employment. The cultural composition (percentage of Alaska Natives) of communities was assumed to either decrease by 1.0% or remain unchanged each five-year period, representing no or modest in-migration or out-migration into the AYK region. Sled dog populations were assumed to either decrease or increase by 2.0% each five-year period, representing modest changes in sled dog numbers. The relative proportion of salmon in wild food diets was assumed to either stay the same or increase by 1.0% each five-year period, representing no or small changes in preference for salmon over other wild foods. The relative composition of salmon species in the village catch was left unchanged.

Fig. 2. Population Projections to 2050 of Villages Harvesting Salmon, AYK Region (Alaska Department of Labor Adjusted Data)



By contrast, the low scenario assumed that human populations would change at the rates of the low projection of the Alaska Department of Labor. Incomes were assumed to substantially increase (8.0% per five-year period in villages and 6.0% per five-year period in Bethel, Nome, and Fairbanks), representing substantially higher employment and earnings in villages, town, and cities. The cultural composition (percent Alaska Natives) of rural communities was assumed to decrease by 1.0% each five-year period, representing modest in-migration of non-Natives into the AYK region. The numbers of sled dogs were assumed to decrease by 2.0% each five-year period, representing modest declines. The contribution of salmon in dog diets was assumed to decrease by 1.0% each five-year period, representing modest shifts to store-bought dog food. The relative proportion of salmon in wild food diets was assumed to stay the same, representing no change in preference for salmon over other wild foods. The relative composition of salmon species was left unchanged.

The high scenario assumed that human populations would increase at the rates of the high projection of the Alaska Department of Labor. Incomes were assumed to remain unchanged, representing unchanged employment patterns in villages, town, and cities. The cultural composition (percent Alaska Natives) of communities was assumed to remain unchanged, representing no net gains through in-migration or out-migration into the AYK region. The numbers of sled dogs was assumed to increase by 10.0% each five-year period, representing a resurgent interest in dog racing and transport, similar to the trends of the 1970s. The contribution of salmon in dog diets was assumed to increase by 2.0% each five-year period, representing shifts away from store-bought dog food due to lower disposable incomes. Salmon's contribution in wild food diets was assumed to increase by 1.0% each five-year period, representing shifts in food preferences toward salmon over other wild foods. The relative composition of salmon species was left unchanged.

The attached paper provides more details on the model, scenarios, and predictions of demand and harvests, including commercial production of salmon. It also provides predictions for other salmon species (Chinook, sockeye, coho, and pink) harvested within villages of western Alaska. The predictions of chum demand presented in the above figures assume that this mix of salmon species remains stable. However, should Chinook stocks decrease in the future (leading to smaller subsistence catches of Chinook), then the demand for other species such as chum salmon would increase even more in the villages of western Alaska.

In conclusion, assuming the assumptions of the mid-scenarios are plausible, chum salmon is predicted to grow in importance as a subsistence food in western Alaska. An analysis of potential impacts on subsistence fisheries by other economic activities (such as bycatch management in the pollock fishery) would be on solid ground to assume an increasing importance of chum salmon as a subsistence food source to the villages of western Alaska, at least to the year 2050.

I hope this short letter provides answers to your query. Please let me know if you have any additional questions regarding these research findings.

Sincerely,

Robert J. Wolfe

Salmon Harvests to the Year 2050: A Predictive Model for the Yukon, Kuskokwim, and Norton Sound Drainages in Alaska

Robert J. Wolfe[1], Gunnar Knapp[2], William R. Bechtol[3], David Andersen[4], and Cheryl Scott[5]

June 2011

Introduction

This paper predicts potential future salmon harvests to the year 2050 in the Yukon, Kuskokwim, and Norton Sound drainages of Alaska. The predictions derive from models of salmon runs, subsistence salmon demand, and commercial salmon production developed by an expert panel of fisheries biologists, anthropologists, and economists. The work addresses research questions about the future of salmon fisheries posed by the Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AYK-SSI), a research-restoration organization concerned with the sustainability of salmon fisheries in Alaska.

The Arctic-Yukon-Kuskokwim region (AYK) includes the Yukon, Kuskokwim, and Norton Sound drainages of Alaska (Krueger and Zimmerman 2009) (Map 1). Salmon and other wildlife have been critical to the survival of the people in the AYK region for thousands of years. In recent decades, residents of about eighty communities have harvested salmon for subsistence purposes in this region, primarily as food for families and secondarily for feeding sled dogs (Wolfe and Spaeder 2009). The salmon runs also have been harvested for commercial sales and sport use (Knapp 2009). The commercial fisheries have generated income to local residents through the sale of fish to middlemen buyers and through employment in fish processing. Historically, the AYK region has had a mixed, subsistence-cash economy where many families survive through subsistence harvests, commercial fishing, and wage employment.

Salmon returns to the AYK region have been variable in recent decades. Between 1997 and 2002, unexpected declines in salmon runs prompted fifteen disaster declarations within local watersheds by the governor of Alaska and federal agencies (Krueger et al. 2009). While some runs have improved since 2002, others have remained at low or uncertain levels. These conditions have created hardships for the people and communities dependent on salmon. Commercial salmon production has fallen with fewer active commercial fishers and buyers, and reduced earnings. Subsistence production for dog food also has fallen substantially with less available salmon and fewer local dog teams. Subsistence production for human food has continued, albeit with greater costs and local shortages for fishing families.

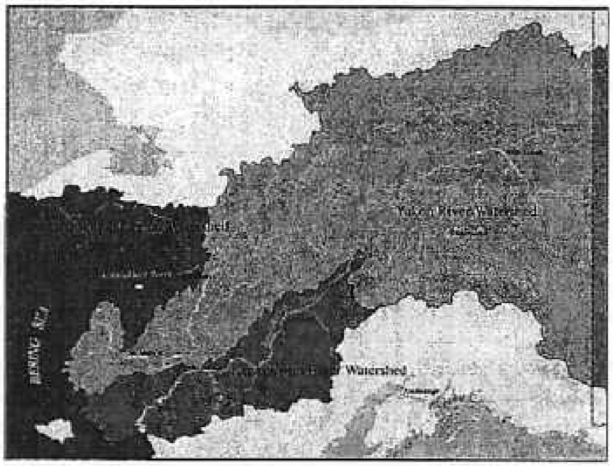
In response to salmon declines, Alaska Native regional organizations joined with state and federal agencies to form the AYK Sustainable Salmon Initiative (AYK-SSI), a partnership for research and restoration[6]. To understand trends and causes of variation in salmon fisheries, the

[1] Robert J. Wolfe and Associates, San Marcos, CA.
[2] University of Alaska Anchorage, Institute for Social and Economic Research, Anchorage, AK.
[3] Bechtol Research, Homer, AK.
[4] Research North, Fairbanks, AK.
[5] Alaskan Connections, Reno, NV.
[6] The partnership includes the Association of Village Council Presidents, Tanana Chiefs Conference, Kawerak, Inc., Bering Sea Fishermen's Association, Alaska Department of Fish and Game, National Oceanic and Atmospheric Administration, and U.S. Fish and Wildlife Service.

AYK-SSI Research and Restoration Program advanced a general hypothesis about future harvests for additional study:

> In the AYK region, human populations will increase over the next fifty years, but alternative affordable food resources will become more available, causing fishing and harvest to remain the same or to decline. (*AYK-SSI Research Framework No. 2, Human Systems and Sustainable Salmon: Social, Economic, and Political Linkages*).

This hypothesis asserts that future harvests will be influenced by increasing human populations and greater availability of store-bought foods, with overall stable or downward trends in subsistence salmon harvests in the AYK region.



Map. 1. Arctic-Yukon-Kuskokwim (AYK) Region in Alaska

The AYK-SSI Research Program charged a nine-member expert panel to examine the future of salmon fisheries in the AYK region with this hypothesis as a starting point. The panel consisted of the authors of this paper, as well as Keith Criddle, University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Caroline Brown and James Magdanz of the Alaska Department of Fish and Game, Division of Subsistence, and Joseph Spaeder of AYK-SSI. The charge was to develop a model that might describe future harvests in the AYK region.

This paper presents the results of that work, including a predictive model of factors and conditions that potentially affect future salmon harvests in the AYK region. As illustrated in Fig. 1, the predictive model contains three main components: (1) salmon run simulations, (2) a subsistence demand component, and (3) a commercial harvest component. The *salmon run simulations* provide scenarios for future run returns based on annual variation of past runs and assumed mean abundance levels. The *subsistence demand component* predicts future demand for subsistence salmon based on anticipated changes in community populations, mean incomes, and other factors. The *commercial harvest component* predicts future commercial harvests for years with harvestable surpluses (after escapement and subsistence demand is sufficiently met). Each component of the predictive model is described below. Findings of the predictive model are then presented, representing scenarios of potential future salmon harvests in the AYK region under alternative conditions. The paper ends with a discussion of the findings and conclusions.

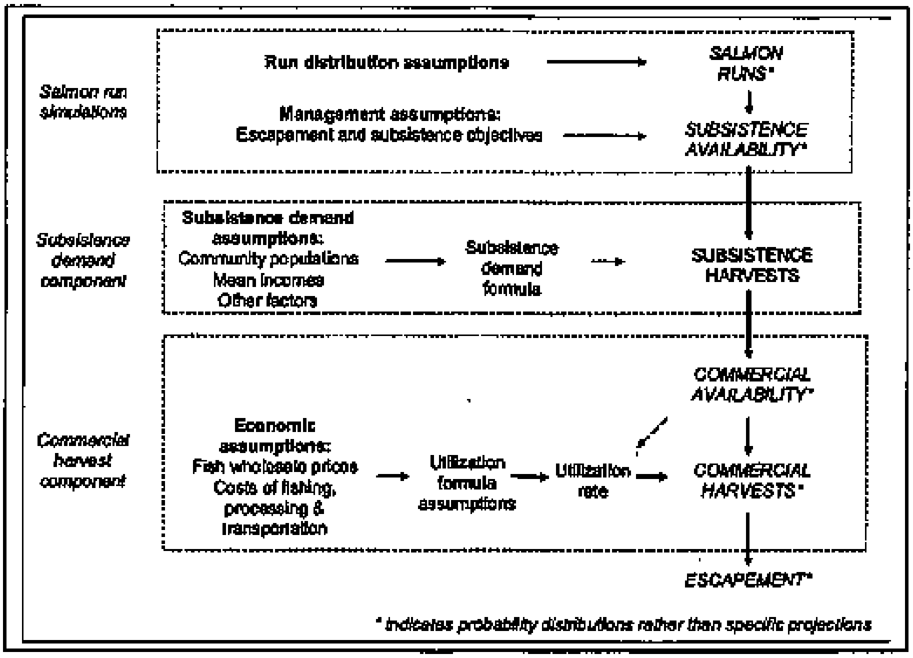


Fig. 1. Conceptual Framework for Analysis

Salmon Run Simulations

Paramount to future salmon harvests in the AYK region is the availability of salmon. If salmon runs are insufficient to provide harvestable surpluses, fishing must be restricted to achieve escapement goals. Historically, the AYK region has supported harvestable runs of six salmon varieties – Chinook (Kuskokwim, Yukon, Norton Sound), summer chum (Kuskokwim, Yukon, Norton Sound), fall chum (Yukon), sockeye (Kuskokwim, Norton Sound), coho (Kuskokwim, Yukon, Norton Sound), and pink (Kuskokwim, Yukon, Norton Sound). Run abundance has varied by area, year, and variety. Overall, the region's commercial fisheries have primarily targeted Chinook and chum with a lesser focus on sockeye, coho, and pink. Commercial fisheries generally have been larger in downriver areas than upriver areas. The Yukon and Kuskokwim systems have been substantially more productive than the Norton Sound systems. All salmon varieties are harvested within local subsistence fisheries, but the species composition and volume of harvests vary substantially by area. Sport fishing has primarily targeted Chinook and coho, with catches relatively modest compared with subsistence and commercial takes.

The run simulations divide the salmon runs in the AYK region into 28 salmon stocks defined by area, species, and run timing (Table 1). For our purposes, "stock" simply refers to a salmon variety within a management area (a river segment or combination of subdistricts). Our analysis assumes that the current general geographic distribution of salmon varieties continues into the future. The Lower Kuskokwim includes harvests from Eek to Tuluksak. The Lower Yukon includes harvests in management subdistricts Y1-Y3. Northern Norton Sound includes harvests from Elim to Brevig Mission, including Port Clarence.

Table 1. Salmon Stocks Represented in Run Simulations						
Area	Chinook	Summer Chum	Fall Chum	Sockeye	Coho	Pink
Lower Kuskokwim	X	X		X	X	
Middle-Upper Kuskokwim	X	X		X	X	
Kuskokwim Bay	X	X		X	X	
Lower Yukon	X	X	X		X	
Middle-Upper Yukon	X	X	X		X	
Southern Norton Sound	X	X			X	X
Northern Norton Sound		X		X	X	X

The data used for simulating future salmon returns was compiled from published reports and personal communications on harvests and escapements in the AYK region[7]. Time series of potential total returns were reconstructed using the available date. Run reconstructions (e.g., Starr and Hilborn 1988; Mundy et al. 1993) are summations of observed or estimated escapements and fishing removals of particular stocks throughout their drainage:

$$(Total\ Return)_{it} = \Sigma(esc)_{ijt} + \Sigma(sub)_{ikt} + \Sigma(com)_{ikt} + \Sigma(rec)_{ikt}.$$

where i indexes a stock of salmon in a particular area, j indexes the tributaries for which escapement estimates are tracked, k indexes fishing zones for which subsistence, commercial, and sport catches are tracked, and t indexes the year. Because some of the time series were inconsistent and discontinuous (i.e., the tributaries monitored and methods used to estimate escapement within management areas were not consistent and catches were subject to management decisions to open or close the fisheries), reconstructing the runs required two modifications to the basic equation. Inconsistencies in the escapement data were addressed by replacing missing values with random draws from log-normal distributions based on the means and standard deviations of log-transformed values of available data in each time series. Binomial distributions were used to characterize the frequency that fisheries were not opened and normal distributions were used to characterize catches in years when the fishery was open. Run reconstructions for each stock were iterated 5,000 times. The means and standard deviations of the log-transformed total returns were estimated from these iterations and used to parameterize the run simulations.

The simulation model was initialized with random draws from a binomial distribution to represent the frequency of run failures. If the binomial random value did not indicate a run failure, the simulation proceeded to draw a random value from the distribution of log-normal total returns. The variance of the random draw was constrained for a few highly variable stocks to prevent unrealistic values (e.g., negative total returns). However, a given iteration of the synthesized total return as constructed in this model was allowed to exceed historical bounds of reconstructed total returns.

[7] Sources included ADF&G 2004; Bergstrom et al. 2009; Borba et al. 2009; Brannian et al. 2006; Brase 2010; Burr 2009; Busher et al. 2009; Chythlook 2009; Estensen et al. 2009; Hayes et al. 2008; Howe et al. 1995, 1996; JTC 2010; Kent and Bergstrom 2009; Linderman and Bergstrom 2006; Menard and Bergstrom 2009a, 2009b; Menard et al. 2009; Mill 1989, 1990, 1991, 1992, 1993, 1994; Parker 1991, 2009; Parker and Viavant 2000; Soong et al. 2008; Volk et al. 2009; Whitmore et al. 2008; K. Howard, ADF&G, pers. comm.; J. Menard, ADF&G, pers. comm.

Once the simulation was initialized, the synthesized total return was subjected to a fishery management simulation regime (e.g., Criddle 1996; Criddle and Streletzki 2000.) The primary management objective was to meet escapement goals. For some stocks, the Alaska Board of Fisheries has adopted formal escapement goals (Brannian et al. 2006; Volk et al. 2009), but has not done so for all of the stocks modeled in our simulations. Because we also wanted to consider tributaries for which goals are not formally adopted, we used the median of the log-transformed historical data as an escapement goal, which was summed with formalized escapement goals. Escapement goals for each stock were pooled across tributaries within a management area or district. The simulation protocol apportioned this summed escapement goal from the total return, which is initially unknown in the protocol. Goals for passage of Chinook salmon and fall chum salmon up the Yukon River into Canada are established through international treaty. In our simulation, we regarded treaty-directed passage into Canada as an escapement goal for Canada[8].

The second highest management objective was to assign sufficient catch to meet subsistence demand. To capture uncertainty in implementation of subsistence harvests, subsistence removals were modeled as random draws from a binomial distribution of the historical mean and standard deviation of subsistence removals, scaled relative to the simulated total run strength. In the case of an exceptionally small total return, both escapement and subsistence harvests might be less than targeted levels. Given the gauntlet characteristic of some river systems, under simulated low total returns, lower river subsistence harvests were restricted in order to provide for sufficient upriver escapement (Starr and Hilborn 1988; Criddle 1996).[9]

Sport harvests were assumed to occur in the same proportions as the historical sport harvests relative to the reconstructed total run. This was done because larger total returns were assumed to generate greater opportunistic sport catches, and in-season adjustments of sport harvests have been relatively infrequent in most management segments, with the primary exception occurring under extremely small total returns that have not provided for subsistence demands. For simulation iterations in which the subsistence harvests were curtailed, sport harvests were set to zero.

Commercial availability was calculated as the difference between the simulated total return and the sum of escapements, subsistence harvests, and sport harvests. Because actual commercial harvests also depend on economic considerations, some or all of the commercial availability might not be harvested in some years. Fish not harvested were treated as additional escapement. Based on discussions with managers, near-term commercial harvests were not anticipated in the Kuskokwim River above District 1, so we allowed for no commercial harvests in the middle or upper Kuskokwim River.

Given the above rules, we created a total of 1,000 iterations of each synthesized harvest return and fishery management simulation for each stock. Each iteration simulated the total

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[8] Historically, passage goals into Canada have not been consistently met. Our simulation rule results in more conservative future harvestable surpluses (compared with historical runs) because it assumes that passage goals would be consistently met.

[9] If the index of run strength was less than one half of a scaled estimate of the historical average escapement, no subsistence fishery was allowed. If the indexed run exceeded one half of the scaled historical escapement, the subsistence goal was set to the smaller of either: (1) the subsistence demand under a given subsistence scenario, or (2) the remainder between the indexed run strength and sum of the escapement goal scaled to run strength plus one half of the upstream subsistence demands. The subsistence goal was given a random implementation error based on the mean and distribution of historical subsistence harvests. Thus, if run strength was sufficiently large enough, then actual subsistence harvest might be slightly larger or smaller than demand.

return, escapement, subsistence harvest, sport harvest, and potential commercial availability for the years 2010 to 2050. As part of this, we examined subsistence scenarios based on potential changes in subsistence demand: (1) Low; (2) Intermediate One; (3) Intermediate Two; and (4) High (as defined below in the subsistence demand component). For each stock, we simulated three potential levels of total returns: (1) the historical mean (the random draw of the total run was based on the mean of the reconstructed log-transformed total return); (2) a decreased mean (the random draw of the total run was based on the first quartile of the reconstructed log-transformed total return); and (3) an increased mean (the random draw of the total run was based on the third quartile of the reconstructed log-transformed total return).

Our analysis assumed that the historic annual variability of returns of these salmon stocks would continue into the future. That is, we assumed that the observed annual variability of historic salmon abundance was the best indication of annual variability expected for future years. Under such an assumption, the large historic Chinook salmon and chum salmon runs that supported substantial commercial fisheries for two decades (1970s-80s) would be statistical possibilities for repeating in the future; similarly, substantial low years of abundance (the crashes of the late 1990s-2003) would be statistical possibilities for repeating.

In simulated returns, our model treated each return year as independent of any other. That is, the model assumed that there is no significant serial correlation and instead, between-year variability could be randomly apportioned across years. This means our model did not consider spawner-recruit relationships or capture other factors that could lead to extended periods of low and high annual runs observed historically, periods of salmon productivity probably linked to environmental and stock conditions. The model includes no assumptions about the causes of between-year variability.

The simulations assumed that current management priorities would continue into the future. Currently, the first management priority is escapement for spawning. In addition, on the Yukon River, there are trans-boundary passage goals for Chinook salmon and fall chum (as required by U.S.-Canada treaties). If there is no expected harvestable surplus considering escapement needs, no fisheries are opened. Subsistence fisheries are given the next highest priority after escapement. Commercial and sport fisheries are opened when surpluses are expected above subsistence demand. Because of sequential fishing from the mouth to upstream in the Yukon and Kuskokwim rivers, management attempts to provide for upstream escapement and subsistence harvests through constraints of downstream harvests. One might imagine different management priorities at some future time. If that happened, the simulation rules would change.

Subsistence Demand for Human Food

The second component of the predictive model is the Subsistence Demand Component. This component was designed to predict future subsistence demand for salmon in the AYK region. Subsistence salmon primarily are harvested for local uses as human food in rural communities. In some communities, subsistence salmon also are harvested for feeding sled dogs. Our analysis predicts demand for human food separately from dog food, with total subsistence demand representing their sum. "Demand" is defined as the amount of salmon that local residents would harvest in years with sufficient salmon runs.

Subsistence salmon production occurs within local mixed subsistence-cash economies (Wolfe and Walker 1987). In mixed economies, families invest labor and income into traditional fishing and hunting pursuits to produce wild foods for local consumption. The organization of mixed economies of rural communities differs substantially from that of Alaska's urban areas where wage sectors are central and most foods derive from non-local sources. Over the past century, production of wild foods (on a per capita basis) has decreased in rural Alaska communities as incomes have increased and the cost of store-bought foods has become less prohibitive. This has been a general trend throughout rural Alaska. At the same time, families continue to produce subsistence foods in substantial amounts in places where store-bought foods are relatively expensive to families, lower in quality, or have unreliable availability compared with local wild foods. Higher wild food production occurs especially in villages off the road system where incomes are modest and insecure. Because of these relationships, the relative mix of wild and store-bought foods is sensitive to mean incomes within communities (Wolfe and Walker 1987). As mean incomes increase or fall within communities, diets shift to include more or less store-bought foods. If general trends continue, wild food production will continue to decrease as mean incomes increase in AYK communities, representing strengthening of local monetary sectors and shifts by households to more store-bought foods.

In addition to income, cultural factors also influence wild food production at the village level (Wolfe and Walker 1987). The press of culture affects dietary preferences, including preferred types of food and quantities consumed[10]. Cultural obligations within extended families promote the production and sharing of wild foods in villages. Traditional preferences about kinds of activities (indoors or outdoors, at camp or in communities, among others) also reflect cultural patterns. The cultural composition of a population (the percentage of Alaska Natives) represents, in a general way, the influence of cultural factors on wild food harvest patterns. In particular, communities with higher percentages of Alaska Natives tend to produce and consume larger amounts of wild foods (Wolfe and Walker 1987).

Because wild food production at the village level is related to income, culture, and geography in Alaska, statistical equations can be created for estimating (that is, inferring) subsistence production based on these factors. The statistical equations can be developed into predictive models of demand, assuming that past relationships among factors continue into the future. As a basis for our predictive model of subsistence food demand, data from a set of 149 communities in Alaska with wild food harvest information were analyzed to assess the statistical relationships among factors (Table 2). The data set derives from Wolfe and Fischer (2003); harvest data were originally collected through face-to-face household surveys or mailed post-season harvest surveys/tickets by the Alaska Department of Fish and Game. The set of communities was selected to represent local economies outside of the AYK region, including rural Southeast Alaska (25 places), rural Gulf of Alaska-Bristol Bay (35 places), rural road-connected Interior Alaska (25 places), and urban and urban-rural fringe areas (64 places).

The presumption is that this set of communities presents a range of socioeconomic and geographic conditions (affecting wage employment, stores, wild food harvests, and other community factors) that may represent AYK communities in the future. As a group, the communities produced negligible harvests for feeding sled dogs, so the analysis can be used to represent wild food harvests for human consumption. AYK communities were excluded from the data set because human and dog consumption cannot be separated out from most community-based studies.

[10] Notable examples of culturally-based food preferences are marine mammal products which are primarily consumed within Alaska Native groups but not non-Native groups.

Table 2. Community Data Set for Regression Analysis of Relationships Between Income, Culture, Roads, and Geography on Wild Food Harvest Levels

	Area and Population	Wild Food Harvest	Population in 2000	Percent Native in 2000	Per Cap Income ($1,000)	Harvest Year
	Interior Road					
1	Sutton-Alpine	24.06	1,080	25.8	20.436	2000
2	S. Parks Highway	58.04	367	11.0	23.686	1985
3	Gakona	95.31	215	17.7	18.143	1987
4	Glennallen	99.51	554	12.1	17.084	1987
5	Skwentna	100.65	146	8.1	23.995	2000
6	Tazlina	107.48	149	30.2	23.892	1987
7	Cantwell	111.50	222	27.0	22.615	1982
8	Mentasta Lake	125.48	142	71.1	11.274	1987
9	Healy	132.06	1,000	6.3	16.160	1987
10	Kenny Lake	135.25	410	13.4	13.121	1987
11	Anderson	139.20	367	6.5	23.837	1987
12	Tok	149.18	1,393	18.0	18.521	1987
13	Gulkana	152.59	88	73.9	13.646	1987
14	Tonsina	155.66	92	9.8	13.390	1987
15	Slana	173.77	124	15.3	20.018	1987
16	Copper Center	174.33	362	50.8	15.152	1987
17	Lake Louise	179.16	88	3.0	11.056	1987
18	Tetlin	213.53	117	97.4	7.371	1987
19	Chickaloon	223.68	213	16.9	14.765	1982
20	McKinley Park	242.06	142	3.5	27.255	1987
21	Tanacross	249.65	140	90.0	9.429	1987
22	Tyonek	259.95	193	95.3	11.261	1983
23	Chistochina	261.54	93	65.6	12.382	1987
24	Northway	276.07	86	62.1	10.300	1987
25	Chitina	342.35	123	48.8	10.835	1987
	Pacific-Gulf-Bristol Bay					
26	Seldovia	54.18	430	26.6	23.689	2000
27	Kodiak City	151.05	6,334	13.1	21.522	1993
28	Kodiak Road	166.13	3,991	16.3	21.522	1991
29	Cordova	178.91	2,454	16.0	25.256	1997
30	Naknek	188.19	678	47.1	21.182	1983
31	Unalaska	194.53	4,283	9.3	24.678	1994
32	Chignik Lagoon	211.36	103	82.5	19.604	1989
33	King Salmon	220.32	442	30.1	26.756	1983
34	Dillingham	242.03	2,466	60.8	21.537	1984
35	Port Graham	253.41	171	89.3	13.656	1997
36	Nanwalek	253.93	177	93.2	10.577	1997
37	Nelson Lagoon	254.01	83	81.9	27.698	1987
38	Sand Point	255.69	952	44.2	21.954	1992
	Pacific-Gulf-Bristol Bay (cont.)					
39	King Cove	258.07	792	47.9	17.791	1992
40	Ouzinkie	263.98	225	87.6	19.324	1997
41	Saint Paul	267.47	532	86.5	18.408	1994
42	Chenega Bay	275.26	86	77.9	13.381	1993
43	South Naknek	296.62	137	83.9	13.019	1992
44	Old Harbor	300.36	237	85.7	14.286	1997
45	Akhiok	321.75	80	93.8	8.472	1992
46	Port Lions	331.46	256	63.7	17.462	1993
47	Chignik Bay	357.61	79	60.8	16.169	1991
48	Clark's Point	362.64	75	82.0	10,989	1989
49	Larsen Bay	370.48	115	78.1	16.227	1997
50	Aleknagik	379.23	221	84.6	10.973	1989
51	Pilot Point	383.74	100	88.0	12.827	1987
52	Manokotak	384.08	399	94.7	9.294	1985
53	Egegik	384.33	116	76.7	16.362	1984
54	Perryville	394.36	107	98.1	20.935	1989
55	Tatitlek	406.37	107	85.0	13.014	1987
56	Port Heiden	407.62	119	79.2	20.932	1987
57	False Pass	412.68	64	65.6	21.465	1988
58	Atka	439.31	92	91.3	17.079	1994
59	Chignik Lake	442.34	145	87.6	13.843	1991
60	Akutan	466.17	713	85.4	12.259	1990
	Southeast Region					
61	Petersburg	161.35	3,224	12.0	25.827	2000
62	Wrangell	167.44	2,308	23.8	21.851	2000
63	Hollis	169.26	139	9.4	17.278	1998
64	Whitestone	178.42	116	6.9	21.810	1996
65	Kake	179.09	710	74.8	17.411	1996
66	Thorne Bay	179.22	557	4.8	20.836	1998
67	Whale Pass	184.96	58	3.4	24.041	1998
68	Haines	195.80	1,811	18.5	22.505	1996
69	Sitka	205.02	8,835	24.7	23.622	1996
70	Angoon	224.42	572	88.4	11.357	1996
71	Craig	231.93	1,397	30.9	20.176	1997
72	Gustavus	240.82	429	8.2	21.088	1987
73	Naukati Bay	241.54	135	9.6	15.949	1998
74	Coffman Cove	276.15	199	6.0	23.249	1998
75	Port Alexander	311.76	81	13.6	14.767	1987
76	Klawock	320.33	854	58.1	14.621	1997

Table 2 (cont). Community Data Set for Regression Analysis of Relationships Between Income, Culture, Roads, and Geography on Wild Food Harvest Levels

Area and Population	Wild Food Harvest	Population in 2000	Percent Native in 2000	Per Cap Income ($1,000)	Harvest Year
Southeast Region (cont.)					
77 Tenakee	329.94	104	4.6	20.483	1987
78 Hyder	345.28	97	4.1	11.481	1987
79 Sitka Tribe	360.18	2,095	99.0	23.822	1996
80 Pelican	365.12	163	25.8	16.201	1987
81 Hoonah	372.04	860	68.4	16.097	1996
82 Hydaburg	384.09	382	88.5	11.401	1997
83 Yakutat	385.51	680	46.8	21.330	2000
84 Port Protection	450.65	63	11.1	12.057	1996
85 Klukwan	608.27	139	88.5	11.812	1996
Urban-Urban Fringe					
86 D-town Anchorag	6.04	1,468	26.7	25.287	2000
87 Avenue Fifteen	8.77	12,288	12.6	25.287	2000
88 North Fairbanks	10.05	8,253	7.0	19.814	2000
89 Merrill Field	10.16	4,128	23.8	25.287	2000
90 Hope	11.22	156	6.4	9.079	2000
91 Houston	11.58	1,202	12.1	17.213	2000
92 Ship Creek	11.86	6,727	23.4	25.287	2000
93 MidFork-RusJack	12.12	10,305	16.2	25.287	2000
94 Russian Jack	12.15	4,084	14.5	25.287	2000
95 Lake Otis	12.19	5,275	7.1	25.287	2000
96 University	12.28	4,633	13.1	25.287	2000
97 Spenard	12.59	14,939	9.9	25.287	2000
98 Delaney Lake	12.99	2,917	11.1	25.287	2000
99 Midtown	13.61	12,687	15.5	25.287	2000
100 Northfork	13.74	4,324	14.9	25.287	2000
101 Little Campbell Cl	15.09	23,581	10.5	25.287	2000
102 Fort Richardson	15.14	5,470	1.7	25.287	2000
103 Campbell Creek	15.48	9,245	8.6	25.287	2000
104 NW Fairbanks	15.90	5,127	9.3	23.381	2000
105 Muldoon	16.64	36,961	12.2	25.287	2000
106 Nikiski	16.83	4,327	10.1	20.129	2000
107 Central Fairbanks	17.09	16,768	17.7	19.814	2000
108 Elmendorf	18.01	6,828	1.3	25.287	2000
109 Airport	18.30	18,625	8.4	25.287	2000
110 Girdwood	18.39	2,091	3.0	25.287	2000
111 Fort Wainwright	19.09	7,391	2.8	19.814	2000
112 SW Fairbanks	19.31	17,674	11.7	19.814	2000
Urban-Urban Fringe (cont.)					
113 Big Lake	19.88	2,635	10.3	19.285	2000
114 O'Malley	21.34	6,000	6.6	25.287	2000
115 Lk. O'Malley	21.35	12,687	8.5	25.287	2000
116 Coastal Refuge	21.35	8,612	7.0	25.287	2000
117 Upper O'Malley	22.08	4,574	3.2	25.287	2000
118 Eielson AFB	22.59	5,400	1.4	19.814	2000
119 Rabbit Creek	22.64	12,318	4.0	25.287	2000
120 Willow	23.24	2,614	7.8	22.323	2000
121 Wasilla	24.10	29,618	8.0	21.127	2000
122 Juneau	25.29	30,711	16.6	26.719	2000
123 Palmer	26.95	15,000	7.7	20.672	2000
124 Eagle River	27.34	20,610	5.1	25.287	2000
125 North Pole Area	27.48	16,285	7.4	21.428	2000
126 Seward	28.42	4,670	18.4	20.360	2000
127 NE Fairbanks	33.22	4,894	7.3	19.814	2000
128 Ketchikan	34.37	7,922	22.2	22.484	2000
129 Glacier View	35.78	249	10.4	14.656	2000
130 Kenai	38.18	9,828	12.2	20.789	2000
131 Chugiak	38.67	4,472	6.6	25.287	2000
132 Homer	38.97	6,472	6.3	21.823	2000
133 Eklutna	41.87	4,635	8.0	25.287	2000
134 Soldotna	42.00	14,948	8.1	21.740	2000
135 Moose Pass	44.02	374	8.6	28.147	2000
136 Salcha-Harding	47.38	1,128	4.8	22.816	2000
137 Trapper Creek	50.74	423	11.3	16.247	1985
138 Anchor Point	54.98	2,334	8.7	18.968	2000
139 Talkeetna	55.38	813	8.1	23.695	2000
140 Kasilof	60.25	1,839	7.0	21.211	2000
141 Fritz Creek	72.14	1,603	5.1	18.837	1986
142 Cooper Landing	77.16	369	4.9	24.795	1990
143 Whittier	79.94	182	12.6	25.700	1990
144 Nikolaevsk	88.45	345	4.9	10.390	1996
145 Clam Gulch	99.14	173	6.8	17.983	2000
146 Valdez	103.45	4,036	10.2	27.341	1992
147 Ninilchik	134.66	772	16.6	18.463	1998
148 Kenai Tribe	141.00	1,149	99.0	20.769	1993
149 Seaman	210.54	431	70.1	15.642	1990

A multiple regression analysis of this data set identified four community-level variables as significantly related to total wild food harvests (lbs per capita per year)[11] within a community – income (mean per capita income in thousands of dollars), cultural composition of a community (percentage Alaska Native), and binary variables reflecting road-connectedness and urban location (in or out of an urban/urban-rural fringe). The relationships are expressed in the following equation:

[11] Total wild food production (lbs per capita) is more predictable at the community level than the constituent food species. Species composition varies substantially between communities due to ecological differences in community harvest areas, so it is more difficult to predict. (Wolfe 2004).

Harvests = 329 – (5.276 x Income) + (1.067 x Cultural Composition),

with the subsistence harvest adjusted downward if the community is road-connected (reduced by 114 lbs) or if the community is located in an urban/urban-rural fringe area (reduced by 188 lbs). In this equation, "Income" is measured in thousands of dollars and "Cultural Composition" is measured as the percentage of Alaska Natives in a community. Based on this equation, for every $1,000 increase in mean per capita income in a community, wild food harvests decrease by 5.276 lbs per capita. For every one percent increase of Alaska Natives in a community, wild food harvests increase by 1.067 lbs per capita. If a community becomes part of an urban or urban-rural fringe area, wild food harvests decrease substantially (to avoid negative harvests under alternative scenarios, 10.0% of predicted harvest was substituted in the equation for the 188 lbs adjustment factor for urban/urban-rural fringe populations). The regression equation is robust and accounts for 80.9% of the variation in wild food harvests within this set of 149 communities (R = 0.902; Rsq = 0.809; sig. <.000 for each variable).[12]

Table 3. Predicted Wild Food Demand for Human Consumption By Community Type and Area, AYK Region (Base Year 2000)

Community Type/Area	Mean Per Capita Income (2000)	Alaska Native (2000)	Wild Food Demand (Lbs per Capita) (Predicted)
Villages			
Lower Yukon River	$9,163	94.6%	381.8
Upper Yukon River	$11,812	78.6%	350.6
Lower Kuskokwim	$7,877	96.7%	390.6
Middle-Upper Kuskokwim	$10,184	80.2%	360.9
South Kuskokwim Bay	$7,537	94.7%	390.3
Bering Sea Coast	$8,990	94.0%	380.6
South Norton Sound	$11,563	92.1%	366.3
North Norton Sound	$10,142	91.6%	373.4
Regional Centers			
Bethel	$20,287	68.0%	176.8
Nome	$23,402	58.0%	107.0
Urban Area			
Fairbanks (NWTractFAI13)	$23,381	9.6%	21.6

Applying this multiple regression equation to AYK areas with community values from the 2000 U.S. Census, per capita demand for wild foods for human consumption was estimated (Table 3). Demand ranged from about 350.6 lbs to 390.6 lbs per capita per year in AYK villages. Demand in urban Fairbanks was estimated at 21.6 lbs per capita. Demand in regional centers was intermediate (Bethel, 176.8 lbs; Nome, 107.0 lbs)[13]. These estimates of demand represented all wild foods consumed by residents, of which salmon was a component.

[12] Standard errors and t statistics were: Constant 30.095, 10.959; Income 1.232, -4.281; Cultural Composition 0.210, 5.074; Roads 15.293, -7.448; Urban/Urban Fringe 13.545, -13.867 (all sig. <.000).
[13] Adjustments to the equation were required in its application to these two regional centers to match observed harvest levels – Bethel (0.600 of predicted) and Nome (0.400 of predicted). The data set of 149 places included only one regional center (Dillingham), which limited the predictive capacity of the multiple regression equation for regional centers.

To calculate the demand for salmon only, the estimated total wild food demand was multiplied by the assumed percentage of salmon in the total wild food harvest of an area (Table 4). By weight, salmon was estimated to comprise from 40.7% to 46.1% of wild food harvests in particular Yukon and Kuskokwim areas, and 21.5% or 33.3% in Norton Sound areas[14]. Yukon drainage salmon comprised 3.0% of wild food harvests in the Fairbanks area (residents typically catch salmon from the Copper River and Kenai Peninsula rivers, not the Yukon River). In the predictive model, this percentage can be varied to examine effects. As shown below, our simulations assumed no or only slight changes in the percentage of salmon in the total wild food harvest within communities[15].

Table 4. Estimated Contribution of AYK Salmon to Total Subsistence Harvests for Human Food

Community Type/Area	Salmon Contribution
Villages	
Lower Yukon River	40.70%
Upper Yukon River	46.10%
Lower Kuskokwim	46.03%
Middle-Upper Kuskokwim	44.81%
South Kuskokwim Bay	44.57%
Bering Sea Coast	5.21%
South Norton Sound	33.33%
North Norton Sound	21.51%
Regional Centers	
Bethel	76.81%
Nome	13.89%
Urban Area	
Fairbanks	3.02%

Using these estimates, the demand for subsistence salmon (lbs) in an area for human consumption was calculated by multiplying the per capita demand for salmon by the area's human population. We used population projections produced by the Alaska Department of Labor (ADL), calculated from trends in fertility rates and migration (Bishop et al. 2007). The population projections include low, medium, and high estimates to represent the uncertainty of inputs (Fig. 2). Our predictive model adjusts these population projections to exclude places marginally connected to AYK salmon[16]. The populations of McGrath, Nikolai, Takotna, and Telida were moved from the Yukon-Koyukuk CA (Census Area) to the Middle-Upper Kuskokwim area. We extended the projected population trends to the year 2050.

[14] Estimates of the percentage of salmon in total wild food harvests derived from community subsistence harvest surveys in selected years: Lower Yukon River (Alakanuk 2007); Middle-Upper Yukon River (the mean of Anvik 1990, 2007; Grayling 1990, 2007; Tanana 1987, 2007; and Stevens Village 1984, 2007); Bethel (the mean of 1993-96 salmon harvests divided by estimated total harvest of 170.15 lbs/capita); Lower Kuskokwim River (the mean of Nunapitchuk 1983, Kwethluk 1986, and Akiachak 1998); Middle-Upper Kuskokwim (the mean of Nikolai and McGrath for 1984); South Kuskokwim Bay (Quinhagak 1982); and Bering Sea Coast (Tununak 1984). For the Norton Sound area, mean per capita salmon from post-season salmon surveys in 2000-2003 was divided by the total per capita wild food harvest predicted by the regression equation.

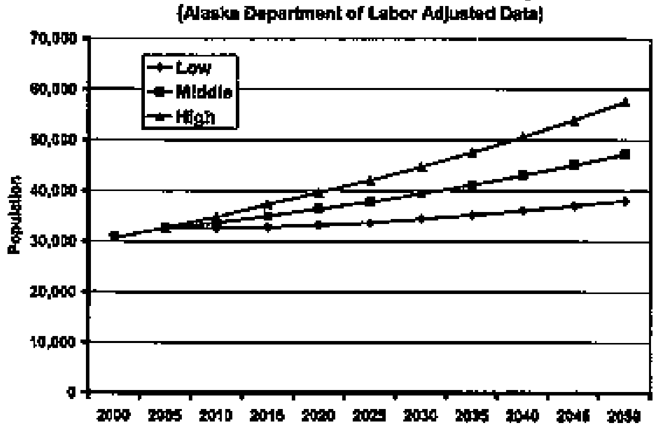
[15] In the set of 149 communities in Table 2, the percentage of salmon decreases slightly as total per capita wild food harvests decrease; however, the relationship is weak (Rsq = 0.1073).

[16] The adjustments removed Bering Sea coastal communities not usually included in the Yukon drainage statistics (Hooper Bay, Chevak, and Scammon Bay), as well as Arctic Village, Central, Coldfoot, Flat, Four Mile Road, Lake Minchumina, Livengood, and Wiseman. Upper Yukon River villages that harvest salmon comprised 77.69% of the Yukon-Koyukuk CA population in 2000. Lower Yukon River villages that harvest salmon comprise 67.57% of the Wade Hampton CA population.

Overall, population projections indicate growing rural populations in the AYK region (Fig. 2). Populations of villages that take salmon are projected to increase from about 30,682 (2000) to 47,282 (2050) (middle projection), an increase of 54.1% (see Fig. 2). The low estimate shows a more modest increase of 24.0% (to 38,057), while the high estimate shows a larger increase of 87.6% (to 57,573). An exception is the Middle-Upper Yukon, where villages that take salmon are projected to decline from 4,899 (2000) to 3,342 (2050), a decrease of 31.8% (middle case). Urban populations in the AYK region also are expected to increase. The Fairbanks area population is projected to increase from 82,840 (2000) to 127,817(2050), an increase of 54.3% (middle case).

Based on these population trends, we can expect more potential human consumers of subsistence salmon in the AYK region (an exception being the villages of the Middle-Upper Yukon). Other things being equal, as population increases, so will demand for salmon.[17]

Fig. 2. Population Projections to 2050 of Villages Harvesting Salmon, AYK Region (Alaska Department of Labor Adjusted Data)



Demand by salmon variety was calculated by multiplying the total salmon harvest by the percentage of each salmon type in an area's catch (Table 5). The percentages of salmon varieties were based on the means since the 1990s, as counted by post-season subsistence salmon surveys of ADF&G. Finally, each salmon variety was divided by a mean fish weight to calculate numbers of fish. These values can be changed in simulations to examine effects; however, for our projections, most are assumed to remain unchanged to 2050.

[17] The ADL population projections are an important driving variable in our subsistence demand equations. If trends differ from these projections, our subsistence projections would also change correspondingly. We made no attempt to evaluate the assumptions on which the population trends are based and have no reason to argue with them. But we note that making long-term regional population projections is difficult due to their sensitivity to in-migration or out-migration, which change in response to many factors including future economic conditions and, potentially, availability of subsistence foods.

Table 5. Assumed Species Composition (by Weight) of AYK Salmon Harvested for Human Food

Community Type/Area	Chinook	Summer Chum	Fall Chum	Coho	Pink	Sockeye
Villages						
Lower Yukon River	43.60%	48.50%	4.90%	3.10%	0.00%	0.00%
Upper Yukon River	80.00%	7.00%	12.00%	1.00%	0.00%	0.00%
Lower Kuskokwim	63.18%	18.54%	0.00%	6.66%	0.09%	11.52%
Middle-Upper Kuskokwim	55.11%	20.06%	0.00%	12.60%	0.04%	12.16%
South Kuskokwim Bay	65.24%	9.50%	0.00%	12.01%	0.07%	13.16%
Bering Sea Coast	23.05%	58.67%	0.00%	9.72%	0.41%	8.15%
South Norton Sound	20.89%	29.98%	0.00%	23.59%	24.46%	1.11%
North Norton Sound	8.05%	28.80%	0.00%	18.36%	27.06%	16.74%
Regional Centers						
Bethel	64.01%	12.04%	0.00%	12.81%	0.09%	11.05%
Nome	2.22%	37.71%	0.00%	20.60%	19.97%	19.60%
Urban Area						
Fairbanks	75.53%	0.05%	4.12%	20.30%	0.00%	0.00%

Subsistence Demand for Dog Food

In addition to the human consumption of salmon, dogs are consumers of salmon in portions of the AYK region. Dog teams continue to be maintained for sport and utility purposes by some households, particularly in the Middle-Upper Yukon area. Many households also retain dogs as scrap dogs and pets. Numerous species of fish, including several species of salmon, have long provided locally-available and relatively cost-effective food sources for feeding dogs (Andersen 1992, Andersen and Scott 2010). Information on dogs and feeding patterns are the most robust for the Yukon drainage. Data on the use of fish to feed dogs in other portions of the AYK region are less detailed but suggest that these Yukon-based findings are more broadly applicable in the region.

Many households keep *pets or scrap dogs*. These dogs often serve as watchdogs to warn of the presence of bears, and also serve as consumers of family table scraps. The term "scrap dog" has become a more formal designation in some western Alaska communities where the feeding of fish cutting scraps to dogs is considered a culturally respectful way to dispose of fish waste. Households sometimes maintain a number of dogs for this specific purpose. Dogs categorized as scrap/pet dogs are primarily fed using scraps and commercially manufactured dog food. In addition, it is common for fish, including small numbers of whole salmon, to be used as a dietary supplement by some owners. While their individual use of salmon is minimal, the large number of dogs falling into this category can make them significant consumers in aggregate.

Sled dogs in small lots (less than 25 dogs) represent another dog category. Most dog teams in the AYK region fall into this category. Small yards or kennels of sled dogs are maintained for general winter transportation, trapping, and racing during village carnivals. The kennels commonly consist of a core team of seven to 10 dogs with smaller numbers of younger and older dogs held as spares or in development for eventual placement in the core team. Owners of dogs in small lots tend to be highly reliant on fish for feeding dogs. In some AYK areas, small lot dogs have been major consumers of chum and coho salmon. Mushers maintaining small kennels of sled dogs primarily for racing tend to be less reliant on fish for food than utility teams, but locally-caught fish are often used to supplement the dog's diets.

Sled dogs in large lots (25 dogs or more) represent a third dog category. In the Upper Yukon River area, some sled dog kennels range in size from 25 to 80 dogs. These large kennels tend to be associated with competitive dog racing. To field a competitive team of 10 to 14 dogs, elite racers will maintain large kennels. Dogs are selected to match specific race distances, trails, and weather conditions. Competitive dog racing requires careful breeding and training regimens. The large kennels typically support one or more "puppy teams" in stages of development, as well as a stable of older dogs that may be past their racing prime but have utility for training and breeding. Dogs in large lots tend to be less reliant on fish as a source of food than smaller lots due to both the special nutritional demands of competitive racing and the monumental tasks of fishing to feed large numbers of dogs. Fish may represent an off-season food staple or in-season food supplement for the most elite dogs, with high-energy commercially manufactured dog foods and supplements serving as their primary food sources.

Before the introduction of snowmachines, virtually every rural household in the AYK region relied on small family-owned teams of sled dogs for winter transportation. Dogs declined with the shift to snowmachines for winter transportation in the early to late 1960s. Dog numbers rebounded during the 1970s following a resurgent interest in dog racing (Fig. 3). While no data sources offer a complete or systematic inventory of historic dog numbers, there are enough community studies that include information on dogs to support these general trends. Sled dog numbers peaked in the early 1990s and have subsequently declined with decreasing interest in racing and increasing costs of dog food. Andersen (2010) associated the most recent decline in sled dog use with the magnified economic stresses being felt in Alaska's rural communities that make the maintenance of dog teams untenable, and a lack of interested young people to replace aging and retiring mushers. In addition, Wolfe and Scott (2010) found fewer sled dogs on the Middle-Upper Yukon alongside declining uses of fish wheels and decreasing supplies of cheap chum and coho salmon for dog food.

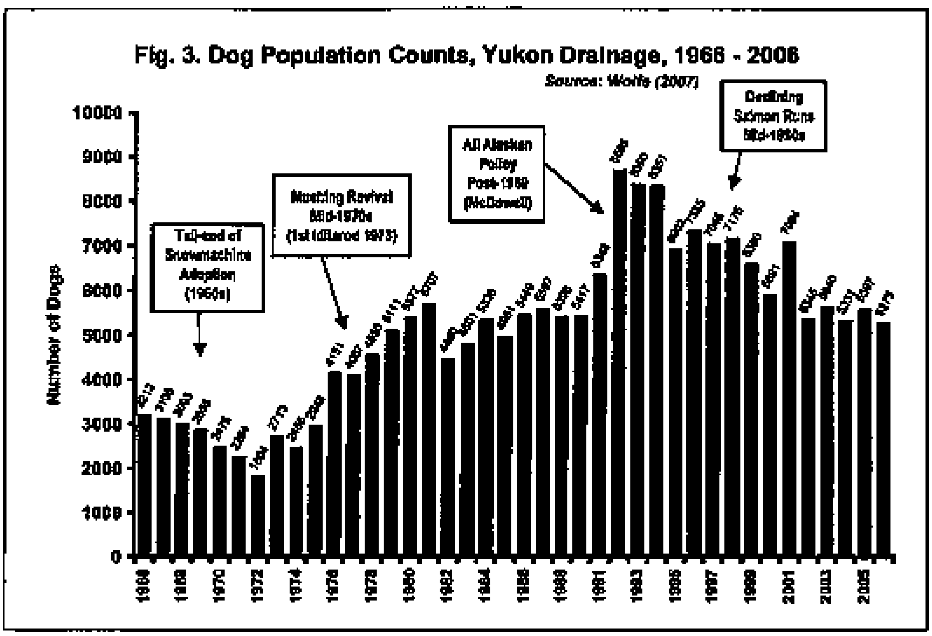


Fig. 3. Dog Population Counts, Yukon Drainage, 1966 - 2006

To predict future demand for dog food, we estimated the numbers of the three categories of dogs – sled dogs in small yards (less than 25 dogs), sled dogs in large yards (25 or more dogs), and scrap/pet dogs. Counts of dogs owned by salmon fishing households were derived from the post-season surveys of the Alaska Department of Fish and Game. For scrap/pet dogs, we assumed an average of one dog per household, calculated by dividing the area's projected population by mean household size (2000 census values). Residents in the AYK region owned about 12,300 dogs in 2005 (Table 6). The large majority of these dogs (75.35%) fell into the category of scrap/pet dogs. While representing a smaller segment of the dog population, sled dog numbers largely drive scenarios of future salmon consumption by dogs in the region.

To calculate the demand for salmon for dog food, we multiplied the number of dogs by the mean number of salmon consumed per dog, assuming a certain proportion of the diet was salmon for each dog category (Table 7). We assumed that a dog almost exclusively fed salmon would consume at most 200 small salmon per year (chum, coho, or sockeye). On average, dogs are fed considerably less. Estimates for the mean amount of salmon in a dog's diet by area were derived from ADF&G post-season surveys for representative years (shown in parentheses): the Kuskokwim area (1995-99), the Norton Sound area (2000-02), the Fairbanks area (1991-95, 2002-06), and the Yukon villages (1995, 1996, and 1999). The mean contribution of salmon ranged from 10.4 salmon per dog (5.18% of the annual diet) in North Norton Sound to 60.0 salmon per dog (30.0% of the annual diet) in the Upper Yukon area (Table 7). Some owners fed their dogs substantially above the mean, while many others fed their dogs substantially less, particularly on years of low run abundance (see Wolfe et al. 2001). Owners fed other products to sled dogs above those amounts. For the diets of scrap/pet dogs, we assumed nominal amounts of whole salmon (0.5 salmon per dog, except for the Yukon River at 3.0 salmon per dog).

Table 6. Estimated Number of Dogs in the AYK Region, 2005

Community Type/Area	Sled Dogs in Lots <25	Sled Dogs in Lots >25	Scrap/Pet Dogs	Total Dogs
Villages				
Lower Yukon River	90	0	1,524	1,614
Upper Yukon River	731	598	2,396	3,724
Lower Kuskokwim	497	0	1,371	1,868
Middle-Upper Kuskokwim	395	0	719	1,114
South Kuskokwim Bay	21	0	338	359
Bering Sea Coast	0	0	771	771
South Norton Sound	115	0	-	115
North Norton Sound	45	0	-	45
Regional Centers				
Bethel	273	0	2,156	2,429
Nome	-	-	-	-
Urban Area				
Fairbanks	270	0	-	270
Total Dogs	2,438	598	9,275	12,310
	19.79%	4.86%	75.35%	100.00%

Finally, demand by salmon variety for dog food was calculated by multiplying the total salmon harvest by the assumed proportion of each salmon type in an area's catch that is fed to dogs (Table 8). The proportion is based on ADF&G post-season subsistence salmon surveys.

Community Type/Area	Percentage of Salmon in Dog's Diet: Sled Dogs in Lots <25	Percentage of Salmon in Dog's Diet: Sled Dogs in Lots >25	Percentage of Salmon in Dog's Diet: Scrap/Pet Dogs	Salmon per Dog per Year: In Lots <25	Salmon per Dog per Year: In Lots >25	Salmon per Dog per Year: Scrap/Pet Dogs
Villages						
Lower Yukon River	6.00%	*	1.50%	12.0	*	3.0
Upper Yukon River	30.00%	15.00%	1.50%	60.0	30.0	3.0
Lower Kuskokwim	5.30%	*	0.25%	10.6	*	0.5
Middle-Upper Kuskokwim	11.20%	*	0.25%	22.4	*	0.5
South Kuskokwim Bay	8.80%	*	0.25%	17.6	*	0.5
Bering Sea Coast	0.00%	*	0.25%	0.0	*	0.5
South Norton Sound	7.35%	*	0.25%	14.7	*	0.5
North Norton Sound	5.18%	*	0.25%	10.4	*	0.5
Regional Centers						
Bethel	5.30%	*	0.25%	10.6	*	0.5
Nome	7.35%	*	0.25%	14.7	*	0.5
Urban Area						
Fairbanks	15.00%	*	*	30.0	*	*

Table 7. Estimated Mean Amounts of Salmon in the Diets of Dogs in the AYK Region, 2000

* *It is assumed that there are no dogs in this category that consume whole salmon.*

Table 8. Assumed Species Composition of AYK Salmon Harvested for Dog Food, 2000

Community Type/Area	Chinook	Summer Chum	Fall Chum	Coho	Pink	Sockeye
Villages						
Lower Yukon River	0.0%	60.0%	29.8%	10.0%	0.2%	0.0%
Upper Yukon River	0.0%	31.8%	60.0%	8.0%	0.2%	0.0%
Lower Kuskokwim	0.0%	65.6%	0.0%	24.7%	0.0%	9.6%
Middle-Upper Kuskokwim	0.0%	67.6%	0.0%	24.8%	0.0%	7.6%
South Kuskokwim Bay	0.0%	14.0%	0.0%	53.2%	0.0%	32.9%
Bering Sea Coast	0.0%	65.6%	0.0%	24.7%	0.0%	9.6%
South Norton Sound	5.0%	48.2%	0.0%	18.0%	28.4%	0.4%
North Norton Sound	0.1%	31.5%	0.0%	12.8%	45.5%	10.1%
Regional Centers						
Bethel	0.0%	65.6%	0.0%	24.7%	0.0%	9.6%
Nome	0.1%	31.5%	0.0%	12.8%	45.5%	10.1%
Urban Area						
Fairbanks	0.0%	41.8%	50.0%	8.0%	0.2%	0.0%

Subsistence Demand Scenarios

Altogether, our model predicts future subsistence demand for salmon based on ten different factors (Table 9). Six factors are used to predict demand for human food, while four factors are used to predict demand for dog food. Each factor acts as a variable in the predictive model insofar as its value can change over time, potentially affecting future levels of demand for subsistence uses. No one can predict with surety trends of human population, dog numbers, incomes, the relative composition of salmon varieties, and other factors. Accordingly, the model allows for varied assumptions on potential future conditions of these factors and projects what the future demand for salmon would be conditional on those assumptions.

Table 9. Factors Related to Subsistence Salmon Demand for Human Food and Dog Food

<u>Human Food Factors</u>
Population Size (Number of People)
Monetary Incomes (Mean Per Capita)
Cultural Composition (Percent Native)
Community Type (Village, Regional Center, Urban Area)
Salmon in Wild Food Harvests (Percentage)
Salmon Varieties in Harvest (Percentage)
<u>Dog Food Factors</u>
Sled Dogs in Community (Number)
Scrap Dogs in Community (Number)
Salmon in Dog Diets (Percentage)
Salmon Varieties in Harvest (Percentage)

Table 10. Scenarios for Predicted Demand for Subsistence Salmon

Model Factor	Scenarios (Change Each 5-Yr Period)			
	Low	Intermediate One	Intermediate Two	High
1. Per Capita Income (Villages)	+6.0%	+5.0%	+3.0%	0.0%
2. Per Capita Income (Bethel, Nome, Fairbanks)	+6.0%	+5.0%	+3.0%	0.0%
3. Community Cultural Composition	-1.0%	-1.0%	0.0%	0.0%
4. Salmon Contribution in Wild Food Harvest	0.0%	0.0%	+1.0%	+1.0%
5. Human Population Projection in Region	Low	Middle	Middle	High
6. Salmon Species Composition (Human Food)	0.0%	0.0%	0.0%	0.0%
7. Number of Sled Dogs in Small Yards (<25 dogs)	-2.0%	-2.0%	+2.0%	+10.0%
8. Number of Sled Dogs in Large Yards (>25 dogs)	-2.0%	-2.0%	+2.0%	+10.0%
9. Number of Scrap Dogs (Human Population/HH size)	Low	Middle	Middle	High
10. Percentage of Salmon in Diet of Sled Dogs in Small Yards (<25 dogs)	-1.0%	0.0%	+1.0%	+2.0%
11. Percentage of Salmon in Diet of Sled Dogs in Large Yards (>25 dogs)	-1.0%	0.0%	+1.0%	+2.0%
12. Percentage of Salmon in Diet of Scrap Dogs	0.0%	0.0%	0.0%	0.0%
13. Salmon Species Composition of Dog Food Harvest	0.0%	0.0%	0.0%	0.0%

To examine potential futures in regards to subsistence salmon demand, we examined four scenarios, each with a different set of assumptions about future conditions (Table 10). We named the scenarios (*Low, Intermediate One, Intermediate Two*, and *High*) based on their relative levels of demand for subsistence salmon (low to high). The scenarios were chosen to illustrate just four potential futures for subsistence demand.

The two intermediate scenarios shown in Table 10 assumed human populations would change at the rates of the middle projection of the Alaska Department of Labor. Income (per capita) was assumed to increase by 3.0% or 5.0% each five-year period, representing modest gains by households in employment. The cultural composition (percentage of Alaska Natives) of communities was assumed to either decrease by 1.0% or remain unchanged each five-year period, representing no or modest in-migration or out-migration into the AYK region. Sled dog populations were assumed to either decrease or increase by 2.0% each five-year period, representing modest changes in sled dog numbers. The relative proportion of salmon in wild food diets was assumed to either stay the same or increase by 1.0% each five-year period, representing no or small changes in preference for salmon over other wild foods. The relative composition of salmon species was left unchanged.

By contrast, the low scenario assumed that human populations would change at the rates of the low projection of the Alaska Department of Labor. Incomes were assumed to substantially increase (8.0% per five-year period in villages and 6.0% per five-year period in Bethel, Nome, and Fairbanks), representing substantially higher employment and earnings in villages, town, and cities. The cultural composition (percent Alaska Natives) of rural communities was assumed to decrease by 1.0% each five-year period, representing modest in-migration of non-Natives into the AYK region. The numbers of sled dogs were assumed to decrease by 2.0% each five-year period, representing modest declines. The contribution of salmon in dog diets was assumed to decrease by 1.0% each five-year period, representing modest shifts to store-bought dog food. The relative proportion of salmon in wild food diets was assumed to stay the same, representing no change in preference for salmon over other wild foods. The relative composition of salmon species was left unchanged.

The high scenario assumed that human populations would increase at the rates of the high projection of the Alaska Department of Labor. Incomes were assumed to remain unchanged, representing unchanged employment patterns in villages, town, and cities. The cultural composition (percent Alaska Natives) of communities was assumed to remain unchanged, representing no net gains through in-migration or out-migration into the AYK region. The numbers of sled dogs was assumed to increase by 10.0% each five-year period, representing a resurgent interest in dog racing and transport, similar to the trends of the 1970s. The contribution of salmon in dog diets was assumed to increase by 2.0% each five-year period, representing shifts away from store-bought dog food due to lower disposable incomes. Salmon's contribution in wild food diets was assumed to increase by 1.0% each five-year period, representing shifts in food preferences toward salmon over other wild foods. The relative composition of salmon species was left unchanged.

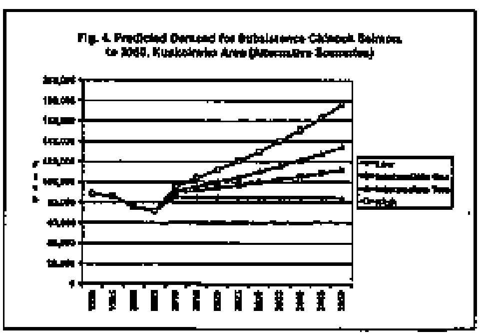
Findings: Subsistence Demand to 2050

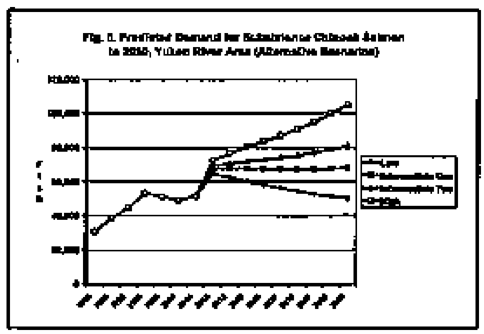
Subsistence demand for salmon to 2050 in the Kuskokwim, Yukon, and Norton Sound areas displays a range of predicted values, depending upon assumed future conditions (Figs. 4 to 15). Predicted demand is shown for each five-year period from 2010 to 2050. Numbers before 2010 are reported subsistence salmon harvests. More details of the predictions (harvests by species, area, human food, and dog food) are summarized in Appendix A.

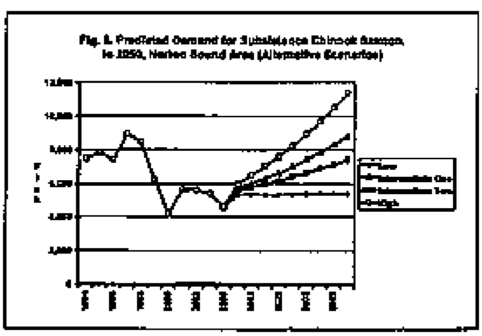
According to our model's outcomes, the ranges of potential demand for subsistence salmon depend on assumed future conditions, salmon variety, and area. The predictive model of subsistence demand provides a way to assess the initial research hypothesis that predicts subsistence fishing in the AYK region will "remain the same or decline".

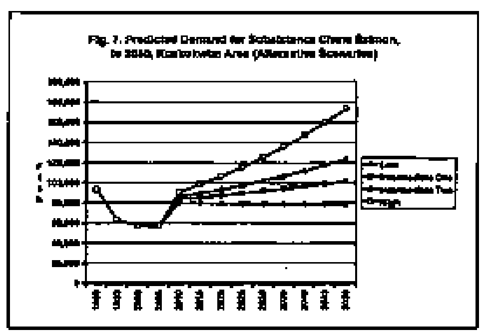
In the Kuskokwim area, demand for Chinook, chum, sockeye, and coho remains the same or declines slightly under the low scenario conditions. This is true for all Kuskokwim areas and species. Demand increases for all salmon species and Kuskokwim areas under the other scenarios. The greatest increase (in terms of numbers of fish) occurs on the lower Kuskokwim River, an area with the most villages and village population. Harvest for dog food is largest on the middle-upper river, representing from 16% to 22% of the harvest. Otherwise, the increased demand for salmon is primarily for human food in the Kuskokwim area.

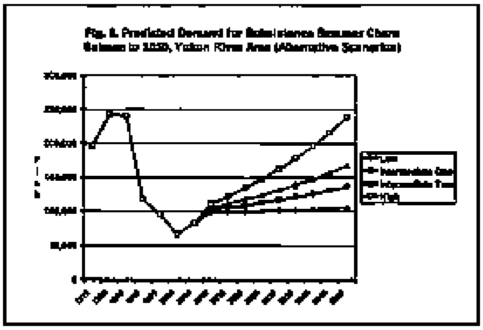
In the Yukon area, demand for Chinook, summer chum, fall chum, and coho remains the same or declines slightly under the low scenario conditions. Under most other scenarios, demand increases for Chinook and summer chum, fall chum, and coho, due primarily to increased demand for food along the lower river (Subdistricts Y1-Y3) for growing human populations. Along the middle-upper river, demand for salmon as human food declines under all scenarios, principally due to falling human populations. Under most scenarios, total demand for salmon for human food increases in the Yukon area. Demand for summer chum, fall chum, and coho along the middle-upper river is sensitive to dog populations as dog food remains a significant component of subsistence demand for small salmon species. If dog populations increase substantially, as in the high scenario, demand for small salmon also increases substantially. Otherwise, dog food demand changes slightly up or down to 2050 along the middle-upper river. Along the lower river, demand for dog food remains relatively low under all scenarios.

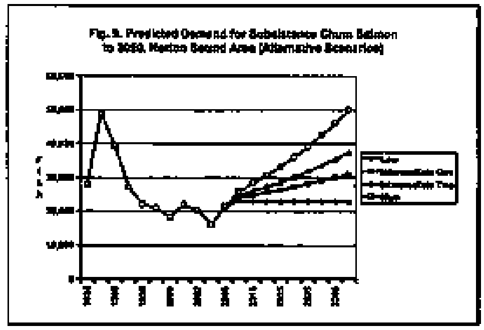


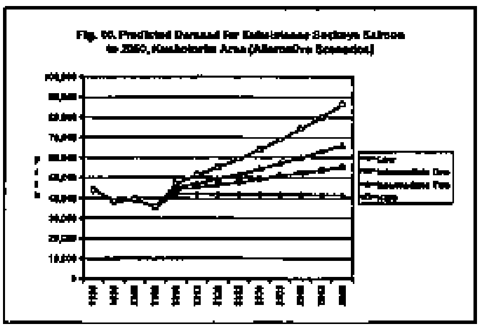


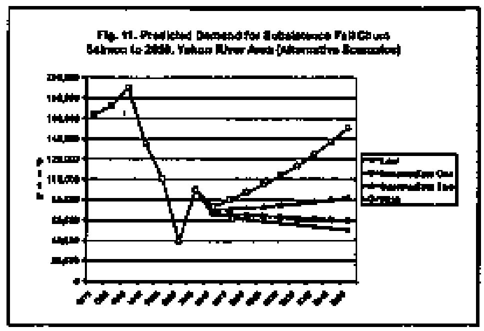


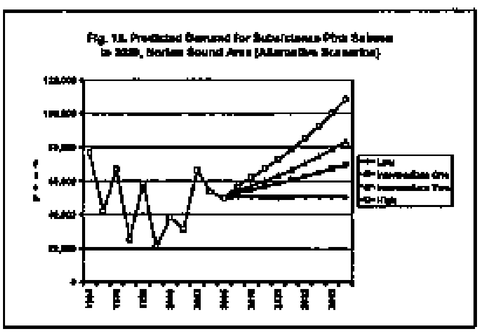


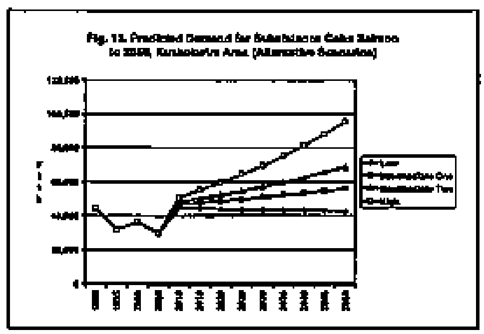


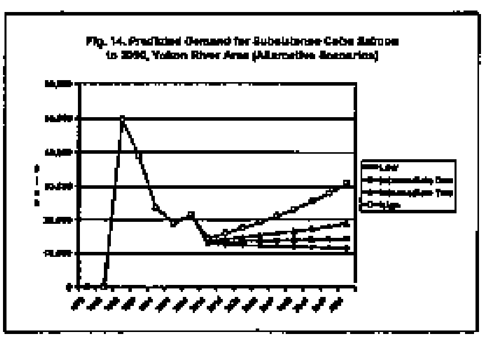


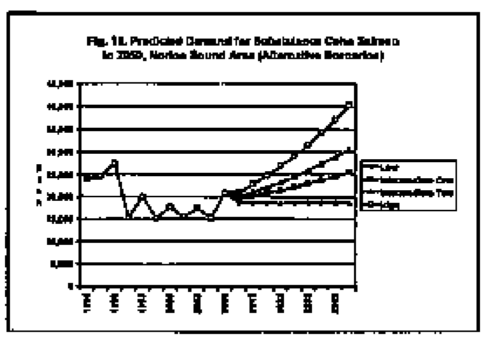












In the Norton Sound area, demand for Chinook, chum, sockeye, coho, and pink remains stable under the low scenario (with slight declines for Nome). Demand for these species increases under all other scenarios, primarily for human food in the villages. Demand for salmon for dog food changes with trends in sled dog numbers, but remains a relatively small component of the area's salmon harvests.

Overall, demand for subsistence salmon increases under most future scenarios examined for the AYK region. Among this range of potential futures, there are fewer cases where subsistence demand "remains the same or declines."

Table 11. Predicted Subsistence Demand in 2020 and 2050 Compared with the Amounts Necessary for Subsistence (ANS) as Determined by the Alaska Board of Fisheries *

ANS Stock		Amount Necessary for Subsistence	Predicted Subsistence Demand for ANS Stock by Scenario							
			Low		Intermediate 1		Intermediate 2		High	
Area	Variety		2020	2050	2020	2050	2020	2050	2020	2050
Norton Sound, Subdistrict 1	Chum	3,430 - 5,716	3,077	2,606	3,461	3,625	3,768	4,864	4,388	7,040
Norton Sound - Port Clarence Area	Salmon	96,000 - 160,000	101,619	101,674	114,316	139,470	121,387	167,473	136,105	220,336
Yukon-Northern Area	Chinook	45,500 - 66,704	60,354	49,965	67,656	68,231	72,076	81,232	89,436	104,981
	Summer chum	83,500 - 142,192	96,883	105,024	108,882	137,213	117,034	165,678	134,128	238,338
	Fall chum	89,500 - 167,100	61,473	50,595	65,589	61,704	72,104	82,305	87,627	161,029
	Coho	20,500 - 51,980	12,494	11,539	13,548	14,997	14,786	18,866	17,636	30,822
Kuskokwim River Drainage	Chinook	64,500 - 83,000	77,832	76,649	87,089	102,680	92,464	123,414	103,632	161,950
	Chum	39,500 - 75,500	70,298	68,760	77,436	89,377	83,222	109,619	95,773	155,915
	Sockeye	27,500 - 39,500	37,676	39,614	42,337	48,919	44,921	59,893	50,313	78,449
	Coho	24,500 - 35,000	39,614	37,813	43,899	49,951	47,141	61,897	54,004	86,393
Kuskokwim Area Remainder	Salmon	7,500 - 13,500	23,709	25,037	26,376	32,987	27,746	38,269	30,721	48,595

* 5AAC 01.186, 01.236, 01.286

In Table 11, our model's predictions for subsistence demand (for the four scenarios in 2020 and 2050) are compared with the amounts necessary for subsistence (ANS) set by the Alaska Board of Fisheries in regulation for 11 salmon stocks (5AAC 01.186, 01.236, and 01.286). In the low subsistence scenario, predicted subsistence demand falls within the ANS ranges for 6 of 11 stocks, falls below for 3 stocks, and exceeds it for 2 stocks. In the high scenario, subsistence demand (by 2050) exceeds the high range of the ANS for 9 of 11 stocks, and falls within it for 2 stocks (fall chum and coho in the Yukon-Northern Area). For the two intermediate scenarios, subsistence demand within the Kuskokwim River Drainage and Kuskokwim Area Remainder exceeds the ANS ranges by 2020 for all stocks. For the two intermediate scenarios, predicted subsistence demand within the Norton Sound and Yukon-Norton areas tends to fall within the ANS ranges for most salmon stocks, with the exception of Chinook salmon in the Yukon-Northern area where predicted demand exceeds the ANS range. Overall, predictions such as these suggest that changes in subsistence demand over time may lead to requests by salmon users for revisions of ANS determinations by the Alaska Board of Fisheries.

Overview of Commercial Harvest Analysis

The Commercial Harvest Component is the third component of the predictive model. This component was designed to project future harvests of commercial salmon in the AYK region. We begin our analysis with a brief overview of the methodology for projecting future commercial harvests. We then discuss, in turn (a) historical AYK commercial harvests; (b) our assumptions about future harvestable commercial surpluses; (c) factors affecting future utilization of harvestable commercial surpluses; (d) our formula for projecting future utilization; and (e) our projections of future commercial harvests.

Future salmon harvests for commercial sale will be constrained by the harvestable *surpluses* for each stock. The *surplus* is the number of fish available for commercial harvest after escapement, subsistence demand, and other priorities are sufficiently met.

For each stock, we project the commercial harvest in any given year as the *surplus* multiplied by *utilization*, the share of the surplus which is harvested:

$$\text{Harvest} = \text{Surplus} \times \text{Utilization}$$

Future surpluses will be driven by returns, subsistence demand, and management actions to achieve escapement and subsistence goals. Future utilization will be driven by economic factors including wholesale prices of AYK salmon products and costs of harvesting, processing, and transporting salmon to markets, which ultimately determine the potential for both harvesting and processing to be profitable. Surpluses also affect utilization, because the size, variability, and uncertainty of surpluses affect both unit costs of harvesting and processing as well as risks associated with investments in harvesting and processing.

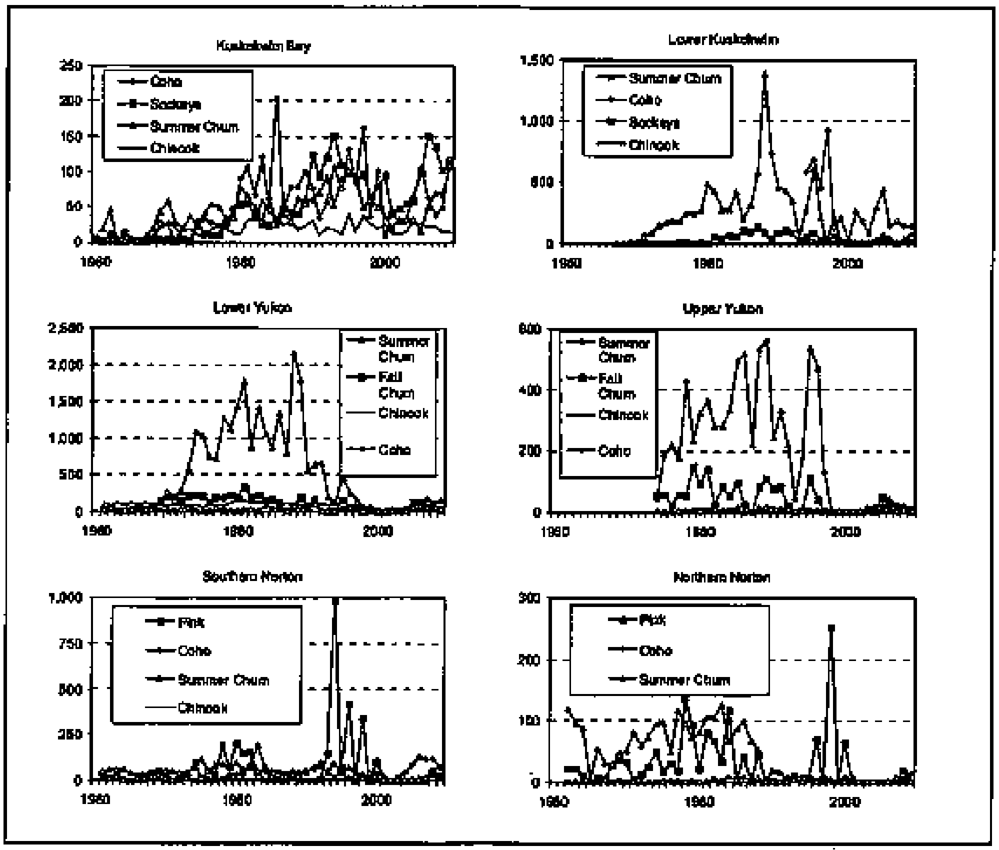
For each stock, we estimated probability distributions for future surpluses by subtracting escapement goals and projected subsistence demand from our estimated probability distributions for future runs. We developed a formula for utilization as a function of assumptions about future economic conditions and surpluses. We then examined the implications of different assumptions about surpluses and economic conditions for the probability distribution of future harvests.

Our commercial harvest projections are inherently much more uncertain than our subsistence demand projections. It is reasonable to project specific levels of future subsistence demand for future years, such as those discussed above. In contrast, given the inherent uncertainty and variability of future salmon returns, it is impossible to project specific levels of future commercial harvestable surpluses or commercial harvests for future years. We can only think of future harvestable surpluses and harvests as *probability distributions*, as ranges within which harvestable surpluses are likely to lie. Although we can describe these with probability distributions with statistical indicators such as the mean, maximum, 10^{th} and 90^{th} percentiles, we cannot predict what harvests will be in any given year.

Historical Commercial Harvests

Historical commercial salmon harvests for the years 1961-2009 are summarized in Fig. 16. Note that over these five decades, for each stock, commercial harvests varied widely both from year to year as well as over longer-term periods. Different stocks showed different trends over time. The scale of harvests varied widely for different species within an area, as well as between areas. Put simply, there is no obvious or common pattern or trend in commercial harvests.

Fig. 16. AYK Commercial Salmon Harvests, by Area 1961-2009 (Thousands of Fish).



If we had enough data, and talked with fishermen, processors and managers familiar with the specific historical circumstances for each stock over time, we could develop explanations for the year-to-year and longer-term changes in commercial harvests for each stock. These would include changes in the commercially *harvestable surpluses* for each stock as a result of changes in returns, management policies, and subsistence harvests. They would also include changes in numbers of buyers, ex-vessel prices, costs of fishing, and other factors that affected the historical *utilization* of harvestable surpluses.

For this analysis, we have not attempted to develop explanations for historical changes in harvests for AYK salmon stocks. One important reason is that no data are available for historical harvestable surpluses or utilization rates. Further, only limited data are available for economic factors affecting utilization rates. Lack of data makes it impossible to develop a formal statistical model of the factors driving historical harvests. Even if data were available to develop such a model, it would be of limited value for projecting future harvests given the uncertainty associated with changes in future salmon returns, subsistence demand, and economic factors affecting utilization of harvestable surpluses.

Consider how difficult it would have been in 1970 to predict specifically how and why AYK commercial salmon harvests of each stock would change over the four decades between 1970 and 2010. It would have been impossible to predict the varying trends in returns and harvestable surpluses for different AYK stocks. Similarly, it would have been impossible to predict the dramatic changes in utilization over time driven by factors such as competition from farmed salmon, competition from other regions of Alaska, changes in the Japanese economy, and (most recently) growing demand for wild salmon (Knapp 2009).

In thinking about how AYK commercial salmon harvests may change over the next four decades, we should recognize that we face similar fundamental uncertainties as we would have faced in 1970. Any long-term projections of future AYK commercial salmon harvests are inherently highly uncertain. Most fundamentally, this uncertainty derives from uncertainty about future returns, exacerbated by the uncertain future effects of climate change. It is compounded by uncertainties associated with subsistence demand and economic conditions. The uncertainty increases the farther we attempt to project into the future. For these reasons, it is important to think of our commercial harvest projections not as predictions but rather as illustrations of what future harvest trends might look like under different assumptions about future returns, subsistence demand, and economic conditions.

The most certain thing we can say about AYK commercial salmon harvests over the next four decades is the same basic points that applied for historical harvests. Commercial harvests are likely to vary widely from year to year, average commercial harvests are likely to vary widely over longer periods, and long-term trends in commercial harvests are likely to vary widely between stocks.

Commercial Harvestable Surpluses

The starting point for our projections of future AYK commercial harvests was the development of *harvestable surplus scenarios*: sets of simulations of potential future harvestable surpluses. As discussed above, we calculated these simulations as the difference between the simulations of total returns and the sum of assumed escapements, subsistence harvests, and "other priorities" (fish reserved for other parts of the river system):

Harvestable surplus = Total return – Escapement – Subsistence harvests – Other priorities

For each stock, three sets of probability distributions were developed for future returns to the system for each year between 2010 and 2050: "Historic," "Low," and "High". The "historic" distributions were based on the assumption that future runs would have the same probability distribution as was estimated for past runs. The "low" and "high" probability distributions were illustrative of alternative distributions which would generate higher or lower future harvests, on average. Based on these probability distributions, three sets of 1,000 "run simulations" for the period 2010-2050 were generated for each stock.

For each set of run simulations, four sets of harvestable surplus simulations were calculated, corresponding to four different assumptions about future subsistence demand. Thus for each stock, 12 sets of 1,000 harvestable surplus simulations were generated (Table 12). We refer to each of these sets of simulations as a "harvestable surplus scenario" or simply a "scenario."

Table 12. Harvestable Surplus Scenarios

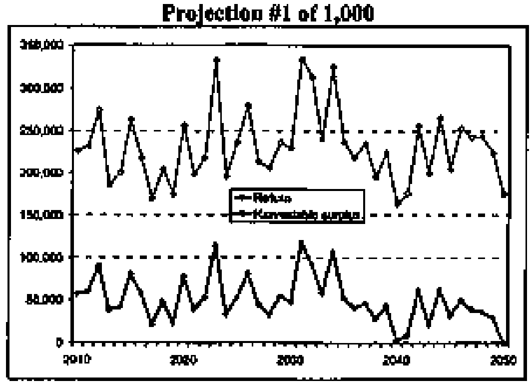
			Assumptions about Probability Distribution of Future Returns *Higher Surplus →*		
			Low	*Historic*	*High*
Assumptions about Future Subsistence Demand	*Lower Surplus →*	*Historic*	Low Return-Low Subsistence	Historic Return-Low Subsistence	High Return-Low Subsistence
		Int1	Low Return-Int1 Subsistence	Historic Return-Int1 Subsistence	High Return-Int1 Subsistence
		Int2	Low Return-Int2 Subsistence	Historic Return-Int2 Subsistence	High Return-Int2 Subsistence
		High	Low Return-High Subsistence	**Historic Return-High Subsistence**	High Return-High Subsistence

Note: We use the "Historic Return-High Subsistence" scenario to illustrate our discussion.

For our discussion below, we use the "Historic Return-High Subsistence" scenarios to illustrate our projection methodology. In using this scenario we do not mean to imply that this scenario is more "likely": it is very difficult to say very much about the relatively likelihood of our twelve scenarios. However, it is useful to use the "high future subsistence demand" assumptions for purposes of illustration because it makes it easier to see how growth in subsistence demand might affect projected harvestable surpluses over time.

For each harvestable surplus scenario, the 1,000 projections together describe, in effect, a probability distribution for harvestable surpluses for each year, derived from the probability distribution for future returns. Figure 17 shows the projected return and harvestable surplus corresponding to one simulation for this stock and scenario. Each of the 999 other simulations for this stock and scenario shows a different random pattern of year-to-year variation, although they all vary within similar ranges.

Fig. 17. Lower Yukon Chinook: Projected Return and Harvestable Surplus (Historic Return-High Subsistence Scenario), Projection #1 of 1,000



Our assumed probability distributions for future returns do not assume any trend over time or any relationship between individual years. In effect, each year's return is considered a random draw from a stationary probability distribution. As discussed above, the probability distribution for future returns was estimated based on available historical data for several decades. This means that for those stocks for which runs and harvestable surpluses for a stock have been relatively low for the most recent historical decade (since 2000), our projections will tend to show an immediate increase in projected future harvests, while for those stocks for which runs and harvestable surpluses have been relatively high for the most recent historical decade, our projections will tend to show an immediate decrease in projected future harvests.

In contrast to future returns, future harvestable surpluses may show a trend over time if projected subsistence harvests show a trend over time. In Fig. 17, for Lower Yukon Chinook, harvestable surplus exhibits a downward trend over time. This is because in the "high subsistence" scenario, projected Lower Yukon Chinook subsistence demand increases over time which results in a decreasing projected commercial harvestable surplus after subsistence demand is subtracted from the projected return.

Figure 18 compares historical harvests of Lower Yukon Chinook for several different measures of the probability distribution for projected future harvestable surpluses for the years 2011-2050. The figure also shows the first of the 1,000 simulations for the harvestable surplus. Note that most, but not all of the projected harvestable surpluses fall within the 10th percentile to 90th percentile band, and all are well below the maximum.

Fig. 18. Lower Yukon Chinook, Historic Harvests and Selected Indicators of Projected Harvestable Surplus (Historic Return-High Subsistence Scenario).

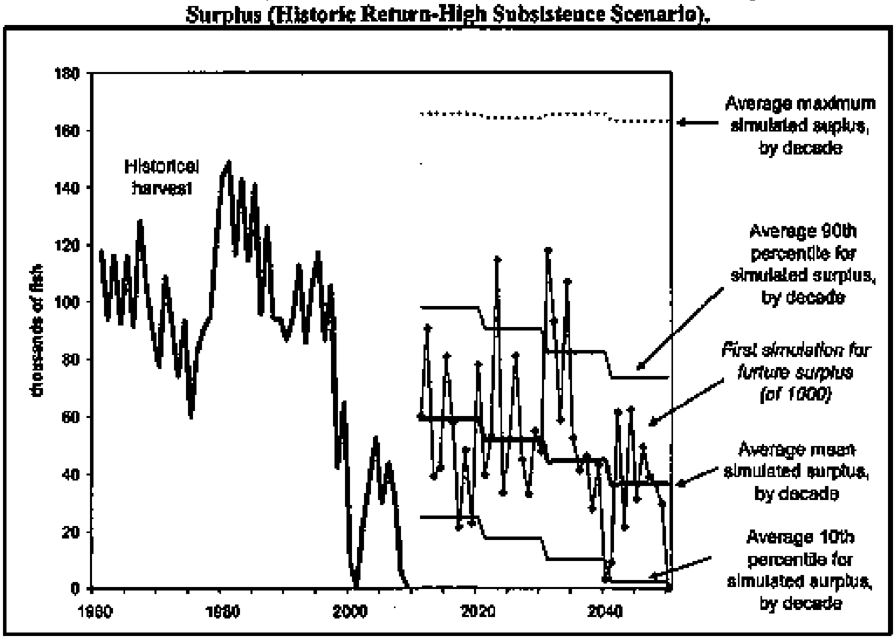
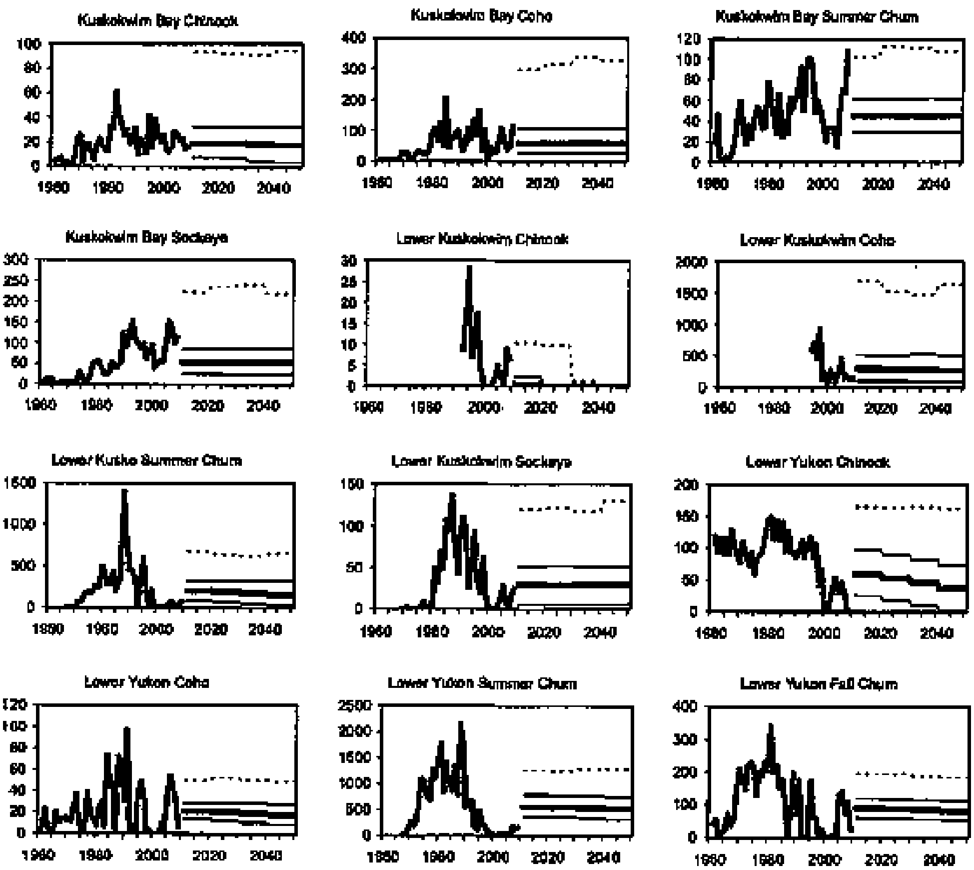


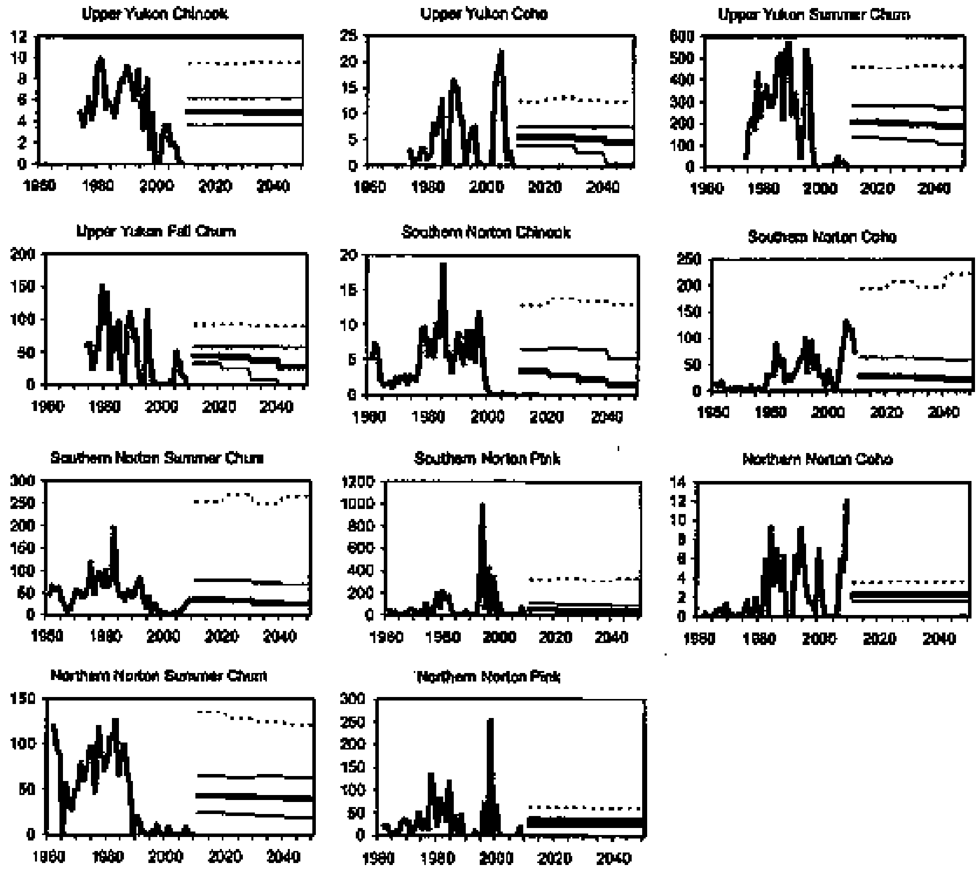
Figure 19 shows, for each stock, similar comparisons of historical harvests with the same four measures of the probability distribution for projected future harvestable surpluses for the years 2011-2050 for the "Historic Return-High Subsistence" scenarios. For each scenario, these projections of harvestable surplus were the starting point for our projections of future commercial harvests. They reflect the assumptions and methodologies (discussed above) used to develop probability distributions for future returns and to predict subsistence demand. Any limitations to those assumptions and methodologies are incorporated in these projections of harvestable surpluses.

Fig. 19. Historic Harvests and Selected Indicators of Projected Harvestable Surplus, by Stock (Historic Return-High Subsistence Scenario).



Note: Scales vary widely for different stocks. Data for the full historical period 1961-2009 were not available for some stocks. Figure continues on next page.

Fig. 19 (continued).



As discussed above, we developed twelve different scenarios corresponding to twelve different sets of assumptions about the probability distribution of future returns (Low, Historic, and High) and four sets of assumptions about the future subsistence demand (Low, Intermediate One, Intermediate Two, and High). Rather than presenting twelve similar sets of figures illustrating projected harvestable surpluses for each scenario, below we compare these projections only in terms of the mean harvestable surplus for the period 2011-2050 and the mean harvestable surplus by decade. However, note that all projections have similarly wide ranges for the probability distributions of projected surpluses, so they should not be viewed as point estimates.

Table 13 shows the mean projected harvestable surplus (averaged across all 1,000 runs and all years) for all 12 scenarios for all stocks.

Table 13. Mean Harvestable Surplus, 2011-2050, by Return and Subsistence Demand Scenarios (thousands of fish)

		Historic return				High return				Low return			
		Subsistence demand scenario				Subsistence demand scenario				Subsistence demand scenario			
Area	Species	Low	Int 1	Int 2	High	Low	Int 1	Int 2	High	Low	Int 1	Int 2	High
Kuskokwim Bay	Chinook	18.8	18.8	18.5	18.3	21.1	20.3	19.7	18.6	14.6	13.6	12.9	11.7
	Coho	62.3	62.4	62.3	62.5	71.3	71.9	71.9	71.7	67.2	66.3	66.4	65.0
	Summer Chum	45.2	45.2	45.2	45.2	47.0	46.9	46.9	47.0	46.9	46.9	47.0	47.0
	Sockeye	51.4	51.5	51.2	51.6	58.6	58.8	58.7	59.0	57.5	57.3	57.1	57.5
Lower Kuskokwim	Chinook	4.4	1.2	0.6	0.2	4.9	1.6	0.8	0.2	4.7	1.4	0.7	0.2
	Coho	296.9	294.8	292.7	285.5	344.6	345.8	347.0	345.3	188.5	184.1	180.4	170.0
	Summer Chum	205.7	201.3	197.3	180.6	239.8	239.8	239.3	235.1	231.9	226.1	217.6	198.8
	Sockeye	29.8	29.8	29.9	29.9	36.3	36.3	36.4	36.3	18.0	18.2	18.1	18.2
Lower Yukon	Chinook	76.8	67.7	60.9	48.1	85.2	80.8	76.1	65.0	71.4	60.9	53.9	40.6
	Coho	21.6	21.0	20.5	19.6	22.7	22.5	22.2	21.4	22.7	22.4	22.0	21.1
	Summer Chum	574.7	565.7	560.4	546.4	596.2	593.7	588.5	579.9	594.0	594.9	591.1	586.8
	Fall Chum	91.1	89.3	88.3	85.8	101.3	99.9	98.9	96.5	90.3	88.7	87.9	85.6
Upper Yukon	Chinook	4.9	4.9	4.9	4.9	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.9
	Coho	5.5	5.5	5.4	5.1	5.8	5.8	5.8	5.6	5.8	5.8	5.8	5.6
	Summer Chum	209.1	208.2	207.7	198.1	216.3	216.4	215.8	211.2	215.1	215.6	213.6	202.8
	Fall Chum	44.7	44.7	44.6	38.1	45.3	45.4	44.8	32.8	45.4	45.4	45.5	44.6
Southern Norton	Chinook	4.0	3.5	3.1	2.5	4.6	4.5	4.3	3.8	3.3	2.5	2.1	1.5
	Coho	31.4	29.3	27.9	25.3	41.5	41.0	40.3	39.4	21.3	18.9	17.4	15.3
	Summer Chum	39.9	36.5	34.8	31.2	53.7	53.2	53.0	51.1	29.1	26.2	24.6	21.3
	Pink	55.3	50.2	47.7	42.3	73.2	70.7	69.5	67.1	37.8	32.4	29.5	24.4
Northern Norton	Coho	2.2	2.2	2.1	2.1	2.3	2.3	2.3	2.3	2.3	2.3	2.2	2.3
	Summer Chum	44.0	43.5	42.8	41.6	47.4	47.1	47.3	47.2	40.8	39.8	38.7	37.0
	Pink	28.5	28.1	27.8	28.6	29.5	29.5	29.4	29.5	28.9	28.4	27.8	28.6

Note that the relative differences in mean harvestable surplus among the "Historic return," "High return," and "Low return" scenarios varies by stock. This is because the relative size of escapement and subsistence demand in relation to the total return varies among stocks. The higher escapement and subsistence demand are relative to the total return, the greater the *relative* effect of a change in the total return on the residual portion of the run available for commercial harvest.

As can be seen in Table 13, the higher subsistence demand, the lower the harvestable surplus available for commercial harvests, and vice versa. In general, for each return scenario, as subsistence demand increases from "low" to "high," the mean harvestable surplus decreases.[18]

As shown in Table 14, the relative effects of subsistence on mean harvestable surplus over time vary by stock. For example, in the "high" subsistence scenario, the Lower Kuskowim mean harvestable surplus of coho declines by 5% between 2011-20 and 2041-50, while the Lower Kuskokwim mean harvestable surplus of summer chum declines by 20%. The relative percentage decline depends upon both the relative size of the surplus and the relative change in subsistence demand; the smaller the stock, the greater the relative effect of a given change in subsistence demand over time.

[18] There are a few stocks and scenarios for which this does not consistently hold, such as for the Kuskokwim Bay coho historic run scenarios, on the second row of the table at the left. This is because the data for each cell of the table are means of 1,000 projections from a probability distribution. When differences in subsistence demand between scenarios is low, random variation in the means of projected harvestable surpluses may outweigh the effects of small changes in subsistence demand.

Table 14. Mean Harvestable Surplus by Decade, Historic Return Scenarios (thousands of fish)

Area	Species	Mean harvestable surplus, 2011-20 Subsistence demand scenario				Mean harvestable surplus, 2041-50 Subsistence demand scenario				Percent change, 2011-20 to 2041-50 Subsistence demand scenario			
		Low	Int1	Int2	High	Low	Int1	Int2	High	Low	Int1	Int2	High
Kuskokwim Bay	Chinook	18.9	18.8	18.6	18.7	18.7	18.6	18.2	17.6	-1%	-1%	-3%	-6%
	Coho	62.8	62.9	62.5	62.1	62.2	62.7	62.6	62.8	-1%	0%	0%	1%
	Summer Chum	45.0	45.3	45.2	45.2	45.3	44.8	45.2	45.1	1%	-1%	0%	0%
	Sockeye	51.2	51.6	51.1	51.5	50.9	51.6	51.4	51.8	0%	0%	0%	1%
Lower Kuskokwim	Chinook	4.3	2.5	1.7	0.6	4.6	0.3	0.0	0.0	8%	-87%	-99%	-100%
	Coho	295.7	299.0	296.0	292.8	298.1	292.5	291.0	276.6	1%	-2%	-2%	-5%
	Summer Chum	205.1	203.9	204.2	198.6	205.4	198.9	189.6	158.1	0%	-2%	-7%	-20%
	Sockeye	29.8	29.7	30.0	29.8	29.9	29.9	30.2	30.0	0%	1%	1%	1%
Lower Yukon	Chinook	72.1	67.4	64.0	59.0	80.5	67.6	56.4	36.6	12%	0%	-12%	-38%
	Coho	21.8	21.5	21.4	21.2	21.4	20.2	19.4	17.5	-2%	-6%	-9%	-17%
	Summer Chum	574.4	571.9	571.9	571.1	575.8	555.7	545.9	515.7	0%	-3%	-5%	-10%
	Fall Chum	92.0	91.2	90.7	89.7	90.0	87.4	85.6	81.5	-2%	-4%	-6%	-9%
Upper Yukon	Chinook	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.8	0%	0%	0%	-1%
	Coho	5.5	5.5	5.4	5.4	5.5	5.5	5.4	4.6	0%	0%	0%	-16%
	Summer Chum	208.4	207.8	207.8	206.9	210.2	208.1	208.1	186.4	1%	0%	0%	-10%
	Fall Chum	44.8	44.7	44.6	44.1	44.6	44.7	44.5	27.6	0%	0%	0%	-37%
Southern Norton	Chinook	4.0	3.8	3.7	3.4	4.0	3.1	2.5	1.4	0%	-18%	-33%	-58%
	Coho	31.4	30.4	30.0	28.7	31.2	27.8	25.8	21.6	0%	-9%	-14%	-25%
	Summer Chum	40.3	38.1	37.6	36.2	39.7	35.4	31.7	26.1	-2%	-7%	-16%	-28%
	Pink	56.0	53.1	52.7	49.6	55.2	47.6	42.2	33.6	-2%	-10%	-20%	-31%
Northern Norton	Coho	2.1	2.1	2.2	2.2	2.2	2.1	2.1	2.1	1%	0%	0%	0%
	Summer Chum	44.0	43.9	43.4	43.4	43.7	43.7	41.9	39.4	-1%	-1%	-3%	-9%
	Pink	28.4	28.2	28.3	28.6	28.5	28.0	27.2	28.6	0%	-1%	-4%	0%

Note: Bold indicates percentage change exceeds -10%.

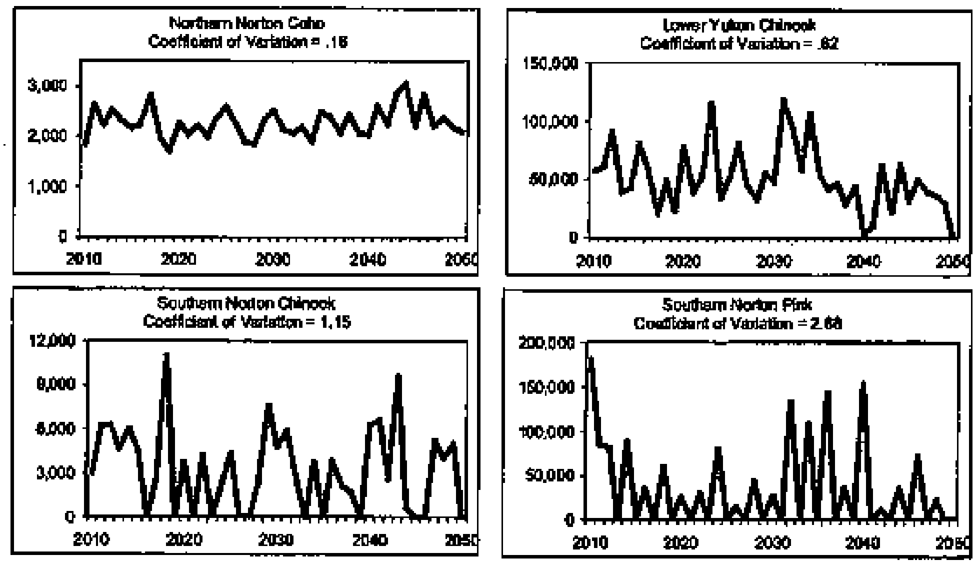
For the "low" subsistence demand scenario, no stocks experience more than a 2% decline in mean harvestable commercial surpluses between 2011-20 and 2041-50. In contrast, for the high subsistence demand scenario, mean harvestable surpluses decline by more than 10% between the two periods for about half the stocks. The five stocks experiencing the greatest relative decline in harvestable surpluses (more than 30%) are Lower Kuskokwim Chinook, Southern Norton Sound Chinook, Lower Yukon Chinook, Southern Norton Sound Pink, and Upper Yukon Fall Chum.

The farther we project into the future, the more important what we assume about how subsistence demand will change in the future becomes for projected commercial harvestable surpluses.

As we discuss below, future commercial harvests of AYK salmon will likely depend not only on the mean level of harvestable surpluses but also on the *variability* of harvestable surpluses. For example, mean commercial harvests are likely to be higher for a stock for which the harvestable surplus is 100,000 fish every year than for a stock for which the harvestable surplus is zero for two-thirds of the years and 300,000 fish every third year. This is because harvesters and processors are more likely to invest in capacity for harvesting and processing a stock with a predictable and consistent surplus than for one with an unpredictable and only occasional surplus.

One simple measure of variability is the coefficient of variation, which is defined as the ratio of the standard deviation to the mean. Figure 20 illustrates harvestable surplus projections with increasing coefficients of variation of 0.16, 0.62, 1.15 and 2.88.

Fig. 20. Projected Harvestable Surpluses for Selected Stocks (Historic Return-High Subsistence Scenario), Projection #1 of 1,000



The harvestable surplus projections in the two bottom figures help to illustrate why variability matters in thinking about future AYK commercial harvests. For these two projections, there are a substantial number of years in which harvestable surpluses are zero. This means that any investment in harvesting or processing capacity, gearing up for the season, or developing markets would provide zero revenue for those years, a major financial risk and disincentive to investing in harvesting or processing.

<u>Harvestable Surpluses for Commercial Fisheries</u>

An important question for this analysis is whether there will be harvestable surpluses for AYK commercial salmon fisheries in the future. The answer to this question depends on what we assume about the distribution of future returns for each stock and subsistence demand for each stock.

Table 15 shows the percentage of our simulations for which our projections of the harvestable surplus were zero or low (<= 5000 fish) for the final decade (2041-2050) of four different harvestable surplus scenarios. Harvestable surpluses are most likely to be zero or low for the "Low Return-High Subsistence Demand" scenario shown in the fourth and eighth columns of Table 15. For this scenario, harvestable surpluses were zero at least 10% of the time from 2041-50 for the following six stocks: Kuskokwim Bay Chinook, Lower Kuskokwim Chinook, Lower Yukon Chinook, Southern Norton Chinook, Southern Norton Summer Chum, and Southern Norton Pink. However, with the exception of these stocks, assuming the distribution of returns and subsistence demand projections for these scenarios, there would be at least some commercial harvestable surpluses for most salmon stocks in most years in the AYK area.

Table 15. Selected Indicators of the Availability of Harvestable Surpluses for Commercial Harvests

Area	Species	Percentage of years between 2041 and 2050 for which harvestable surplus = 0				Percentage of years between 2041 and 2050 for which harvestable surplus <=5000			
		Low subsistence demand		High subsistence demand		Low subsistence demand		High subsistence demand	
		Historic return	Low return	Historic return	Low return	Historic return	Low return	Historic return	Low return
Kuskokwim Bay	Chinook	0%	2%	4%	18%	4%	18%	14%	42%
	Coho	0%	0%	0%	0%	0%	0%	0%	0%
	Summer Chum	0%	0%	0%	0%	0%	0%	0%	0%
	Sockeye	0%	0%	0%	0%	0%	0%	0%	0%
Lower Kuskokwim	Chinook	26%	24%	100%	100%	45%	42%	100%	100%
	Coho	0%	0%	0%	2%	0%	0%	0%	2%
	Summer Chum	0%	0%	4%	3%	0%	0%	4%	4%
	Sockeye	0%	1%	0%	1%	9%	29%	9%	30%
Lower Yukon	Chinook	0%	0%	9%	14%	0%	0%	13%	20%
	Coho	0%	0%	0%	0%	0%	0%	2%	1%
	Summer Chum	0%	0%	0%	0%	0%	0%	0%	0%
	Fall Chum	0%	0%	0%	0%	0%	0%	0%	0%
Upper Yukon	Chinook	0%	0%	2%	4%	57%	54%	57%	55%
	Coho	0%	0%	8%	5%	42%	33%	45%	35%
	Summer Chum	0%	0%	0%	0%	0%	0%	0%	0%
	Fall Chum	0%	0%	20%	3%	0%	0%	26%	4%
Southern Norton	Chinook	4%	11%	56%	75%	69%	75%	89%	96%
	Coho	0%	0%	3%	7%	11%	23%	39%	58%
	Summer Chum	9%	20%	20%	36%	9%	20%	36%	50%
	Pink	34%	32%	58%	68%	38%	38%	60%	71%
Northern Norton	Coho	0%	0%	0%	0%	100%	100%	100%	100%
	Summer Chum	0%	0%	0%	0%	0%	0%	0%	0%
	Pink	1%	0%	1%	0%	2%	3%	1%	1%

Note: Bold font indicates percentage is greater than or equal to 10%.

It is important to recognize that we cannot give any *definitive* answer to the question "will there be harvestable commercial surpluses for AYK salmon?" Our simulations are based on the assumption that run distributions will be similar over the next four decades to what they were over the past five decades. Clearly, if runs are significantly larger, harvestable commercial surpluses will be larger. If runs are significantly smaller, harvestable commercial surpluses will be smaller, with more years with no commercially harvestable surplus.

Commercial Harvests

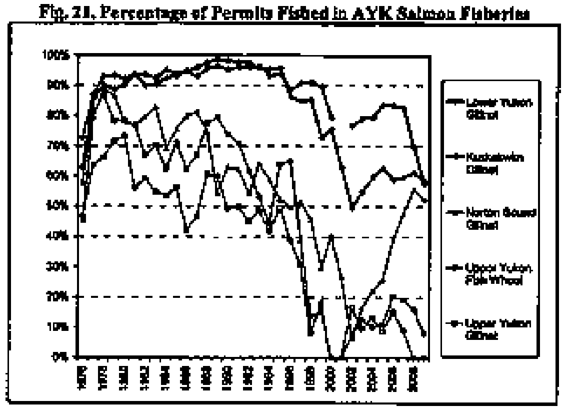
Having discussed potential harvestable surpluses which may be available for future commercial AYK commercial salmon harvests, we next discuss the extent to which these surpluses are likely to be utilized for commercial harvests. We use the term "utilization" to refer to the percentage of a surplus actually harvested during a year.

No data are available to estimate the annual historical utilization of AYK commercially harvestable salmon surpluses. No data have been collected systematically or estimated for how many salmon have historically returned each year to AYK systems, or were potentially available for commercial harvest each year. We cannot tell the extent to which historical changes in harvests from year to year resulted from changes in surpluses or changes in utilization rates.

Lack of data made it impossible for us to develop a formal statistical model of how different factors have affected utilization historically.

One potential indicator of historical utilization of AYK salmon harvests is *fishery participation*. Historical data for the five AYK limited entry permit types (which are differentiated only by area, not species) show the fishery participation was relatively high in all areas in the 1990s, but declined in all fisheries during the 1990s (Fig. 21). The decline was particularly sharp for Norton Sound gillnet and the Upper Yukon fish wheel and gillnet fisheries.

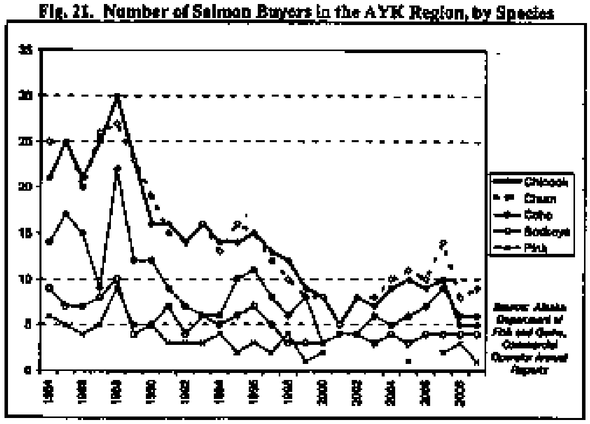
Fig. 21. Percentage of Permits Fished in AYK Salmon Fisheries



The decline in fishery participation could partly reflect lower harvestable surpluses. If there are few or no fish to be caught, fewer permit holders will participate in a fishery. But the fact that the decline in participation is correlated with falling prices in the 1990s (discussed below) suggests that it was attributable in part to market conditions, and declining participation resulted in lower utilization of harvestable surpluses (although lower participation could be offset in part by higher catches by the remaining fishermen).

Another potential indicator of lower utilization is the number of *salmon buyers*. Commercial harvesters will not harvest fish without buyers. A dramatic decline in the number of buyers in the AYK region occurred during the 1990s for all species (Fig. 22). Again, the decline in buyers could partly result from lower harvestable surpluses. If there are fewer fish to be bought, fewer buyers are likely to participate. But the fact that the number of buyers dropped so sharply, and that there were no buyers in large areas of the AYK region, is a strong indicator of declining utilization.

Fig. 21. Number of Salmon Buyers in the AYK Region, by Species



A variety of studies, as well as anecdotal evidence, describe underutilization of specific stocks in particular years. Consider, for example, the following discussions of commercial harvests for selected AYK salmon stocks:

> Kuskokwim River: "The lack of markets, buyers and processing capacity for chum salmon has been a major impediment in recent years for the commercial fisheries . . . Although a harvestable surplus existed each year 2001-2005, no market existed for chum salmon in the Kuskokwim River fishery from 2001 through 2003, and only modest commercial fisheries were prosecuted from 2004 through 2005. . . Given the scale of record Chinook, chum and sockeye salmon escapements observed from 2004 through 2005 in the Kuskokwim River, large surpluses of these species were available for commercial harvest. These surpluses were unexploited and contributed, in part, to the record escapements in these years. Given the poor market conditions which have persisted in the Kuskokwim Area for almost a decade, full exploitation of the large harvestable surpluses is unlikely. Along with harvest, the average number of permit holders participating in the fishery has declined significantly to approximately 20% of historical highs. Even if effort had been at, or near, historical highs, market interest in large harvests from the Kuskokwim Area did not exist, especially for chum salmon" (Linderman and Bergstrom, 2009).

> Norton Sound: "Beginning in the early 2000s, no market interest existed for chum or pink salmon, and the commercial fishery targeted Chinook and coho salmon . . ." (Menard, Krueger and Hilsinger, 2009).

> Yukon River: "Given the improved total return in recent years, greater commercial harvest of salmon might have been expected. The decline of salmon stocks from 1998 through 2002 changed the character of the fisheries. Many fishers moved away from using long established fish camps, fishing gear fell into disrepair or was replaced with other types, prices for salmon fell, and market interest shifted to other available fisheries outside the region. With the return of the salmon, fishers and markets are slowly returning and may improve in the future . . ." (Bue et al, 2009).

Note that none of these sources attempt to estimate specific utilization rates, or how utilization may have varied from year to year. However, they do convey that harvestable commercial surpluses for many AYK salmon stocks have been significantly underutilized since the late 1990s, particularly for chum and pink salmon.

Factors Affecting Utilization of Harvestable Surpluses

In any given year, a very wide variety of factors may *appear* to determine the extent to which harvestable surpluses of a given stock are utilized. Examples include:

- The ex-vessel prices processors offer to fishermen.
- The cost of fuel for fishermen.
- Whether buyers or processors choose to operate in the region for a salmon species.
- How much of the season processors or buyers operate.
- The extent to which processors offer tendering to fishermen.
- Whether processors put fishermen on "limits".
- The extent to which transportation is available to ship whole or processed fish out of the region.

All of these factors are manifestations of market or cost conditions which together determine economic conditions for the stock. "Economic conditions" refer broadly to factors affecting the potential total profitability of harvesting and processing salmon (the wholesale value that could potentially be derived from commercial salmon products minus all the costs of harvesting salmon and processing and transporting salmon products to the wholesale point of sale).

Stocks will not be harvested unless fishing and processing are profitable for both fishermen and processors. Potential total profitability limits the extent to which both fishing and harvesting can be profitable.

Extremely favorable economic conditions (i.e., when potential total profitability is very high) are likely to be reflected in the types of factors listed above. For example, if economic conditions are extremely favorable:

- Processors are likely to offer higher ex-vessel prices to fishermen.
- Fishermen are likely to fish even if the cost of fuel is high.
- More processors and buyers are likely to operate in the region.
- Fishermen are likely to fish, and processors are likely to buy, for more of the run.
- Processors are more likely to offer tendering over greater distances.
- More transportation options will be economically profitable.
- Utilization is likely to be high.

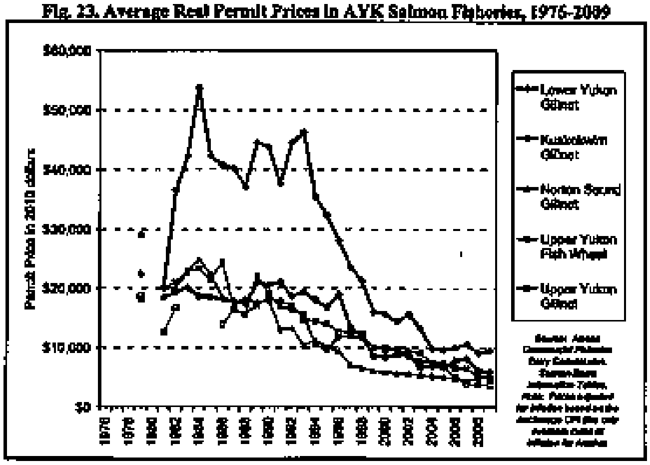
Conversely, if economic conditions are extremely unfavorable:

- Processors are likely to offer lower ex-vessel prices to fishermen.
- Fishermen are less likely to fish if the cost of fuel is high.
- Fewer processors and buyers are likely to operate in the region.
- Fishermen are likely to fish, and processors are likely to buy, for less of the run.
- Processors are less likely to offer tendering, or to offer it for shorter distances.
- Fewer transportation options will be economically profitable.

- Utilization is likely to be low.

Real (inflation-adjusted) limited entry permit prices declined sharply in all AYK salmon fisheries during the 1990s (Fig. 23). Since permit prices are an indicator of expected future profits, this suggests that fishery profitably declined very sharply during this period. In part this would be an expected result of lower harvestable surpluses. But it likely to some extent also reflects lower prices, which would have contributed to lower utilization.

Fig. 23. Average Real Permit Prices in AYK Salmon Fisheries, 1976-2009



A wide variety of factors affect potential total profitability of a fishery. We briefly review some of the most important factors below.

Market Conditions

Market conditions are reflected in wholesale prices paid for products produced from AYK salmon fisheries, and also in the ex-vessel prices processors pay fishermen. Figures 24-28 show average real (inflation-adjusted) ex-vessel prices paid by processors to fishermen for AYK salmon, as well as the corresponding average statewide ex-vessel prices. Note that these prices are weighted averages of prices from different regions, so part of the changes in prices over time (particularly for Chinook) derive from changes in the relative share of differently-priced AYK fisheries in the total catch.

Real prices declined dramatically in the 1990s and early 2000s, both in the AYK region and statewide, for all species except Chinook. Similar declines occurred in the wholesale prices of most of the frozen, fresh and roe products made from these species, although the specific price changes varied by product and species. A wide variety of factors contributed to the price declines, including growth in worldwide farmed salmon production, large world harvests of wild salmon (including Japanese and Alaska chum salmon hatchery production), changes in the Japanese economy, and changes in the seafood distribution and retailing industries (Knapp 2009). The AYK Chinook salmon, which enjoyed a niche-market reputation as a very high-quality product, was less dramatically affected by these market changes than other species and suffered a less dramatic price decline. These market changes during the 1990s contributed to, and were reflected in, declining processor interest in buying AYK salmon and operating in the high-cost AYK region. They are probably the most significant factor contributing to reduced utilization during this period.

Since about 2003, real prices have been rising for all species, both in the AYK region and statewide. Although real ex-vessel prices have more than doubled for all species, they remain well below real price levels of the 1980s for all species except Chinook. The improvement in prices reflect a variety of continuing changes in world salmon markets, including strong growth in world salmon demand, market differentiation of wild salmon from farmed salmon, generic marketing efforts for wild salmon, development of new wild salmon products, and development of new domestic and European markets for Alaska wild salmon resulting in diversification of markets and reduced dependence on the Japanese market.

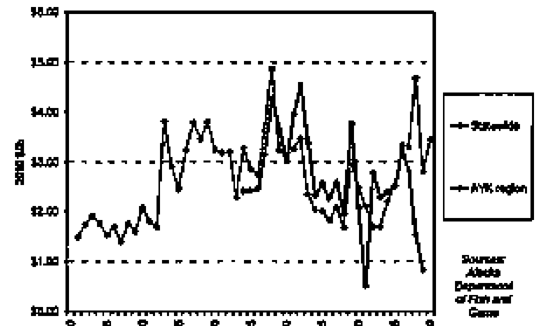
It is difficult to predict how AYK wild salmon prices will change in the future, particularly over the extremely long time period of the next four decades. History strongly suggests that price cycles will continue to occur. There will be periodic periods of higher or lower prices due to periods of relatively lower or higher world supply relative to demand. However, several factors suggest that over the long-term, real prices for AYK wild salmon may trend upward, continuing the trend of recent years.

The most fundamental factor is that world demand for salmon is likely to grow more rapidly than supply. Factors contributing to likely long-term growth in world salmon demand include continued growth in the world population; rising global incomes, particularly for emerging middle classes in populous Asian countries such as China and India; and the likelihood that real prices of meat and poultry will increase due to constraints on the supply of feeds, land, and water. Another favorable factor is that wild salmon, limited in supply by nature, is likely to become increasingly differentiated from farmed salmon and appreciated for unique "wild" characteristics. At the same time, there are substantial differences in the value of different salmon species; pink and chum are unlikely to command prices comparable to those of Chinook, sockeye, or coho. The limited sizes of the Chinook, coho, and sockeye runs in the AYK region also limits the potential value of commercial salmon harvests.

Potentially offsetting these generally favorable market factors (limiting and at times reversing long-term positive trends in real prices) is the potential for continued dramatic technological advances in aquaculture contributing to lower costs of production and increased supply of farmed salmon and other species (potentially including species not yet farmed in significant volumes). As for any other commodity, future price increases for salmon will be limited by the incentives they create for producers to expand production of farmed salmon and other competing species, and for consumers to shift to other, lower-priced alternatives.

It would have been impossible in 1970 to predict the price trends over the next four decades illustrated by Figs. 24-28. Although it is always tempting to assume that the trends of the past few years will continue indefinitely, in reality it is just as impossible to predict what will actually happen to AYK salmon prices over the next four decades as it would have been in 1970. Although our best guess would be that AYK salmon prices will trend upwards over the next four decades, it should be recognized that any projection for this long a time period is ultimately only a guess.

Fig. 24. Selected Chinook Salmon Real Average Ex-Vessel Prices (adjusted for inflation)



Note: Steep drops in AYK region average price in 2001 and 2008-09 likely reflect declines in the share of higher-priced Yukon Chinook to total AYK catches.

Fig. 25. Selected Sockeye Salmon Real Average Ex-Vessel Prices (adjusted for inflation)

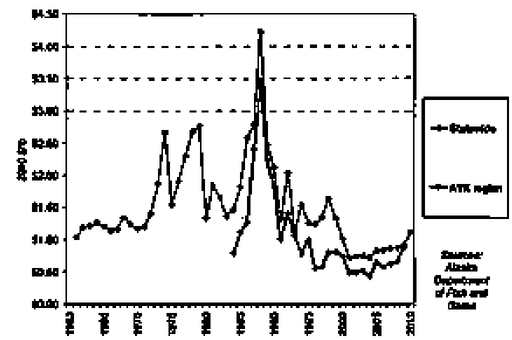


Fig. 26. Selected Coho Salmon Real Average Ex-Vessel Prices (adjusted for inflation)

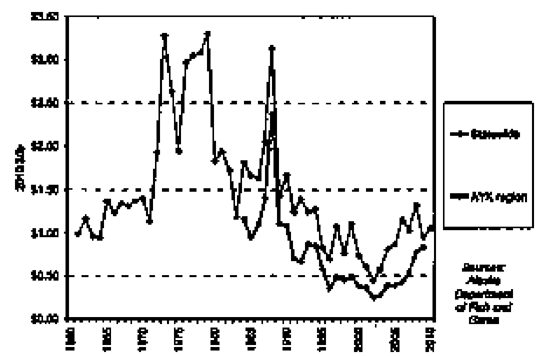


Fig. 27. Selected Chum Salmon Real Average Ex-Vessel Prices (adjusted for inflation)

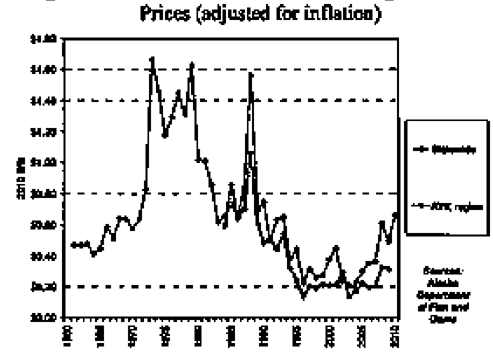
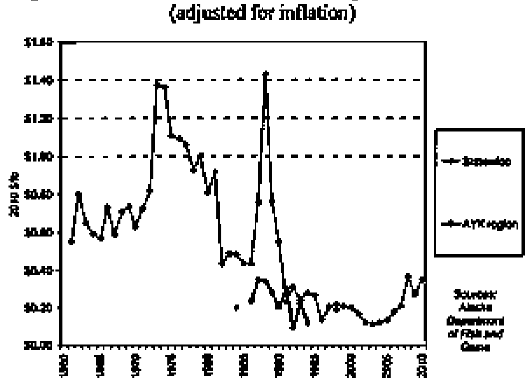


Fig 28. Selected Pink Salmon Real Average Ex-Vessel Prices (adjusted for inflation)



Transportation Infrastructure

Among the most important factors which could affect the future profitability of utilizing AYK salmon is the future development of transportation infrastructure. One of the most important differences between AYK salmon fisheries and other AYK fisheries is the much higher costs of transporting supplies into the region and transporting fish products out of the region. Most other salmon-producing areas of Alaska have access to roads, jet air service, or large ocean-going vessels. In contrast, fisheries in much of the AYK region are accessible only by small aircraft or shallow-draft boats. This increases the relative costs of everything associated with fishing and processing and transporting fish to market, such as fuel, fishing gear, processing labor, utilities, machinery maintenance, packaging, and transporting processed frozen and fresh fish. Transportation limitations also reduce the reliability of services for getting fresh products to market.

Over the longer term, it is possible that new transportation infrastructure, particularly roads, could be built to parts of the AYK region. Road connections to western Alaska have been discussed for decades, but they have yet to be built because of extremely high costs and ambivalence within the region about the desirability of road access. In general, road connections to the Kuskokwim, Lower Yukon, or Seward Peninsula could change the cost structure of AYK fisheries and would likely result in greater utilization of harvestable surpluses.

It is also possible that transportation services to the AYK region could decline and costs of transportation could increase, if energy costs increase significantly or if changes in national and state political priorities result in reductions in the significant subsidies to air transportation to the region, such as for bypass mail and airport construction, maintenance, and operation. This would tend to reduce future utilization of AYK salmon.

Variability and Uncertainty of Harvestable Surpluses

For any given market conditions and cost conditions, utilization will be affected by the variability and uncertainty of harvestable surpluses. Commercial fishing cannot occur (and will not be allowed) unless there are processors willing to buy and process commercial harvests. Processors will not buy or process salmon unless they have a reasonable expectation, prior to the season, that they will make money. The more likely they think it is that there will not be enough fish for them to make processing worthwhile (or worse, no fish at all to process) the lower the chance that they will choose to operate in an area.

The amount of fish processors can buy is also affected by longer-term investments that they make in processing facilities and equipment in a region. This is central for the economics of AYK commercial salmon fisheries. Successful commercial salmon fisheries depend on markets: processors willing and able to pay fishermen enough to make commercial fishing worthwhile for fishermen. Processing requires long-term investments in facilities and equipment within a region, as well as annual pre-season investments in bringing in labor, packaging, and other supplies. The less frequently facilities and equipment are used, the more favorable economic conditions need to be to justify investing in them. The more variable and uncertain the processors expect future harvestable surpluses to be, the less profitable long-term investments in processing capacity will appear, and the less they will invest. The more uncertain processors are prior to a season about whether there will be a harvestable surplus, the less likely they are to make the necessary investments to be ready to buy if a harvestable surplus occurs.

For this reason, a critical factor affecting the utilization of future AYK salmon harvests will be how often the harvestable surpluses are very low or zero. The effects of low or zero harvestable surpluses go beyond the year in which they occur. If they lead to expectations that low or zero harvestable surpluses are likely in the future, then buyers are less likely to be present in years when surpluses *are* available, reducing future utilization.

This has an important policy implication. Managers should recognize that how they manage commercial fisheries when runs are weak may affect the extent to which they will have a commercial fishery in years when runs are strong. While meeting subsistence and escapement goals are clearly very important, the more that managers fully close commercial fishing when runs are weak, the fewer commercial buyers there are likely to be when runs are strong.

What will matter for investment in processing and utilization of future AYK salmon harvestable surpluses will be not just the percentage of years over the entire period for which surpluses are low or zero, but the extent to which years of low or zero surpluses are bunched together so that an extended period occurs of low or zero surpluses. Put simply, processors may not leave because of one bad year, but are more likely to leave if they encounter or expect multiple bad years in a row.

Our methodology for simulating future salmon returns for this study is limited in that it assumes that returns are not governed by predictable spawner-recruit relationships but are instead characterized as independent draws from a stationary distribution of run sizes. Consequently, the model does not provide a way of projecting how often "multiple bad years in a row" may occur. Thus, an important question for the future of AYK commercial salmon harvests, which we do not address in this study, is the extent to which extended periods of low salmon returns may occur. Utilization of harvestable surpluses is likely to be higher, with higher commercial salmon harvests on average, if the next four decades are characterized by relatively stable returns and surpluses than if they are characterized by varying multi-year periods of low and high returns and surpluses.

Economies of Scale and Fishery Synergies

In general, unit costs of processing and harvesting tend to decline as volume increases, as long as there is sufficient harvesting and processing capacity. This suggests that all else equal, harvesting and processing is more likely to be profitable for larger-scale fisheries.

However, smaller stocks may be profitable to harvest if runs overlap with larger-scale fisheries. Similarly, if investments in processing capacity are justified by larger-scale fisheries, plants may stay open to take advantage of other, smaller runs which would not have been profitable on their own.

An important limitation of our modeling for this analysis is that we treat each stock within a region separately. In reality, within each AYK region, future utilization of different species will be interdependent. The profitability of processing any particular species will depend on the profitability of harvesting other species and the extent to which they can help to offset fixed costs of harvesting and processing.

Fishery Management

The potential profitability of a commercial fishery depends in part on how it is managed (that is, when and how fish may be harvested and who may harvest them). Management regulations can dramatically affect both costs of harvesting and processing as well as potential market value.

Current management regulations strictly limit the types of gear which may be used in AYK salmon fisheries. Regulations are intended, in part, to achieve social goals such as widespread participation in fish harvesting. Despite drastic changes in technology in other food-producing industries, relatively little has changed over the past fifty years in how AYK salmon (and other Alaska salmon) are harvested.

It is possible to imagine very different management regulations for AYK commercial fisheries which could result in very different ways of harvesting fish. For example, fish could be harvested in fish traps (as are common in the Russian Far East) or by other gear types from larger vessels. Fishing could be organized cooperatively, or conducted by companies rather than individuals. Such changes could, in theory, lead to significantly more efficient and profitable fisheries which would utilize available commercial surpluses more intensively.

We are not advocating or predicting such changes, and they seem unlikely given the policy goals for AYK fisheries. But over a long time frame, they are theoretically possible, particularly if significant economic and social changes occur in the AYK region that lead to declining interest in traditional commercial fishing.

CDQ Program

A unique factor affecting western Alaska salmon fisheries is the Community Development Quota program. In general, commercial salmon fisheries are economically sustainable over the long-term only if they are economically profitable. The exception to this principle is if subsidies are available to offset losses on a long-term basis. Community Development Quota groups have been subsidizing some AYK salmon processing operations to a significant scale. This has likely increased the utilization of salmon in the areas from which these processing operations are buying. It also may have contributed to a decline in other private processing operations which cannot compete with subsidized CDQ operations.

Examples of significant AYK salmon processing operations operated or subsidized by CDQ groups include Norton Sound Economic Development Corporation's joint ventures with Glacier Fish Company, Yukon Delta Fisheries Development Association's Kwik'pak Fisheries, and Coastal Villages Region Fund's large new processing facility in Platinum. These operations buy significant volumes of fish and provide markets in their regions.

The future scale of AYK commercial salmon fisheries will partly depend on how the CDQ program evolves in the future, and particularly, the extent to which large revenues continue to be generated, whether CDQ groups are mandated to invest revenues in fisheries-related economic development within the region, and whether CDQ groups choose to subsidize salmon processing operations.

Utilization Formula and Assumptions

As the above discussion suggests, a wide variety of factors will affect future utilization commercial harvestable surpluses of AYK salmon. We cannot accurately predict how these factors will combine to determine actual utilization. It is plausible to imagine very different futures for AYK commercial salmon fisheries, particularly over the longer term.

For this reason we do not attempt to predict future utilization. Rather, our goal is to illustrate different potential futures, that is, what long-term trends in commercial harvests might look like under different assumptions about future trends in utilization. To do this we developed a simple utilization formula to calculate utilization rates as a function of two main factors: (1) general economic conditions affecting utilization; and (2) variability of harvestable surpluses. The formula is based on a "logistic function" which calculates an annual utilization value between 0% and 100% based on the values of two variables:

Table 16. Utilization Formula Variables

Variable	Definition	Scale	Assumed or calculated?	How utilization changes as the variable increases
Utilization index	An assumed annual index of utilization for the stock	1-10	Assumed	Increases
Coefficient of variation of the harvestable surplus	The annual ratio of the standard deviation to the mean for 1,000 simulations of harvestable surplus	0-infinity	Calculated	Decreases

The formula is:

$$U = 1/(1+EXP(-(-3 + 0.6\,I - 0.7V)))$$

where

U = Utilization (the proportion of harvestable surplus which is harvested),
I = Utilization index, and
V = Coefficient of variation of the harvestable surplus.

Table 17 shows utilization for several different combinations of the utilization index and the coefficient of variation of the harvestable surplus which result from this formula:

Table 17. Utilization with Selected Combinations of Utilization Index and Coefficient of Variation

		Utilization Index									
		1	2	3	4	5	6	7	8	9	10
Coefficient of Variation	0.0	8%	14%	23%	35%	50%	65%	77%	86%	92%	95%
	0.5	6%	10%	18%	28%	41%	56%	70%	81%	89%	93%
	1.0	4%	8%	13%	21%	33%	48%	62%	75%	85%	91%
	1.5	3%	5%	10%	16%	26%	39%	54%	68%	79%	88%
	2.0	2%	4%	7%	12%	20%	31%	45%	60%	73%	83%
	2.5	2%	3%	5%	9%	15%	24%	37%	51%	66%	78%
	3.0	1%	2%	4%	6%	11%	18%	29%	43%	57%	71%

Note that at a utilization index of 5, utilization is 50% if the coefficient of variation is zero (implying that the projected harvestable surplus is the same for each of 1,000 simulations). Utilization falls to 33% for a coefficient of variation of 1 and to 31% for a coefficient of variation of 2.

The coefficients of the formula were chosen so that it would calculate: (a) the utilization rates shown in the first row of the table for a coefficient of variation of 0; and (b) the changes in utilization rates shown in the table columns as the coefficient of variation increases. Note that the formula is *not* based on economic analysis. It only provides a simple way of combining assumptions about long-term trends in factors affecting utilization with assumptions about how variability in harvestable surpluses may affect utilization. This is useful because of the potential importance of variability for utilization, the wide differences in variability between stocks, and the changes in variability that may occur over time as harvestable surpluses increase or decrease.

The purpose of the formula and our analysis is to illustrate potential long-term trends in harvests under alternative assumptions. As historical experience clearly shows, shorter-term increases and decreases in utilization in response to shorter-term trends in economic conditions and harvestable surpluses are clearly possible or probable.

Another important limitation is that the formula treats each stock separately: it does not take account of the clear synergies between commercial harvests of different species within a given geographic area. As noted above, it is likely that utilization will be correlated for different species within a given area, but we do not attempt to account for this correlation in our projections.

For the purposes of our analysis, we developed six sets of assumptions about utilization indexes, by species. For each set of assumptions, we assumed a "starting" value of the index in 2010 and an "ending" value in 2050. When the starting and ending values differed, we assumed that the index changes by a constant annual amount between the starting and ending year.

Table 18 summarizes our utilization index assumptions. For the "Same" assumptions we assume the same indexes for all species; for the "Varied" assumptions we assume different indexes for each species. For the "Low" assumptions we assume a "low" utilization index over the entire period; for the "High" assumptions we assume a "high" utilization index for the entire period, and for the "Rising" assumptions we assume the index rises from "low" to "high" over the period.

Table C-7. Utilization Index Assumptions, by Species

	Same-Low		Same-High		Same-Rising		Varied-Low		Varied-High		Varied-Rising	
Species	2010	2050	2010	2050	2010	2050	2010	2050	2010	2050	2010	2050
Chinook	5	5	8	8	5	8	7	7	9	9	7	9
Sockeye	5	5	8	8	5	8	5	5	9	9	5	9
Coho	5	5	8	8	5	8	5	5	9	9	5	9
Summer Chum	5	5	8	8	5	8	4	4	8	8	4	8
Fall Chum	5	5	8	8	5	8	4	4	8	8	4	8
Pink	5	5	8	8	5	8	3	3	8	8	3	8

Note: "Same" or "Varied" indicates whether the assumptions are the same for all species or vary across species. "Low," "High," and "Rising" indicate whether the assumptions are low across the projection period, high across the projection period, or rising across the projection period.

It is important to understand that we are *not* arguing that any of these sets of utilization index assumptions are "best" or "most likely" or "most realistic." As discussed above, due to both lack of historical data about utilization and our uncertainty about the factors which may affect utilization in the future, it would be impossible to predict with any certainty how utilization will change. Rather, our purpose is to illustrate the implications of different sets of assumptions about utilization.

Commercial Harvest Projection Scenarios

For each stock, we calculated 72 sets of 1,000 simulations of future commercial salmon harvests, corresponding to the 48-possible combinations of 3 sets of assumptions about future returns (Historic, Low, High), 4 sets of assumptions about future subsistence demand (Low, Int1, Int2, High), and 6 sets of assumptions about utilization indexes (Same-Low, Same-High, Same-Rising, Varied-Low, Varied-High, Varied-Rising). We refer to each of these sets of simulations as a commercial "harvest projection scenario."

In discussing our harvest projection scenarios, we begin by describing the "Historic Return-High Subsistence-Varied-Rising Utilization" scenario projections as an example. Figure 29 (on the following two pages) shows four indicators of projected harvestable surpluses and harvests for each stock for the years 2011-2050 for this scenario. Recall that the assumptions for this scenario imply that:

- Future salmon returns will be drawn from the same probability distribution as that which we estimated drove historic salmon returns ("historic return" assumption),

- Future subsistence demand will reflect a combination of assumptions leading to relatively high future subsistence demand ("high subsistence" assumption), and

- Utilization indexes will vary between species and will be rising over the period 2010-2050 ("varied-rising utilization" assumption). In particular starting (2010) and ending (2050) utilization indexes will be 7 and 9 for Chinook; 5 and 9 for sockeye and coho; 4 and 8 for chum; and 3 and 8 for pink salmon.

Each graph in the figure has four lines:

- A light line showing the projected annual surplus for simulation #1 of 1,000 simulations.
- A dark line showing the projected annual harvest for simulation #1 of 1,000 simulations.
- A light line showing the average projected surplus by decade.
- A dark line showing the average projected harvest by decade.

The differences between the light lines (surplus) and dark lines (harvest) are an indicator of utilization: the closer projected harvests are to projected surpluses, the greater utilization is.

Fig. 29. Projected Harvestable Surpluses and Commercial Harvests: Averages by Decade and Simulation #1 of 1000 (Historic Return-High Subsistence-Varied-Rising Utilization Scenario)

Note: Light lines show surpluses, heavy lines show harvests; graphs continue on next page.

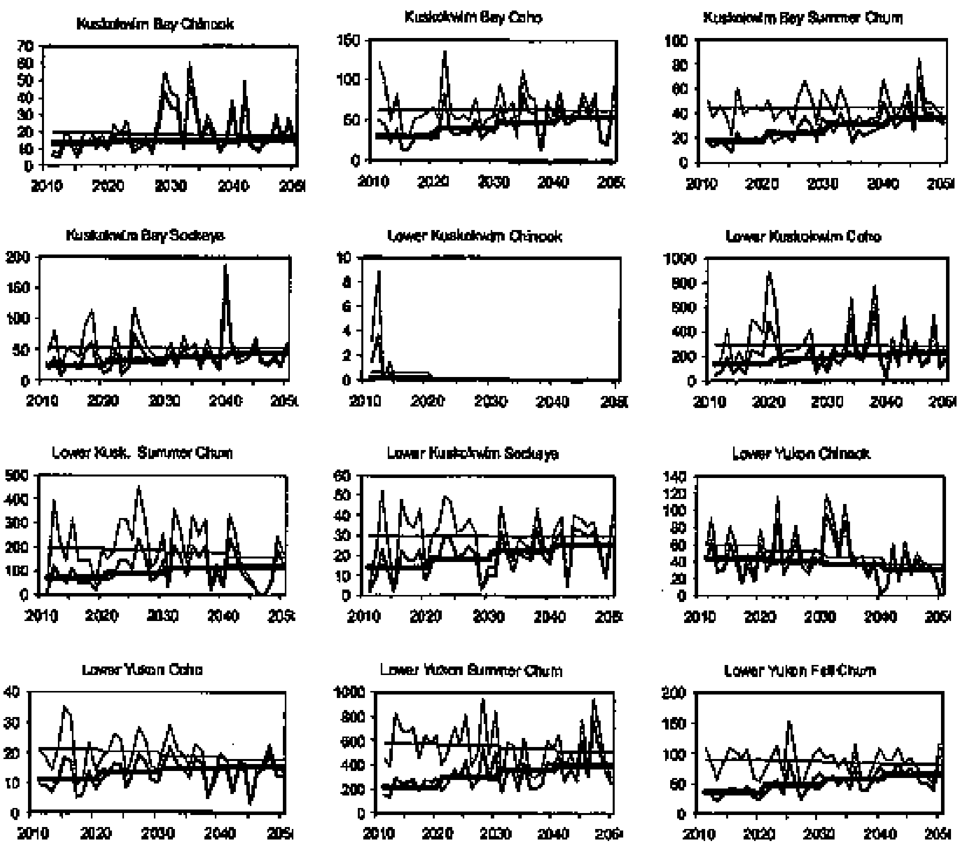
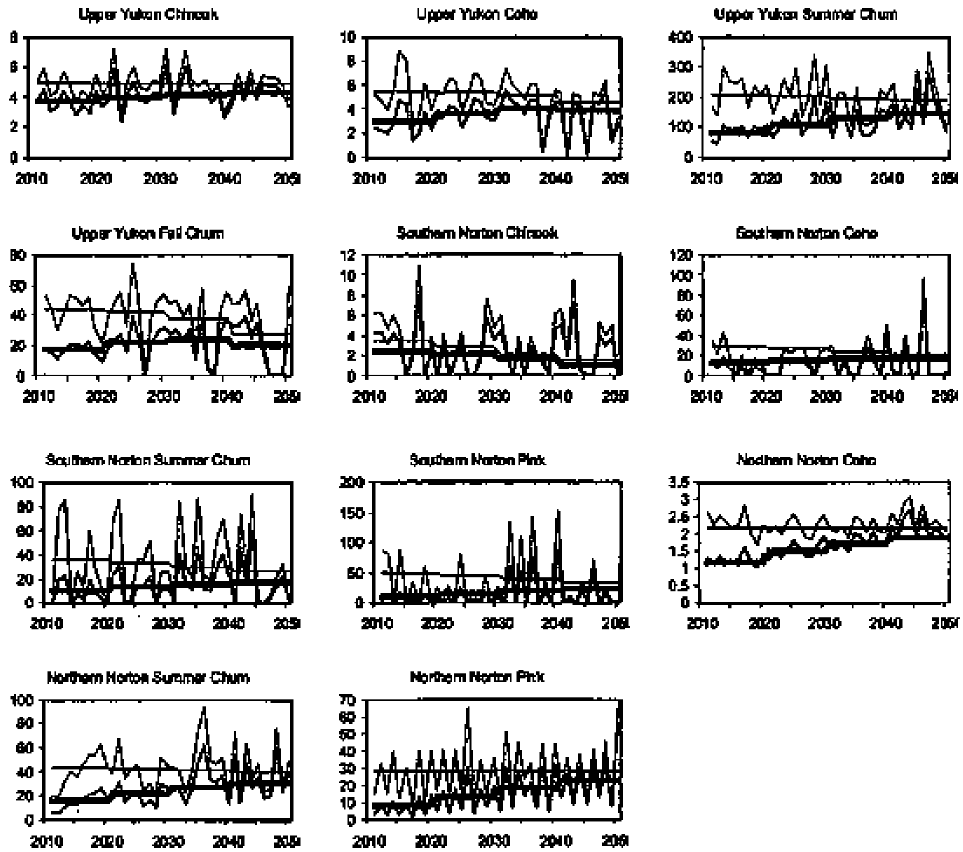


Fig. 29 (continued).



For each of the 23 stocks, future projected harvest trends reflect the effects of two trends over time: changes in subsistence demand (increases in subsistence demand result in lower harvestable surpluses) and assumed increasing utilization indexes. Whether future projected harvests increase, decrease, or stay about the same depends on the relative strength of these two trends.

We may divide the stocks into five different groups based upon the relative effects of the two different trends on trends in projected harvests (Table 19).

Table 19. Grouping of Stocks Based on Trends in Projected Surpluses and Commercial Harvests

Trend in Projected Surpluses	Assumed Increase in Utilization Index	Trend in Projected Commercial Harvests	Stocks
Relatively stable surplus reflecting relatively stable subsistence demand	Relatively small	Relatively Stable	Kuskokwim Bay Chinook Upper Yukon Chinook
	Relatively large	Increasing	Kuskokwim Bay Coho Kuskokwim Bay Summer Chum Kuskokwim Bay Sockeye Lower Kuskokwim Coho Lower Kuskokwim Sockeye Lower Yukon Summer Chum Lower Yukon Fall Chum Upper Yukon Coho Upper Yukon Summer Chum Northern Norton Coho Northern Norton Summer Chum Northern Norton Pink
Declining surplus reflecting increasing subsistence demand	Relatively small	Decreasing	Lower Kuskokwim Chinook Lower Yukon Chinook Southern Norton Chinook
	Relatively large: Utilization increases about as much as needed to offset the projected decline in harvestable surplus	Relatively Stable	Upper Yukon Fall Chum Southern Norton Coho
	Relatively large: Utilization increases sufficiently to more than offset the projected decline in harvestable surplus	Increasing	Lower Kuskokwim Summer Chum Lower Yukon Coho Southern Norton Summer Chum Southern Norton Pink

Note that this grouping reflects the specific assumptions of the "Historic Return-High Subsistence-Varied-Rising Utilization" scenario. Different scenarios would result in different sets of groupings.

Appendix B provides tables illustrating how projected harvests change for different sets of assumptions about returns, subsistence demand, and utilization. In general, the projections suggest that for most AYK stocks there are likely to be commercial harvestable surpluses, and that commercial harvests are likely to rise over time if improving economic conditions lead to higher utilization rates. However, for a few stocks, increasing subsistence demand may reduce harvestable surpluses significantly, resulting in decreasing commercial harvests.

Discussion

Our predictive model of subsistence demand provides a basis for assessing the initial research hypothesis that subsistence fishing in the AYK region will "remain the same or decline" in the future. The model's findings show a range of future outcomes depending upon future conditions of human populations, dog populations, household incomes, community cultural composition, and other factors. Under many plausible future scenarios, subsistence demand for salmon remains the same or increases in the AYK region according to the model. There are also future conditions where subsistence demand decreases, particularly if human populations decrease in the AYK region. It is safe to conclude that the initial hypothesis that predicts stable or decreasing subsistence harvests is not a sound prediction. Our model of subsistence demand portrays a range of potential outcomes in subsistence demand for salmon depending upon future conditions.

In our model, the size of the population of consumers has a major affect on local subsistence salmon harvests. Growing human populations in the villages of the AYK region will result in growing subsistence demand for salmon, provided that other aspects of the mixed economy and culture do not change radically in the area. Overall, village populations are growing in the AYK area according to Alaska Department of Labor projections. These population trends would result in increased subsistence demand for salmon according to our model. Based on our model, declining village populations would result in declining demand for salmon, but this scenario is probably less likely than others in the AYK region.

Our model suggests there may be "upriver-downriver" shifts in the location of subsistence demand for salmon because of human population trends. On the Yukon River, demand would disproportionately shift from upriver areas to lower river areas because village populations are growing at greater rates along the lower river while village populations are stable or declining in some upper river areas. Similarly, as Lower Kuskokwim and Bethel populations are increasing at greater rates than upriver areas, demand for salmon will increase more in lower river areas compared with upriver areas according to the model.

Trends in dog populations are less predictable than human populations in the AYK area. The populations of dogs significantly affect the subsistence demand for chum and coho salmon in upriver areas on the Yukon and Kuskokwim rivers. A resurgent interest in dog mushing would mean increased demand for chum and coho. But such resurgence may be unlikely. On the racing circuit, newer dog breeds and more expensive diets give outside dog teams a competitive advantage over local teams. This creates disincentives to local racers to compete. However, interest in local dog racing might increase once again. Race sponsorship and race reward monies affect participation. Increased fuel prices in villages might lead to increased use of dogs for transportation. But at the same time, dog food may also increase as an expense with low salmon runs and decreased supplies of cheap salmon. These factors make it difficult to predict trends in dog populations. Overall, the model suggests that fishing for dog food will continue as a significant component of the subsistence demand for chum and coho in upriver areas.

Trends in income (per capita) affect subsistence harvests in rural areas. Constraints on the growth in mean per capita incomes (due to underdeveloped wage sectors, low employment, and poor commercial fisheries, among other factors) tend to be associated with higher overall subsistence demand in AYK communities. At the same time, increasing costs of imported products to households (especially fuel, boat motors, and nets used for fishing) strain the capacity of households to catch and process wild foods. To deal with such potential economic conditions, some households may adopt fishing strategies that require lower monetary costs (because households may have less income to invest in fishing) and that involve strategic applications of labor (because local labor is comparatively more available). It can be expected that core households with access to income, fuel, and equipment will continue to link with households of kinsmen (in extended family networks) to share capital and labor in the production and distribution of salmon. This has been a central economic strategy for producing wild foods by family groups in the AYK area.

Roads are a potential factor affecting subsistence demand. According to the model, if roads push into the AYK region, socioeconomic changes may substantially lower salmon harvests for subsistence. Elsewhere in the state, roads have been associated with lower food costs in stores, greater mean incomes, in-migration by non-Natives, out-migration by Natives, greater competition between rural and urban fishers and hunters, and more restrictive regulations for fishing and hunting. Roads tend to be associated with lower harvests for local subsistence use.

Urban transformation is another potential future factor. If the industrial capitalism of urban areas transforms the local economics of communities in the AYK area, lower subsistence harvests are predicted by the model. But this seems unlikely, short of large-scale mineral development in the region. It is more likely that household incomes in villages will change incrementally over time, allowing for more or less purchases of imported food. The effects of these income changes are shown in the range of potential outcomes of subsistence demand.

The model of subsistence demand says nothing about other kinds of transforming events that might occur in the next several decades in the AYK region. During the previous fifty years, snowmachines and ATVs replaced sled dogs for everyday winter transportation, a technological transformation that substantially decreased local demand for chum and coho salmon. Is there another technological change in the offing? It is difficult to see any of such a magnitude. Another transforming event during the previous century was the development of commercial fisheries on AYK stocks. That event may have permanently altered the potential productivity of the AYK drainages in ways not understood. Examples of potential future transforming events might be fish hatcheries in the AYK region, or changes in fish productivity due to global warming, or an unprecedented disinterest by young people in traditional culture. Our model of subsistence demand does not account for effects of these types of potentially transforming factors.

In the commercial salmon fisheries, the fundamental constraint to future salmon harvests will be future salmon returns to the AYK region. As is clear from historical experience, returns may vary dramatically from year to year and over longer-term periods. There may be years or extended periods of very low returns, and years or extended periods of very high returns.

Potential future changes to management control rules are also not predictable. The primary management policy has been, and will likely continue to be, to ensure escapement that will provide reproductive output sufficient to provide for a desired level of future returns. However, long periods with reduced run strength (returns) for a particular salmon stock can result in more conservative management measures in an effort to boost spawning escapements. The relatively recent recognition of long-term shifts in productivity, likely driven by environmental changes, may also result in re-defined escaped goals. The goals may be reduced in acknowledgement of lower sustainable productivity for a particular stock. Although our run strength model applied the most recent accepted escapement goals on systems for which formal escapement goals have been adopted (Brannian et al. 2006; Volk et al. 2009), these goals are likely to be amended over the next four decades as additional information becomes available. Ultimately, changes to the escapement goals will affect both subsistence and commercial harvests.

Because future returns are highly uncertain, any long-term projections of future AYK commercial salmon harvests are inherently highly uncertain. Our "projections" of future returns are not predictions of actual returns, or even of the range within which actual returns will fall. Rather, they should be interpreted as illustrations or examples of the range within which returns might fall, if the distribution of future returns is similar to that of the past five decades.

Because subsistence harvests have, and will likely retain, priority over commercial harvests, growing subsistence demand could affect commercial harvestable surpluses for some stocks over time. In general, assuming that the distribution of future returns is similar to that of past returns, it appears likely that there will be at least some commercial harvestable surpluses for most stocks in most years. Assuming the distribution of future returns is similar to that of the past five decades, for the "low" subsistence demand scenario, no stocks would experience more than a 2% decline in mean harvestable commercial surpluses between 2011-20 and 2041-50. However, for the high subsistence demand scenario, harvestable surpluses could decline by more than 10% between the two periods for about half the stocks. The five stocks experiencing the greatest relative decline in harvestable surpluses (more than 30%) are Lower Kuskokwim Chinook, Southern Norton Chinook, Lower Yukon Chinook, Upper Yukon Fall Chum, and Southern Norton Pink. However, if future returns are significantly lower than past returns, harvestable commercial surpluses will be smaller, with more stocks experiencing more years with no commercially harvestable surplus.

Future AYK commercial salmon harvests will depend not only on harvestable surpluses but also the extent to which those surpluses are utilized. A wide variety of factors may affect future utilization. Among the most important of these are likely to be market trends, the development of transportation infrastructure, variability and uncertainty of harvestable surpluses, synergies between harvests of different species within the same area, fisheries management regulations, and the future evolution of the Community Development Quota program. The uncertainty associated with these factors make it impossible to predict with any certainty how utilization will change over the long term.

In general, long-term market trends may be favorable for AYK wild salmon. Following a drastic decline in the 1990s and early 2000s, market conditions have been generally improving for wild salmon over the past decade, particularly for higher-valued species (Chinook, coho, and sockeye). Major contributing factors have been strong growth in world demand for salmon, differentiation in market demand for wild salmon, and a slowdown in the growth of production of farmed salmon due to constraints of disease, feed costs, availability of sites, and the potential for technological improvements. All of these may continue over the long term, although there is clearly potential for periods of lower prices should farmed salmon production increase too rapidly. Unique characteristics of Yukon and Kuskokwim salmon could become long-term marketing advantages in niche markets. If market conditions for AYK salmon improve, this would tend to increase utilization of AYK salmon commercial harvestable surpluses over time.

More general factors contributing to a positive long-term outlook for market conditions include growing world demand for protein as populations and incomes expand, and constraints to corresponding increases in protein production including availability of water and farmland.

Because of significantly higher costs and lack of transportation infrastructure, AYK salmon will nevertheless likely remain "last in, first out" in comparison with salmon from other areas of Alaska in the event of future market downturns, particularly for lower-valued species (pink and chum). Although the long-term outlook is favorable, increases in utilization are more likely to occur gradually rather than rapidly or dramatically. Moreover, likely future increases in fuel costs could make fishing, processing, and transportation increasingly less affordable in the AYK region.

Variability and uncertainty of harvestable surpluses have been and are likely to remain important factors limiting utilization in some AYK commercial salmon fisheries. Processors are less likely to plan to buy and process salmon during a season unless they are reasonably certain there will be a harvestable surplus for them to process. There may not be investment in facilities and equipment to buy and process salmon in the future unless processors are reasonably certain there will be harvestable surpluses to buy and process in most years. Managers should recognize that how they manage commercial fisheries when runs are weak may affect the extent to which they will have a commercial fishery in years when runs are strong. The more years that there are no commercial harvestable surpluses, the fewer commercial buyers there are likely to be when runs are strong. Future AYK commercial salmon harvests will depend in part on the extent to which management policies can reduce the variability and uncertainty of harvestable surpluses.

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Appendix A. Subsistence Demand Scenario Details

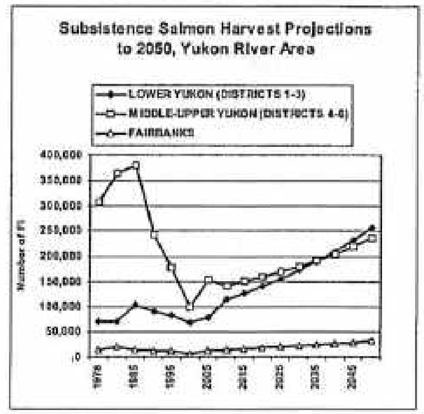
Fig. A1. Subsistence Demand Scenario, Yukon River Area (High)

Subsistence Salmon Demand Model

High Scenario: Yukon River Area (Lower Yukon, Middle-Upper Yukon, Fairbanks)

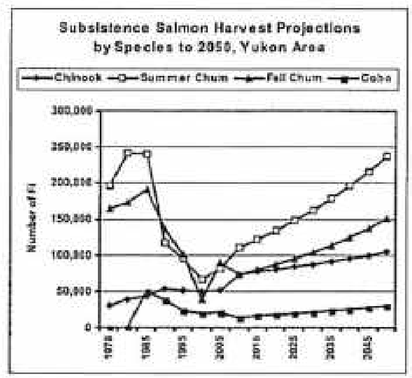
Subsistence Salmon Demand (All Species and Uses)

	L Yukon	M-U Yukon	Fairbanks	Total
2010	115,188	141,416	14,326	270,930
2015	127,997	150,827	15,922	294,746
2020	141,864	160,257	17,608	319,729
2025	156,504	169,691	19,438	345,633
2030	172,760	179,824	21,432	374,016
2035	190,706	191,415	23,645	405,765
2040	210,517	204,638	26,100	441,256
2045	232,389	219,688	28,826	480,903
2050	256,534	236,783	31,854	525,171



Subsistence Salmon Demand by Species

	Chinook	S Chum	Fall Chum	Coho	Total
2010	72,684	110,243	73,513	14,489	270,930
2015	76,730	121,729	80,322	15,965	294,746
2020	80,436	134,128	87,627	17,538	319,729
2025	83,675	147,281	95,457	19,220	345,633
2030	86,968	161,866	104,113	21,069	374,016
2035	90,700	178,076	113,861	23,129	405,765
2040	94,914	196,089	124,830	25,423	441,256
2045	99,657	216,104	137,165	27,977	480,903
2050	104,981	238,338	151,029	30,822	525,171



Subsistence Salmon Demand for Human or Dog Food*

	L Yukon Human Food	L Yukon Dog Food	M-U Yukon Human Food	M-U Yukon Dog Food
2010	109,052	6,143	66,353	75,110
2015	121,219	6,786	67,445	83,436
2020	134,391	7,482	67,643	92,673
2025	148,296	8,218	66,820	102,937
2030	163,738	9,032	65,477	114,419
2035	180,790	9,928	64,161	127,335
2040	199,616	10,914	62,872	141,857
2045	220,403	12,000	61,608	158,181
2050	243,355	13,195	60,370	176,526

** Urban Fairbanks not shown.*

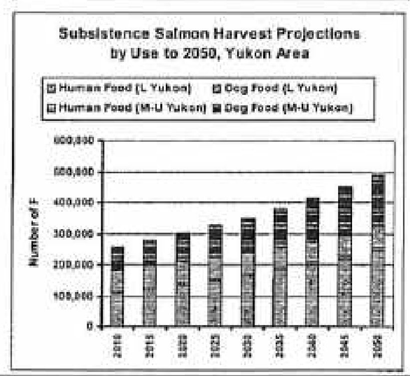


Fig. A2. Subsistence Demand Scenario, Yukon River Area (Intermediate Two)

Subsistence Salmon Demand Model

Intermediate Two Scenario: Yukon River Area (Lower Yukon, Middle-Upper Yukon, Fairbanks)

Subsistence Salmon Demand (All Species and Uses)

	L Yukon	M-U Yukon	Fairbanks	Total
2010	110,338	133,237	13,309	256,884
2015	118,557	133,812	13,773	266,142
2020	127,812	133,963	14,205	275,981
2025	137,513	133,400	14,628	285,541
2030	148,394	132,649	15,043	296,086
2035	160,116	132,072	15,463	307,651
2040	172,741	131,666	15,887	320,294
2045	186,334	131,430	16,314	334,078
2050	200,967	131,361	16,743	349,071

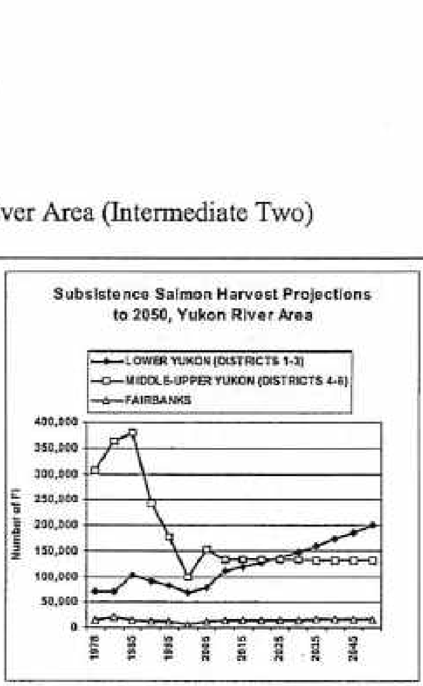
Subsistence Salmon Demand by Species

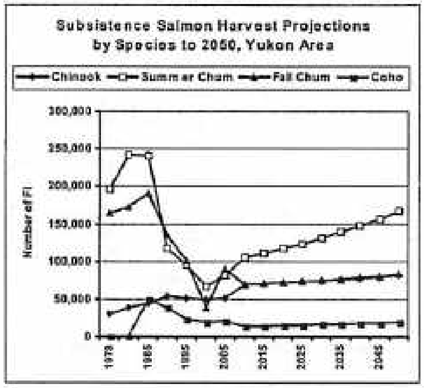
	Chinook	S Chum	Fall Chum	Coho
2010	69,413	104,817	69,011	13,643
2015	70,770	110,616	70,563	14,193
2020	72,076	117,034	72,104	14,766
2025	73,035	123,647	73,519	15,339
2030	74,125	131,008	74,999	15,955
2035	75,477	138,950	76,613	16,612
2040	77,103	147,513	78,365	17,313
2045	79,017	156,741	80,260	18,060
2050	81,232	166,678	82,305	18,856

Subsistence Salmon Demand for Human or Dog Food*

	L Yukon Human Food	L Yukon Dog Food	M-U Yukon Human Food	M-U Yukon Dog Food
2010	104,461	5,885	63,358	69,924
2015	112,316	6,248	62,191	71,666
2020	121,166	6,653	60,589	73,421
2025	130,445	7,076	58,286	75,161
2030	140,857	7,546	55,757	76,941
2035	152,076	8,050	53,324	78,798
2040	164,162	8,590	50,985	80,733
2045	177,178	9,167	48,736	82,746
2050	191,193	9,786	46,574	84,841

* *Urban Fairbanks not shown.*





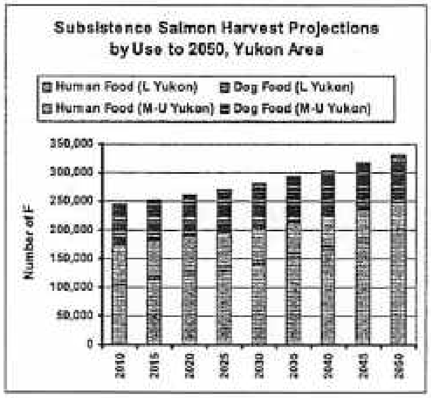


Fig. A3. Subsistence Demand Scenario, Yukon River Area (Intermediate One)

Subsistence Salmon Demand Model
Intermediate One Scenario: Yukon River Area
(Lower Yukon, Middle-Upper Yukon, Fairbanks)

Subsistence Salmon Demand (All Species and Uses)

	L Yukon	M-U Yukon	Fairbanks	Total
2010	107,149	129,373	12,807	249,329
2015	113,392	126,277	12,806	252,475
2020	120,369	122,765	12,751	255,885
2025	127,482	118,583	12,666	258,731
2030	135,382	114,249	12,549	262,180
2035	143,704	110,099	12,412	266,215
2040	152,462	106,126	12,250	270,839
2045	161,665	102,321	12,063	276,049
2050	171,323	98,676	11,846	281,844

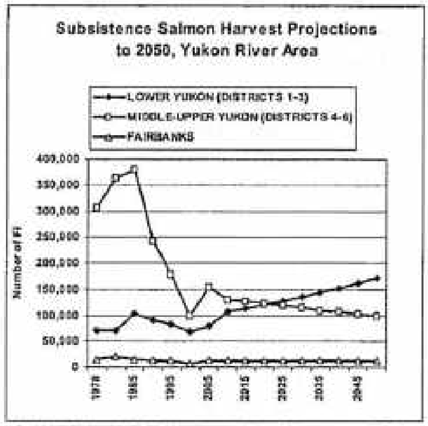
Subsistence Salmon Demand by Species

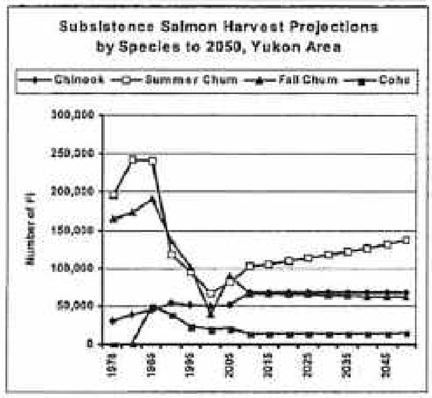
	Chinook	S Chum	Fall Chum	Coho
2010	67,631	101,660	66,828	13,211
2015	67,799	105,065	66,233	13,378
2020	67,866	108,882	65,589	13,548
2025	67,559	112,690	64,784	13,699
2030	67,328	116,982	64,002	13,868
2035	67,284	121,574	63,304	14,053
2040	67,423	126,474	62,689	14,253
2045	67,740	131,685	62,156	14,468
2050	68,231	137,213	61,704	14,697

Subsistence Salmon Demand for Human or Dog Food*

	L Yukon Human Food	L Yukon Dog Food	M-U Yukon Human Food	M-U Yukon Dog Food
2010	101,315	5,842	61,960	67,456
2015	107,239	6,161	59,810	66,509
2020	113,855	6,521	57,278	65,529
2025	120,593	6,898	54,137	64,487
2030	128,069	7,322	50,855	63,434
2035	135,936	7,778	47,732	62,407
2040	144,204	8,268	44,762	61,403
2045	152,880	8,796	41,937	60,423
2050	161,970	9,364	39,249	59,465

** Urban Fairbanks not shown.*





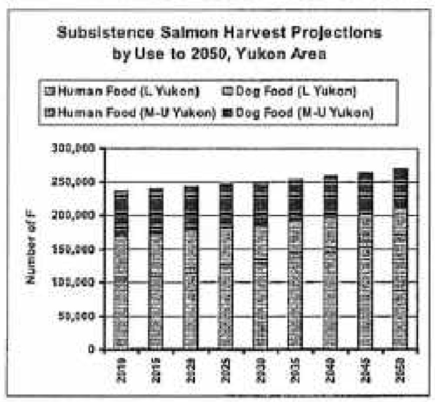


Fig. A4. Subsistence Demand Scenario, Yukon River Area (Low)

Subsistence Salmon Demand Model

Low Scenario: Yukon River Area

(Lower Yukon, Middle-Upper Yukon, Fairbanks)

Subsistence Salmon Demand (All Species and Uses)

	L Yukon	M-U Yukon	Fairbanks	Total
2010	102,881	126,408	12,587	241,876
2015	105,058	120,072	12,245	237,374
2020	107,756	113,693	11,865	233,314
2025	110,718	107,243	11,482	229,444
2030	114,406	101,062	11,091	226,560
2035	118,037	95,228	10,685	223,949
2040	121,572	89,718	10,260	221,550
2045	124,971	84,514	9,815	219,299
2050	128,181	79,595	9,347	217,123

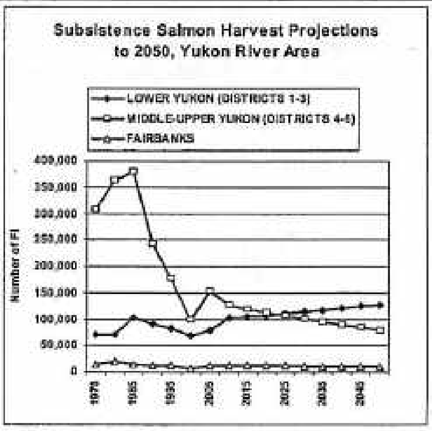
Subsistence Salmon Demand by Species

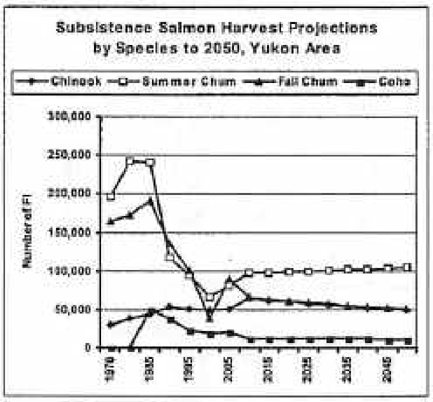
	Chinook	S Chum	Fall Chum	Coho
2010	64,734	98,487	65,757	12,898
2015	62,527	98,565	63,591	12,692
2020	60,364	98,983	61,473	12,494
2025	58,191	99,569	59,377	12,307
2030	56,307	100,672	57,426	12,154
2035	54,565	101,798	55,581	12,004
2040	52,944	102,921	53,833	11,853
2045	51,418	104,007	52,174	11,700
2050	49,965	105,024	50,595	11,539

Subsistence Salmon Demand for Human or Dog Food*

	L Yukon Human Food	L Yukon Dog Food	M-U Yukon Human Food	M-U Yukon Dog Food
2010	97,202	5,686	59,225	67,226
2015	99,243	5,822	55,041	65,072
2020	101,770	5,994	50,777	62,956
2025	104,536	6,190	46,410	60,872
2030	107,977	6,437	42,245	58,854
2035	111,346	6,699	38,354	56,910
2040	114,604	6,976	34,717	55,036
2045	117,708	7,271	31,318	53,230
2050	120,606	7,584	28,139	51,488

* *Urban Fairbanks not shown.*





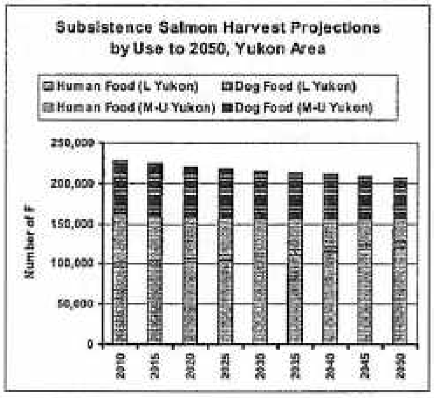


Fig. A5. Subsistence Demand Scenario, Kuskokwim Area (High)

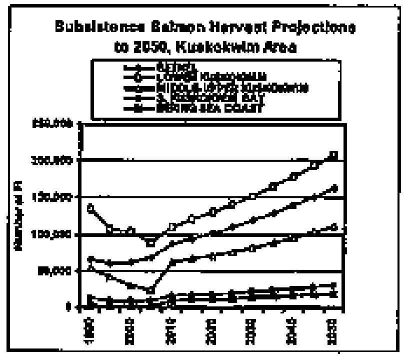
Subsistence Salmon Demand Model

High Scenario: Kuskokwim Area

(Bethel, Lower Kuskokwim, Middle-Upper Kuskokwim, South Kuskokwim Bay, Bering Sea Coast)

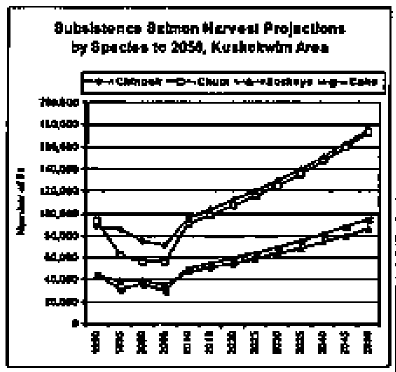
Subsistence Salmon Demand (All Species and Uses)

	Bethel	L Kusk	Mid-U Kusk	S Kusk B	Bering SC	Total
2010	86,844	110,580	61,529	16,204	10,057	285,213
2015	94,613	120,420	66,576	17,628	10,923	310,062
2020	102,334	130,471	71,691	19,079	11,803	335,378
2025	110,350	140,795	76,865	20,561	12,700	361,302
2030	119,298	152,316	82,651	22,215	13,702	390,180
2035	128,978	164,792	88,949	24,003	14,783	421,503
2040	139,460	178,308	95,840	25,935	15,950	455,480
2045	150,784	192,944	103,351	28,024	17,209	492,341
2050	163,050	208,802	111,631	30,282	18,568	532,333



Subsistence Salmon Demand by Species

	Chinook	Chum	Sockeye	Coho
2010	86,780	80,702	47,216	50,713
2015	103,981	96,806	51,242	56,166
2020	112,263	107,152	55,306	59,724
2025	120,668	116,797	59,424	64,412
2030	130,024	125,437	64,006	69,836
2035	140,132	135,840	68,981	75,314
2040	151,054	147,386	74,313	81,487
2045	162,852	159,861	80,065	88,189
2050	175,597	173,462	86,342	95,498



Subsistence Salmon Demand for Human or Dog Food

	L Kusk-Bet Human Food	L Kusk-Bet Dog Food	M-U Kusk Human Food	M-U Kusk Dog Food	SK Bay-Cst Human Food	SK Bay-Cst Dog Food
2010	167,641	10,819	52,218	10,107	26,507	984
2015	204,084	11,999	56,153	11,311	27,743	1,056
2020	220,763	13,317	60,024	12,661	30,012	1,143
2025	237,776	14,787	63,833	14,174	32,326	1,234
2030	256,747	16,440	66,024	15,873	34,907	1,337
2035	277,233	18,287	72,567	17,777	37,894	1,450
2040	299,364	20,351	77,491	19,912	40,704	1,574
2045	323,239	22,659	82,826	22,305	43,963	1,711
2050	349,031	25,239	88,603	24,988	47,483	1,862

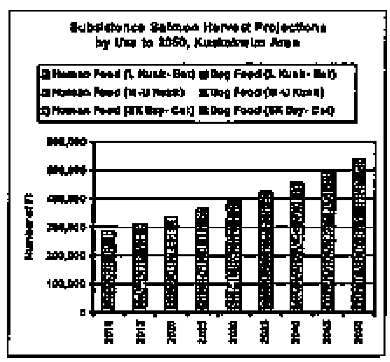


Fig. A6. Subsistence Demand Scenario, Kuskokwim Area (Intermediate Two)

Subsistence Salmon Demand Model

Intermediate Two Scenario: Kuskokwim Area
(Bethel, Lower Kuskokwim, Middle-Upper Kuskokwim, South Kuskokwim Bay, Bering Sea Coast)

Subsistence Salmon Demand (All Species and Uses)

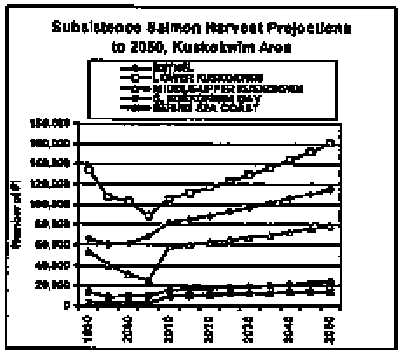
	Bethel	L Kusk	Mid-U Kusk	S Kusk B	Bering SC	Total
2010	81,796	105,563	58,006	15,923	9,650	270,538
2015	85,354	111,019	60,227	16,339	10,151	283,090
2020	89,084	116,825	62,529	17,207	10,684	296,329
2025	92,791	122,742	64,777	18,092	11,226	309,628
2030	97,068	129,580	67,361	19,114	11,853	324,953
2035	101,480	136,743	70,102	20,191	12,512	341,028
2040	106,032	144,310	73,005	21,327	13,207	357,880
2045	110,717	152,278	76,077	22,523	13,938	375,533
2050	115,530	160,689	79,325	23,764	14,706	394,014

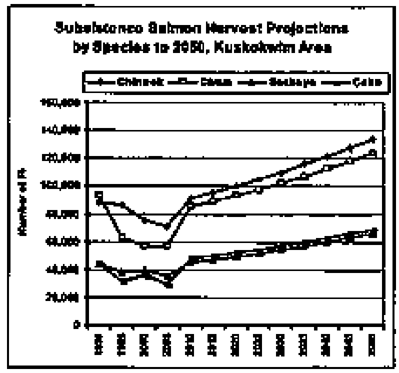
Subsistence Salmon Demand by Species

	Chinook	Chum	Sockeye	Coho
2010	91,334	85,611	46,041	47,887
2015	96,679	89,406	47,178	50,029
2020	100,267	93,511	49,433	52,262
2025	104,675	97,648	51,897	54,539
2030	110,204	102,386	54,316	57,133
2035	115,794	107,362	57,058	59,849
2040	121,654	112,583	59,950	62,690
2045	127,791	118,056	62,973	65,661
2050	134,216	123,795	66,139	68,763

Subsistence Salmon Demand for Human or Dog Food

	L Kusk-Bet Human Food	L Kusk-Bet Dog Food	M-U Kusk Human Food	M-U Kusk Dog Food	SK Bay-Cst Human Food	SK Bay-Cst Dog Food
2010	178,714	9,660	49,960	8,743	24,457	927
2015	187,442	9,678	51,922	9,013	25,744	964
2020	196,679	10,208	53,987	9,281	27,116	1,003
2025	205,996	10,546	56,961	9,578	28,611	1,043
2030	216,763	10,907	58,260	9,876	30,124	1,087
2035	228,023	11,280	60,716	10,183	31,624	1,134
2040	239,782	11,668	63,320	10,500	33,615	1,183
2045	252,083	12,069	66,100	10,827	35,602	1,234
2050	264,910	12,484	69,037	11,164	37,469	1,288





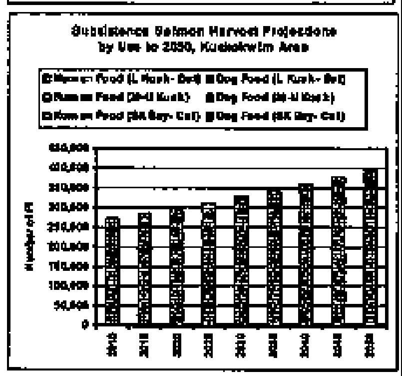


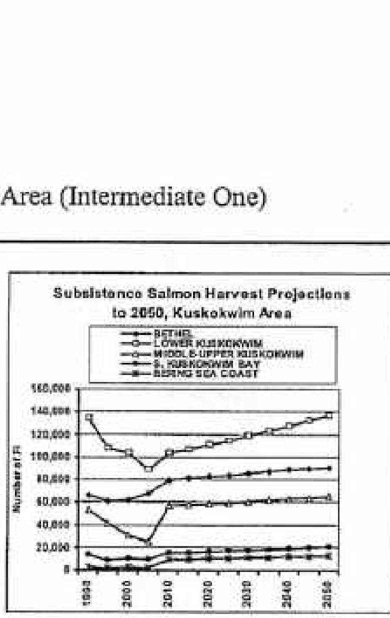
Fig. A7. Subsistence Demand Scenario, Kuskokwim Area (Intermediate One)

Subsistence Salmon Demand Model

Intermediate One Scenario: Kuskokwim Area
(Bethel, Lower Kuskokwim, Middle-Upper Kuskokwim, South Kuskokwim Bay, Bering Sea Coast)

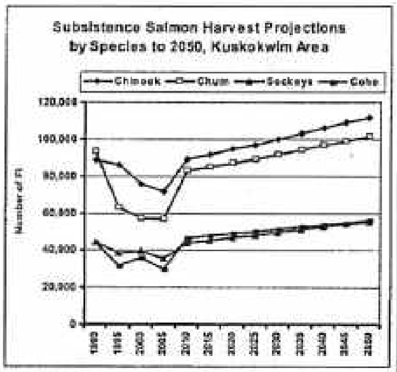
Subsistence Salmon Demand (All Species and Uses)

	Bethel	L Kusk	Mid-U Kusk	S Kusk B	Bering SC	Total
2010	79,245	103,253	56,375	15,213	9,462	263,548
2015	80,873	106,827	57,375	15,769	9,805	270,649
2020	82,465	110,575	58,382	16,351	10,164	277,936
2025	83,820	114,255	59,266	16,924	10,514	284,778
2030	85,448	118,591	60,383	17,596	10,926	292,945
2035	86,926	123,055	61,556	18,289	11,349	301,175
2040	88,222	127,643	62,780	19,002	11,781	309,428
2045	89,300	132,351	64,050	19,735	12,223	317,659
2050	90,122	137,175	65,360	20,486	12,674	325,816



Subsistence Salmon Demand by Species

	Chinook	Chum	Sockeye	Coho
2010	89,206	83,059	44,004	46,532
2015	91,833	85,105	45,300	47,643
2020	94,522	87,221	46,629	48,776
2025	97,049	89,222	47,878	49,822
2030	100,042	91,632	49,359	51,081
2035	103,046	94,084	50,849	52,340
2040	106,051	96,569	52,342	53,589
2045	109,034	99,076	53,830	54,820
2050	111,977	101,593	55,303	56,022



Subsistence Salmon Demand for Human or Dog Food

	L Kusk-Bet Human Food	L Kusk-Bet Dog Food	M-U Kusk Human Food	M-U Kusk Dog Food	SK Bay-Cst Human Food	SK Bay-Cst Dog Food
2010	174,391	8,967	48,912	8,099	23,977	900
2015	179,645	8,909	50,038	7,962	24,858	920
2020	185,030	8,859	51,168	7,829	25,779	942
2025	190,106	8,813	52,171	7,699	26,683	965
2030	196,097	8,784	53,403	7,575	27,744	992
2035	202,056	8,764	54,686	7,455	28,835	1,021
2040	207,951	8,752	56,017	7,339	29,953	1,052
2045	213,741	8,748	57,390	7,228	31,099	1,084
2050	219,383	8,753	58,799	7,120	32,271	1,119

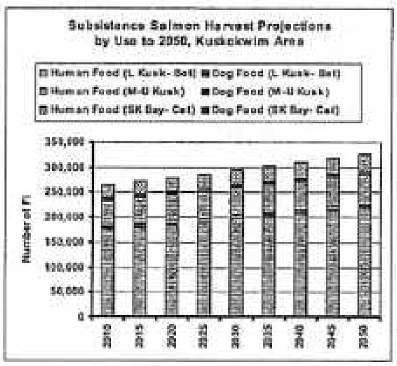


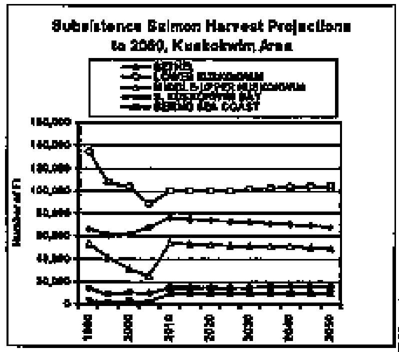
Fig. A8. Subsistence Demand Scenario, Kuskokwim Area (Low)

Subsistence Salmon Demand Model

Low Scenario: Kuskokwim Area
(Bethel, Lower Kuskokwim, Middle-Upper Kuskokwim, South Kuskokwim Bay, Bering Sea Coast)

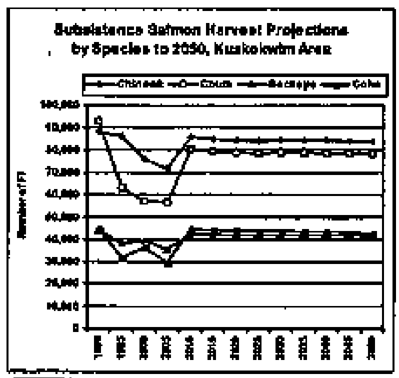
Subsistence Salmon Demand (All Species and Uses)

	Bethel	L Kusk	Mid-U Kusk	S Kusk B	Bering SC	Total
2010	76,180	99,362	54,319	14,632	9,094	253,607
2015	75,097	99,369	53,457	14,655	9,105	251,713
2020	74,047	99,559	52,656	14,703	9,130	250,094
2025	73,065	99,863	51,909	14,788	9,174	248,897
2030	72,496	101,106	51,487	14,983	9,268	249,337
2035	71,689	102,140	50,980	15,164	9,385	249,367
2040	70,619	103,043	50,463	15,326	9,470	248,921
2045	69,257	103,794	49,871	15,457	9,537	247,926
2050	67,569	104,387	49,197	15,562	9,585	246,300



Subsistence Salmon Demand by Species

	Chinook	Chum	Sockeye	Coho
2010	86,626	80,199	42,236	44,837
2015	86,082	79,674	41,957	44,409
2020	84,599	79,053	41,724	44,022
2025	84,284	78,888	41,583	43,702
2030	84,617	78,774	41,690	43,653
2035	84,612	78,784	41,740	43,529
2040	84,524	78,675	41,704	43,319
2045	84,226	78,428	41,698	43,010
2050	83,690	78,021	41,314	42,586



Subsistence Salmon Demand for Human or Dog Food

	L Kusk-Bet Human Food	L Kusk-Bet Dog Food	M-U Kusk Human Food	M-U Kusk Dog Food	SK Bay-Cst Human Food	SK Bay-Cst Dog Food
2010	167,464	8,987	46,855	8,099	23,028	900
2015	166,494	8,839	46,199	7,886	23,046	917
2020	165,719	8,723	45,578	7,681	23,101	936
2025	166,239	8,613	45,013	7,483	23,212	956
2030	165,892	8,625	44,745	7,294	23,498	980
2035	166,189	8,446	44,435	7,113	23,766	1,007
2040	166,083	8,382	44,069	6,939	23,877	1,035
2045	165,521	8,328	43,631	6,772	24,158	1,065
2050	164,448	8,284	43,104	6,612	24,293	1,098

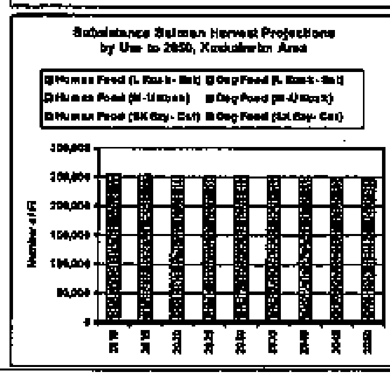


Fig. A9. Subsistence Demand Scenario, Norton Sound Area (High)

Subsistence Salmon Demand Model
High Scenario: Norton Sound Area
(South Norton Sound, Nome,
North Norton Sound-Port Clarence)

Subsistence Salmon Demand (All Species and Uses)

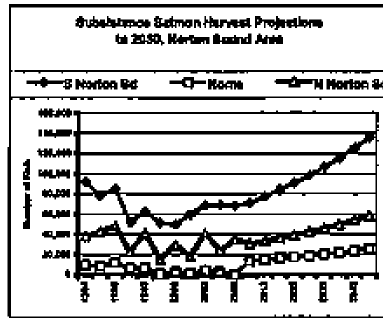
	S Norton Sd	Nome	N Norton Sd	Total
2010	70,838	13,453	30,543	114,831
2015	77,501	14,711	33,407	125,619
2020	83,958	15,929	36,169	136,105
2025	90,596	17,167	39,016	146,779
2030	98,280	18,608	42,309	159,196
2035	106,619	20,170	45,877	172,666
2040	115,669	21,863	49,746	187,280
2045	125,491	23,698	53,947	203,136
2050	136,151	25,687	58,500	220,338

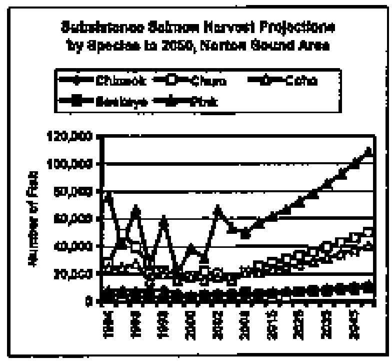
Subsistence Salmon Demand by Species

	Chinook	Chum	Coho	Sockeye	Pink
2010	5,967	25,883	20,940	5,256	56,787
2015	6,524	28,333	22,909	5,746	62,108
2020	7,065	30,727	24,825	6,222	67,266
2025	7,614	33,174	26,776	6,705	72,510
2030	8,253	36,015	29,045	7,266	78,614
2035	8,946	39,102	31,507	7,878	85,233
2040	9,697	42,466	34,179	8,539	92,409
2045	10,511	46,099	37,078	9,256	100,191
2050	11,393	50,059	40,226	10,093	108,628

Subsistence Salmon Demand for Human or Dog Food

	S Norton Sd Human Food	S Norton Sd Dog Food	Nome Human Food	Nome Dog Food	N Norton Sd Human Food	N Norton Sd Dog Food
2010	69,360	1,493	13,453	0	30,242	352
2015	75,836	1,675	14,711	0	33,070	386
2020	82,118	1,880	15,929	0	35,610	443
2025	88,498	2,109	17,167	0	38,692	497
2030	95,928	2,366	18,608	0	41,632	556
2035	103,976	2,655	20,170	0	45,343	626
2040	112,705	2,979	21,863	0	49,149	703
2045	122,165	3,342	23,698	0	53,274	788
2050	132,420	3,750	25,687	0	57,746	884





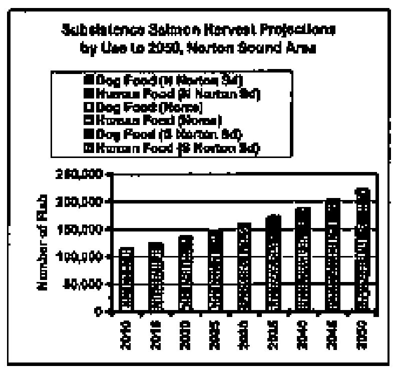


Fig. A10. Subsistence Demand Scenario, Norton Sound Area (Intermediate Two)

Subsistence Salmon Demand Model

Intermediate Two Scenario: Norton Sound Area (South Norton Sound, Nome, North Norton Sound-Port Clarence)

Subsistence Salmon Demand (All Species and Uses)

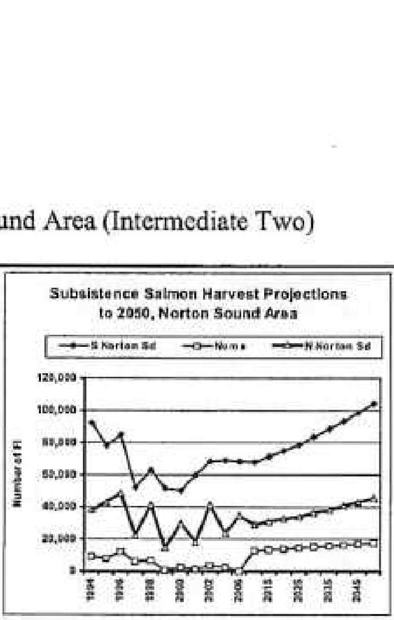
	S Norton Sd	Nome	N Norton Sd	Total
2010	67,649	12,622	29,219	109,490
2015	71,424	13,202	30,881	115,508
2020	75,125	13,748	32,514	121,387
2025	78,849	14,278	34,160	127,287
2030	83,418	14,940	36,180	134,538
2035	88,235	15,620	38,312	142,167
2040	93,309	16,315	40,563	150,188
2045	98,655	17,025	42,938	158,618
2050	104,282	17,747	45,444	167,473

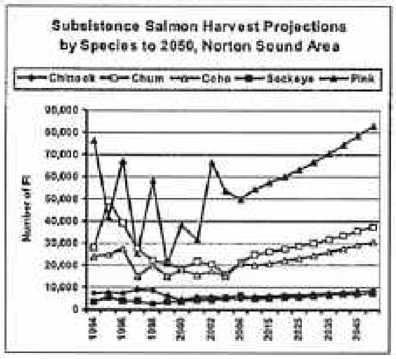
Subsistence Salmon Demand by Species

	Chinook	Chum	Coho	Sockeye	Pink
2010	5,701	24,648	19,965	4,995	54,181
2015	6,022	25,980	21,061	5,261	57,184
2020	6,336	27,281	22,132	5,519	60,118
2025	6,652	28,586	23,208	5,777	63,065
2030	7,040	30,186	24,528	6,095	66,688
2035	7,450	31,868	25,918	6,429	70,502
2040	7,882	33,635	27,379	6,778	74,514
2045	8,336	35,491	28,915	7,143	78,734
2050	8,815	37,437	30,528	7,524	83,169

Subsistence Salmon Demand for Human or Dog Food

	S Norton Sd Human Food	S Norton Sd Dog Food	Nome Human Food	Nome Dog Food	N Norton Sd Human Food	N Norton Sd Dog Food
2010	66,271	1,384	12,622	0	28,941	327
2015	70,005	1,426	13,202	0	30,594	336
2020	73,663	1,469	13,748	0	32,218	347
2025	77,343	1,514	14,278	0	33,855	357
2030	81,867	1,559	14,940	0	35,866	368
2035	86,636	1,606	15,620	0	37,989	379
2040	91,663	1,655	16,315	0	40,230	390
2045	96,958	1,705	17,025	0	42,595	402
2050	102,534	1,756	17,747	0	45,090	414





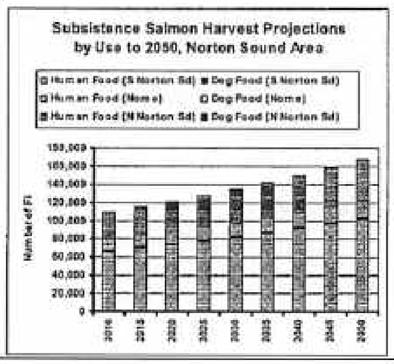


Fig. A11. Subsistence Demand Scenario, Norton Sound Area (Intermediate One)

Subsistence Salmon Demand Model

Intermediate One Scenario: Norton Sound Area
(South Norton Sound, Nome,
North Norton Sound-Port Clarence)

Subsistence Salmon Demand (All Species and Uses)

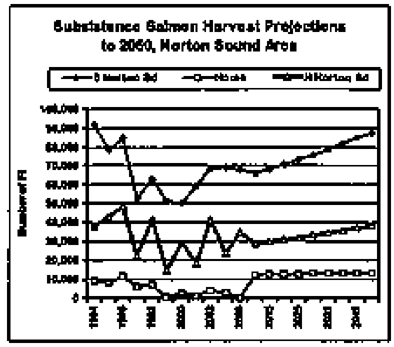
	S Norton Sd	Nome	N Norton Sd	Total
2010	66,128	12,181	28,569	106,916
2015	68,615	12,444	29,734	110,793
2020	70,902	12,626	30,788	114,316
2025	73,081	12,753	31,800	117,634
2030	75,894	12,951	33,099	121,944
2035	78,762	13,109	34,430	126,301
2040	81,677	13,219	35,792	130,688
2045	84,630	13,273	37,162	135,065
2050	87,611	13,262	38,597	139,470

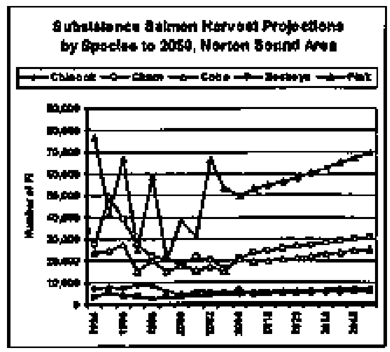
Subsistence Salmon Demand by Species

	Chinook	Chum	Coho	Sockeye	Pink
2010	5,574	24,060	19,495	4,887	52,929
2015	5,790	24,876	20,199	5,031	54,896
2020	5,988	25,623	20,639	5,176	56,690
2025	6,177	26,323	21,442	5,309	58,383
2030	6,420	27,236	22,225	5,484	60,577
2035	6,668	28,160	23,017	5,658	62,798
2040	6,919	29,086	23,815	5,828	65,039
2045	7,174	30,011	24,615	5,995	67,281
2050	7,431	30,930	25,413	6,155	69,542

Subsistence Salmon Demand for Human or Dog Food

	S Norton Sd Human Food	S Norton Sd Dog Food	Nome Human Food	Nome Dog Food	N Norton Sd Human Food	N Norton Sd Dog Food
2010	64,803	1,330	12,191	0	28,331	314
2015	67,318	1,304	12,444	0	29,472	307
2020	69,631	1,277	12,626	0	30,631	301
2025	71,835	1,252	12,763	0	31,646	295
2030	74,874	1,227	12,951	0	32,862	289
2035	77,566	1,202	13,109	0	34,166	284
2040	80,506	1,178	13,219	0	35,555	278
2045	83,461	1,155	13,273	0	36,890	272
2050	86,485	1,132	13,262	0	38,389	267





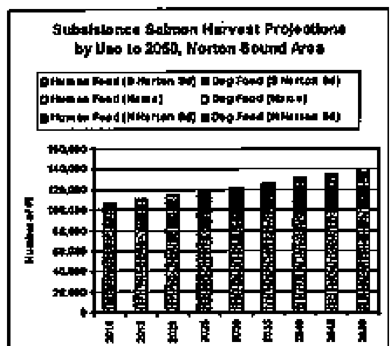


Fig. A12. Subsistence Demand Scenario, Norton Sound Area (Low)

Subsistence Salmon Demand Model

Low Scenario: Norton Sound Area (South Norton Sound, Nome, North Norton Sound-Port Clarence)

Subsistence Salmon Demand (All Species and Uses)

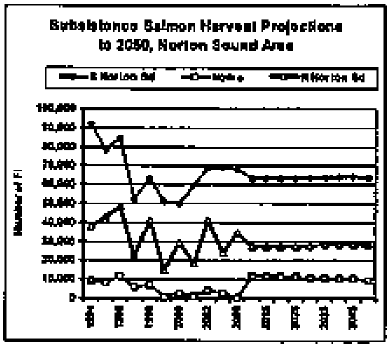
	S Norton Sd	Nome	N Norton Sd	Total
2010	63,330	11,672	27,419	102,421
2015	63,328	11,476	27,489	102,293
2020	63,118	11,226	27,476	101,819
2025	62,876	10,970	27,601	101,445
2030	63,460	10,801	27,814	102,076
2035	63,800	10,578	28,077	102,455
2040	63,970	10,295	28,280	102,844
2045	63,944	9,943	28,413	102,300
2050	63,682	9,516	28,466	101,674

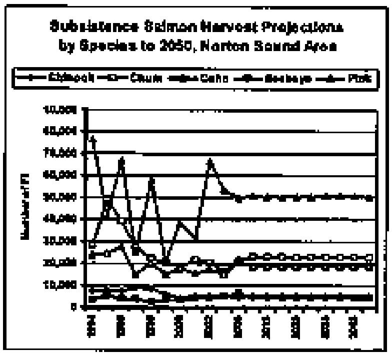
Subsistence Salmon Demand by Species

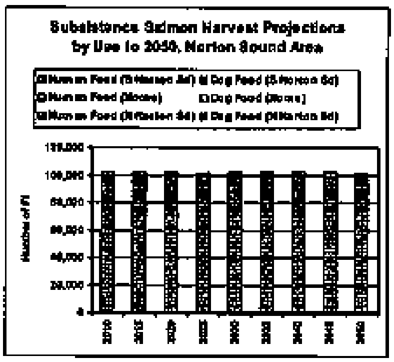
	Chinook	Chum	Coho	Sockeye	Pink
2010	5,335	23,064	18,677	4,862	50,683
2015	5,337	23,012	18,652	4,844	50,646
2020	5,322	22,863	18,565	4,609	50,441
2025	5,312	22,776	18,495	4,577	50,285
2030	5,358	22,866	18,609	4,590	50,635
2035	5,388	22,941	18,676	4,590	50,881
2040	5,405	22,930	18,690	4,576	50,944
2045	5,405	22,844	18,643	4,542	50,864
2050	5,386	22,673	18,528	4,480	50,587

Subsistence Salmon Demand for Human or Dog Food

	S Norton Sd Human Food	S Norton Sd Dog Food	Nome Human Food	Nome Dog Food	N Norton Sd Human Food	N Norton Sd Dog Food
2010	62,007	1,330	11,672	0	27,151	314
2015	62,030	1,304	11,476	0	27,227	307
2020	61,847	1,277	11,226	0	27,219	301
2025	61,729	1,262	10,970	0	27,249	295
2030	62,240	1,227	10,801	0	27,567	289
2035	62,603	1,202	10,578	0	27,635	284
2040	62,787	1,178	10,285	0	28,043	276
2045	62,795	1,155	9,843	0	28,161	272
2050	62,568	1,132	9,516	0	28,239	267







Appendix B:
Comparison of Projections of Mean Commercial Harvests and Mean Utilization for Selected Combinations of Scenario Assumptions and Time Periods

The tables in this appendix provide summary comparisons of projections of mean harvests and mean utilization for the following combinations of scenario assumptions and time periods:

Table B-1. Overview of Appendix B Tables

Tables	Assumptions about probability distribution of future returns	Assumptions about future subsistence demand	Utilization assumptions	Time periods
B-2, B-3	Historic, Low, High	Low, Int1, Int2, High	Varied-Rising	2011-2050
B-4, B-5	Historic	Low, High	Varied-Rising	2011-20 2021-30 2031-40 2041-50
B-6, B-7	Historic	High	Same-Low Same-High Same-Rising Varied-Low Varied-High Varied-Rising	2011-20 2041-50
B-8, B-14	Historic	Low	"	2011-2050
B-9, B-15	Historic	High	"	"
B-10, B-16	Low	Low	"	"
B-11, B-17	Low	High	"	"
B-12, B-18	High	Low	"	"
B-13, B-19	High	High	"	"

Table B-2. Mean Projected Commercial Harvest, 2011-2050, with "Varied-Rising" Utilization (000 fish)

Area	Species	Historic return Subsistence demand: Low	Int 1	Int 2	High	High return Subsistence demand: Low	Int 1	Int 2	High	Low return Subsistence demand: Low	Int 1	Int 2	High
Kuskokwim Bay	Chinook	15.0	14.9	14.7	14.5	16.6	15.8	15.3	14.2	11.3	10.4	9.8	8.8
	Coho	42.4	42.5	42.4	42.5	48.2	48.6	48.6	48.6	45.6	44.9	44.9	43.9
	Summer Chum	26.9	26.9	26.9	26.9	27.9	27.9	27.9	27.9	27.9	28.0	28.0	28.0
	Sockeye	35.2	35.2	35.1	35.3	40.0	40.2	40.1	40.2	39.3	39.2	39.1	39.4
Lower Kuskokwim	Chinook	3.4	0.7	0.3	0.1	3.9	1.0	0.4	0.1	3.7	0.8	0.3	0.1
	Coho	199.5	197.5	196.0	189.7	231.3	232.2	233.2	231.6	125.3	121.7	118.6	110.5
	Summer Chum	118.1	114.5	110.8	97.4	138.3	138.1	137.7	133.7	133.1	128.1	121.6	106.8
	Sockeye	20.1	20.1	20.2	20.1	25.2	25.2	25.3	25.2	11.1	11.3	11.2	11.2
Lower Yukon	Chinook	63.4	55.3	49.2	38.0	70.9	66.7	62.4	52.3	58.8	49.5	43.3	31.7
	Coho	15.4	14.9	14.5	13.7	16.3	16.1	15.8	15.1	16.3	16.0	15.7	14.9
	Summer Chum	344.0	336.5	332.2	320.7	357.0	354.2	350.1	342.6	356.2	356.3	353.4	349.0
	Fall Chum	54.5	53.3	52.5	50.8	60.6	59.6	58.9	57.2	54.1	52.9	52.3	50.7
Upper Yukon	Chinook	4.1	4.1	4.1	4.1	4.2	4.1	4.1	4.1	4.1	4.2	4.1	4.1
	Coho	3.9	3.9	3.9	3.6	4.1	4.1	4.1	4.0	4.2	4.2	4.2	3.9
	Summer Chum	125.4	124.7	124.3	116.1	129.6	129.5	129.1	124.9	129.0	129.2	127.6	118.8
	Fall Chum	26.9	26.9	26.8	20.9	27.3	27.3	26.8	16.5	27.4	27.4	27.4	26.6
Southern Norton	Chinook	3.2	2.7	2.4	1.8	3.8	3.6	3.4	3.0	2.5	1.8	1.5	1.0
	Coho	20.2	18.5	17.2	15.1	27.5	27.0	26.4	25.5	13.1	11.2	10.0	8.3
	Summer Chum	20.3	18.0	16.7	14.1	28.6	28.2	27.9	26.4	14.2	12.2	11.0	8.8
	Pink	25.5	22.3	20.5	17.1	35.2	33.7	32.7	31.1	16.3	12.9	11.2	8.3
Northern Norton	Coho	1.6	1.6	1.6	1.6	1.7	1.6	1.7	1.6	1.7	1.6	1.6	1.7
	Summer Chum	25.6	25.3	24.7	23.7	27.6	27.5	27.6	27.5	23.6	22.9	22.1	20.9
	Pink	15.3	15.0	14.7	15.4	15.9	15.9	15.8	15.9	15.5	15.1	14.7	15.5

Note: ##### indicates value is very low or zero.

Table B-3. Mean Projected Average Utilization, 2011-2050, with "Varied-Rising" Utilization

Area	Species	Historic return Subsistence demand: Low	Int 1	Int 2	High	High return Subsistence demand: Low	Int 1	Int 2	High	Low return Subsistence demand: Low	Int 1	Int 2	High
Kuskokwim Bay	Chinook	80%	79%	79%	79%	79%	78%	77%	77%	77%	77%	76%	75%
	Coho	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%
	Summer Chum	60%	59%	60%	60%	59%	59%	59%	59%	60%	60%	60%	60%
	Sockeye	69%	68%	69%	68%	68%	68%	68%	68%	68%	68%	68%	68%
Lower Kuskokwim	Chinook	77%	55%	45%	31%	79%	60%	51%	38%	78%	58%	48%	35%
	Coho	67%	67%	67%	66%	67%	67%	67%	67%	66%	66%	66%	65%
	Summer Chum	57%	57%	56%	54%	58%	58%	58%	57%	57%	57%	56%	54%
	Sockeye	68%	67%	67%	67%	69%	69%	69%	69%	62%	62%	62%	62%
Lower Yukon	Chinook	83%	82%	81%	79%	83%	83%	82%	80%	82%	81%	80%	78%
	Coho	71%	71%	71%	70%	72%	71%	71%	70%	72%	71%	71%	70%
	Summer Chum	60%	59%	59%	59%	60%	60%	59%	59%	60%	60%	60%	59%
	Fall Chum	60%	60%	59%	59%	60%	60%	60%	59%	60%	60%	60%	59%
Upper Yukon	Chinook	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%
	Coho	72%	72%	72%	70%	72%	72%	72%	71%	72%	72%	72%	71%
	Summer Chum	60%	60%	60%	59%	60%	60%	60%	59%	60%	60%	60%	59%
	Fall Chum	60%	60%	60%	55%	60%	60%	60%	50%	60%	60%	60%	60%
Southern Norton	Chinook	80%	78%	76%	73%	81%	81%	80%	78%	77%	74%	71%	65%
	Coho	64%	63%	62%	60%	66%	66%	66%	65%	62%	59%	57%	54%
	Summer Chum	51%	49%	48%	45%	53%	53%	53%	52%	49%	46%	45%	41%
	Pink	46%	44%	43%	40%	48%	48%	47%	46%	43%	40%	38%	34%
Northern Norton	Coho	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%
	Summer Chum	58%	58%	58%	57%	58%	58%	58%	58%	58%	57%	57%	56%
	Pink	54%	53%	53%	54%	54%	54%	54%	54%	54%	53%	53%	54%

Note: ##### indicates value is very low or zero.

Table B-4. Mean Projected Commercial Harvests by Decade, with "Varied-Rising" Utilization (000 fish)

Area	Species	Low subsistence demand Decade ending: 2020	2030	2040	2050	High subsistence demand Decade ending: 2020	2030	2040	2050
Kuskokwim Bay	Chinook	13.6	14.7	15.5	16.2	13.5	14.5	14.9	15.0
	Coho	30.5	39.3	47.0	52.8	30.0	39.2	47.7	53.2
	Summer Chum	17.4	24.0	30.4	35.8	17.4	24.0	30.5	35.6
	Sockeye	25.2	32.7	39.5	43.4	25.4	32.9	39.0	44.1
Lower Kuskokwim	Chinook	2.9	3.3	3.4	3.9	0.2	0.0	0.0	0.0
	Coho	140.6	182.7	223.1	251.4	137.6	177.7	211.7	231.6
	Summer Chum	74.5	104.5	134.5	158.9	70.4	93.2	109.5	116.4
	Sockeye	14.2	18.6	22.4	25.3	14.2	18.5	22.5	25.3
Lower Yukon	Chinook	54.2	61.2	66.9	71.4	43.4	40.7	36.7	31.0
	Coho	11.6	14.6	16.8	18.6	11.2	13.6	14.9	15.1
	Summer Chum	224.0	308.3	388.1	455.5	220.9	297.3	360.7	404.0
	Fall Chum	35.9	49.0	61.8	71.3	34.9	46.8	57.3	64.3
Upper Yukon	Chinook	3.7	4.0	4.2	4.4	3.8	4.0	4.2	4.3
	Coho	2.9	3.7	4.3	4.8	2.9	3.6	4.0	3.9
	Summer Chum	81.3	112.2	141.6	166.6	80.0	107.8	130.8	145.7
	Fall Chum	17.6	24.1	30.5	35.5	17.2	22.4	24.3	19.8
Southern Norton	Chinook	2.9	3.1	3.3	3.4	2.4	2.1	1.6	1.1
	Coho	13.8	18.8	22.5	25.8	12.3	15.0	16.3	16.7
	Summer Chum	12.1	17.4	23.3	28.5	10.3	13.4	15.5	17.0
	Pink	12.2	20.6	29.6	39.6	10.4	15.7	20.0	22.3
Northern Norton	Coho	1.2	1.5	1.7	1.9	1.2	1.5	1.7	1.9
	Summer Chum	16.3	22.9	29.3	34.1	16.0	21.7	26.9	30.3
	Pink	8.0	12.8	18.0	22.3	8.1	13.0	18.1	22.4

Note: ##### indicates value is very low or zero.

Table B-5. Mean Projected Average Utilization by Decade, with "Varied-Rising" Utilization

Area	Species	Low subsistence demand Decade ending: 2020	2030	2040	2050	High subsistence demand Decade ending: 2020	2030	2040	2050
Kuskokwim Bay	Chinook	72%	78%	83%	86%	72%	77%	82%	85%
	Coho	48%	63%	76%	85%	48%	63%	76%	85%
	Summer Chum	39%	53%	67%	79%	39%	53%	67%	79%
	Sockeye	49%	64%	76%	85%	49%	63%	76%	85%
Lower Kuskokwim	Chinook	69%	75%	80%	85%	33%	1%	13%	#DIV/0!
	Coho	48%	62%	75%	84%	47%	62%	74%	84%
	Summer Chum	36%	51%	65%	77%	35%	49%	62%	74%
	Sockeye	48%	62%	75%	85%	48%	62%	75%	84%
Lower Yukon	Chinook	75%	81%	85%	89%	74%	78%	82%	85%
	Coho	53%	67%	79%	87%	53%	66%	78%	86%
	Summer Chum	39%	54%	68%	79%	39%	53%	67%	78%
	Fall Chum	39%	54%	68%	79%	39%	54%	68%	79%
Upper Yukon	Chinook	77%	82%	86%	89%	77%	82%	86%	89%
	Coho	53%	68%	79%	87%	53%	67%	78%	85%
	Summer Chum	39%	54%	68%	79%	39%	53%	67%	78%
	Fall Chum	39%	54%	68%	79%	39%	53%	64%	72%
Southern Norton	Chinook	73%	78%	83%	87%	70%	73%	75%	75%
	Coho	44%	59%	72%	83%	43%	56%	68%	77%
	Summer Chum	30%	44%	59%	72%	29%	41%	53%	65%
	Pink	22%	37%	55%	72%	21%	34%	50%	66%
Northern Norton	Coho	55%	69%	80%	88%	55%	69%	80%	88%
	Summer Chum	37%	52%	66%	78%	37%	51%	65%	77%
	Pink	28%	45%	63%	78%	28%	45%	63%	78%

Note: #DIV/0! indicates projected mean harvestable surplus is zero.

Table B-6. Mean Projected Commercial Harvest, by Utilization Assumptions (000 fish)

		Same-Low		Same-High		Same-Rising		Varied-Low		Varied-High		Varied-Rising	
		Decade ending:		Decade ending:		Decade ending:		Decade ending:		Decade ending:		Decade ending:	
Area	Species	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050
Kuskokwim Bay	Chinook	7.4	6.7	15.0	13.8	8.6	13.2	12.8	11.8	16.5	15.3	13.5	15.0
	Coho	24.9	25.2	49.8	50.4	28.7	48.2	24.9	25.2	54.7	55.3	30.0	53.2
	Summer Chum	20.4	20.3	37.6	37.5	23.1	36.1	14.0	14.0	37.6	37.5	17.4	35.6
	Sockeye	21.2	21.1	41.6	41.8	24.3	40.0	21.2	21.1	45.5	45.8	25.4	44.1
Lower Kuskokwim	Chinook	0.1	0.0	0.3	0.0	0.1	0.0	0.2	0.0	0.4	0.0	0.2	0.0
	Coho	113.9	105.8	232.1	218.3	131.6	208.1	113.9	105.8	255.8	241.3	137.6	231.6
	Summer Chum	83.0	60.1	161.4	124.5	95.1	118.6	56.1	39.8	161.4	124.5	70.4	116.4
	Sockeye	11.8	11.8	23.8	23.9	13.6	22.9	11.8	11.8	26.2	26.3	14.2	25.3
Lower Yukon	Chinook	24.6	13.5	47.9	28.5	28.1	27.1	41.5	24.2	52.3	31.7	43.4	31.0
	Coho	9.5	7.5	17.6	14.3	10.8	13.7	9.5	7.5	19.1	15.6	11.2	15.1
	Summer Chum	258.1	227.8	475.7	426.6	293.2	410.1	177.9	156.1	475.7	426.6	220.9	404.0
	Fall Chum	40.8	36.7	74.8	67.8	46.3	65.2	28.2	25.3	74.8	67.8	34.9	64.3
Upper Yukon	Chinook	2.3	2.2	4.1	4.0	2.6	3.9	3.6	3.5	4.4	4.4	3.8	4.3
	Coho	2.5	1.8	4.5	3.7	2.8	3.5	2.5	1.8	4.9	4.0	2.9	3.9
	Summer Chum	93.4	81.9	172.3	153.9	106.2	147.9	64.4	56.0	172.3	153.9	80.0	145.7
	Fall Chum	20.1	10.0	36.9	21.4	22.8	20.3	13.9	6.6	36.9	21.4	17.2	19.8
Southern Norton	Chinook	1.3	0.3	2.7	0.9	1.5	0.9	2.3	0.7	3.0	1.1	2.4	1.1
	Coho	10.1	6.3	22.0	15.4	11.7	14.4	10.1	6.3	24.6	17.7	12.3	16.7
	Summer Chum	12.4	7.6	27.5	18.6	14.5	17.4	8.1	4.8	27.5	18.6	10.3	17.0
	Pink	17.7	10.5	37.9	24.5	20.8	23.2	7.1	4.1	37.9	24.5	10.4	22.3
Northern Norton	Coho	1.0	1.0	1.8	1.8	1.1	1.7	1.0	1.0	2.0	1.9	1.2	1.9
	Summer Chum	18.8	16.6	35.7	32.2	21.5	30.8	12.8	11.3	35.7	32.2	16.0	30.3
	Pink	13.1	13.1	23.9	23.9	14.9	23.1	5.8	5.8	23.9	23.9	8.1	22.4

Note: All projections are for Historic Return-High Subsistence Demand assumptions. ##### indicates harvest is very low or zero.

Table B-7. Mean Projected Average Utilization, by Utilization Assumptions

		Same-Low		Same-High		Same-Rising		Varied-Low		Varied-High		Varied-Rising	
		Decade ending:		Decade ending:		Decade ending:		Decade ending:		Decade ending:		Decade ending:	
Area	Species	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050
Kuskokwim Bay	Chinook	40%	38%	80%	79%	46%	75%	69%	67%	88%	87%	72%	85%
	Coho	40%	40%	80%	80%	46%	77%	40%	40%	88%	88%	48%	85%
	Summer Chum	45%	45%	83%	83%	51%	80%	31%	31%	83%	83%	39%	79%
	Sockeye	41%	41%	81%	81%	47%	77%	41%	41%	89%	88%	49%	85%
Lower Kuskokwim	Chinook	13%	#####	44%	#####	14%	#####	32%	#####	58%	#####	33%	#####
	Coho	39%	38%	79%	79%	45%	75%	39%	38%	88%	87%	47%	84%
	Summer Chum	42%	38%	81%	79%	48%	75%	28%	25%	81%	79%	35%	74%
	Sockeye	40%	39%	80%	80%	46%	76%	40%	39%	88%	88%	48%	84%
Lower Yukon	Chinook	42%	37%	81%	78%	48%	74%	70%	66%	89%	87%	74%	85%
	Coho	45%	43%	83%	82%	51%	78%	45%	43%	90%	89%	53%	86%
	Summer Chum	45%	44%	83%	83%	51%	80%	31%	30%	83%	83%	39%	78%
	Fall Chum	45%	45%	83%	83%	52%	80%	31%	31%	83%	83%	39%	79%
Upper Yukon	Chinook	46%	46%	84%	83%	52%	80%	74%	73%	90%	90%	77%	89%
	Coho	45%	40%	83%	80%	51%	77%	45%	40%	90%	88%	53%	85%
	Summer Chum	45%	44%	83%	83%	51%	79%	31%	30%	83%	83%	39%	78%
	Fall Chum	46%	36%	84%	77%	52%	73%	31%	24%	84%	77%	39%	72%
Southern Norton	Chinook	38%	24%	78%	65%	43%	60%	67%	51%	87%	77%	70%	75%
	Coho	35%	29%	76%	71%	41%	67%	35%	29%	86%	82%	43%	77%
	Summer Chum	34%	29%	76%	71%	40%	66%	22%	18%	76%	71%	29%	65%
	Pink	36%	31%	78%	73%	42%	69%	14%	12%	76%	73%	21%	66%
Northern Norton	Coho	47%	47%	84%	84%	53%	81%	47%	47%	91%	91%	55%	88%
	Summer Chum	43%	42%	82%	82%	49%	78%	30%	29%	82%	82%	37%	77%
	Pink	46%	46%	84%	84%	52%	81%	20%	20%	84%	84%	28%	78%

Note: All projections are for Historic Return-High Subsistence Demand assumptions. ##### indicates harvest is very low or zero.

Table B-8. Mean Commercial Harvest, 2011-2050, Historic Return-Low Subsistence Scenario

		Utilization Assumptions					
		Same-Low	Same-High	Same-Rising	Varied-Low	Varied-High	Varied-Rising
Kuskokwim Bay	Chinook	7,483	15,047	11,601	12,920	16,540	14,983
	Coho	25,209	50,133	38,807	25,209	54,992	42,409
	Summer Chum	20,332	37,579	29,985	14,003	37,579	26,905
	Sockeye	21,036	41,496	32,256	21,036	45,446	35,210
Lower Kuskokwim	Chinook	1,598	3,399	2,575	2,872	3,780	3,390
	Coho	116,753	236,553	181,961	116,753	260,437	199,482
	Summer Chum	87,712	168,266	132,246	59,607	168,266	118,114
	Sockeye	11,842	23,846	18,390	11,842	26,221	20,140
Lower Yukon	Chinook	34,050	63,584	50,815	55,716	68,927	63,435
	Coho	9,671	17,922	14,264	9,671	19,401	15,416
	Summer Chum	260,817	479,317	383,216	180,001	479,317	343,996
	Fall Chum	41,426	76,025	60,719	28,604	76,025	54,473
Upper Yukon	Chinook	2,252	4,093	3,287	3,612	4,415	4,077
	Coho	2,474	4,555	3,638	2,474	4,925	3,928
	Summer Chum	95,136	174,548	139,681	65,698	174,548	125,442
	Fall Chum	20,504	37,400	29,975	14,190	37,400	26,930
Southern Norton	Chinook	1,607	3,194	2,476	2,751	3,503	3,181
	Coho	11,345	24,322	18,276	11,345	27,091	20,329
	Summer Chum	14,289	30,783	23,068	9,353	30,783	20,329
	Pink	20,360	42,789	32,572	8,321	42,789	25,487
Northern Norton	Coho	1,016	1,817	1,468	1,016	1,954	1,578
	Summer Chum	19,212	36,280	28,674	13,128	36,280	25,648
	Pink	12,945	23,742	19,057	5,722	23,742	15,286

Table B-9. Mean Commercial Harvest, 2011-2050, Historic Return-High Subsistence Scenario

		Utilization Assumptions					
		Same-Low	Same-High	Same-Rising	Varied-Low	Varied-High	Varied-Rising
Kuskokwim Bay	Chinook	7,131	14,522	11,107	12,425	16,005	14,456
	Coho	25,175	50,196	38,890	25,175	55,088	42,530
	Summer Chum	20,348	37,606	29,990	14,013	37,606	26,901
	Sockeye	21,108	41,655	32,370	21,108	45,623	35,336
Lower Kuskokwim	Chinook	20	70	23	50	91	53
	Coho	110,551	226,277	172,706	110,551	249,630	189,658
	Summer Chum	72,631	144,936	110,615	48,715	144,936	97,393
	Sockeye	11,818	23,838	18,377	11,818	26,221	20,133
Lower Yukon	Chinook	19,184	34,488	28,784	33,064	42,399	37,567
	Coho	8,576	16,135	12,644	8,576	17,541	13,695
	Summer Chum	244,438	453,757	359,133	168,077	453,757	320,723
	Fall Chum	38,869	71,549	56,824	26,809	71,549	50,819
Upper Yukon	Chinook	2,232	4,070	3,262	3,589	4,393	4,054
	Coho	2,239	4,232	3,321	2,239	4,599	3,604
	Summer Chum	88,395	164,346	130,002	60,747	164,346	116,067
	Fall Chum	16,197	31,071	23,860	11,022	31,071	20,937
Southern Norton	Chinook	809	1,829	1,252	1,515	2,067	1,789
	Coho	8,210	18,799	13,434	8,210	21,259	15,056
	Summer Chum	9,978	23,063	16,354	6,405	23,063	14,064
	Pink	14,237	31,592	22,913	5,648	31,592	17,103
Northern Norton	Coho	1,013	1,813	1,464	1,013	1,950	1,574
	Summer Chum	17,604	34,080	26,660	12,109	34,080	23,727
	Pink	13,073	23,900	19,290	5,790	23,908	15,602

Table B-10. Mean Commercial Harvest, 2011-2050, Low Return-Low Subsistence Scenario

		Utilization Assumptions					
		Same-Low	Same-High	Same-Rising	Varied-Low	Varied-High	Varied-Rising
Kuskokwim Bay	Chinook	8,062	16,664	12,690	14,198	18,420	16,587
	Coho	28,527	57,150	44,090	28,527	62,779	48,240
	Summer Chum	21,098	39,048	31,119	14,523	39,048	27,908
	Sockeye	23,809	47,173	36,647	23,809	51,707	40,032
Lower Kuskokwim	Chinook	1,888	3,887	2,983	3,315	4,294	3,876
	Coho	135,138	274,289	210,917	135,138	302,086	231,315
	Summer Chum	102,908	196,549	154,747	70,042	196,549	138,269
	Sockeye	15,256	29,548	23,136	15,256	32,247	25,179
Lower Yukon	Chinook	38,891	71,207	57,088	62,722	76,919	70,940
	Coho	10,217	18,874	15,052	10,217	20,420	16,260
	Summer Chum	270,613	497,295	397,612	186,764	497,295	356,963
	Fall Chum	46,070	84,548	67,536	31,811	84,548	60,592
Upper Yukon	Chinook	2,297	4,174	3,351	3,684	4,503	4,158
	Coho	2,600	4,792	3,826	2,600	5,182	4,132
	Summer Chum	98,252	180,464	144,327	67,821	180,464	129,588
	Fall Chum	20,755	37,908	30,370	14,356	37,908	27,284
Southern Norton	Chinook	1,964	3,769	2,961	3,278	4,106	3,753
	Coho	15,882	32,771	25,040	15,882	36,212	27,539
	Summer Chum	20,540	42,407	32,334	13,622	42,407	28,630
	Pink	28,314	57,772	44,590	11,760	57,772	35,154
Northern Norton	Coho	1,062	1,902	1,536	1,062	2,046	1,651
	Summer Chum	20,688	39,037	30,867	14,141	39,837	27,613
	Pink	13,477	24,670	19,806	5,964	24,670	15,883

Table B-11. Mean Commercial Harvest, 2011-2050, Low Return-High Subsistence Scenario

		Utilization Assumptions					
		Same-Low	Same-High	Same-Rising	Varied-Low	Varied-High	Varied-Rising
Kuskokwim Bay	Chinook	6,669	14,336	10,605	12,074	15,979	14,223
	Coho	28,675	57,453	44,410	28,675	63,113	48,600
	Summer Chum	21,129	39,083	31,154	14,548	39,083	27,941
	Sockeye	23,965	47,501	36,820	23,965	52,070	40,218
Lower Kuskokwim	Chinook	36	116	41	85	146	90
	Coho	135,552	274,940	211,247	135,552	302,760	231,623
	Summer Chum	99,481	191,885	150,086	67,479	191,885	133,672
	Sockeye	15,260	29,558	23,155	15,260	32,259	25,203
Lower Yukon	Chinook	27,169	52,807	40,454	45,770	57,676	52,285
	Coho	9,450	17,709	13,944	9,450	19,210	15,098
	Summer Chum	260,615	482,232	383,000	179,412	482,232	342,621
	Fall Chum	43,672	80,436	63,896	30,115	80,436	57,159
Upper Yukon	Chinook	2,281	4,157	3,332	3,666	4,487	4,140
	Coho	2,465	4,617	3,650	2,465	5,008	3,955
	Summer Chum	94,942	175,643	139,600	63,364	175,640	124,929
	Fall Chum	13,149	26,191	19,263	8,845	26,191	16,525
Southern Norton	Chinook	1,472	3,024	2,258	2,580	3,341	2,997
	Coho	14,578	30,734	23,128	14,578	34,114	25,533
	Summer Chum	18,903	39,869	29,997	12,455	39,869	26,394
	Pink	25,454	52,365	39,933	10,521	52,365	31,107
Northern Norton	Coho	1,061	1,899	1,534	1,061	2,044	1,649
	Summer Chum	20,599	38,904	30,761	14,076	38,904	27,518
	Pink	13,481	24,681	19,820	5,964	24,681	15,897

Table B-12. Mean Commercial Harvest, 2011-2050, High Return-Low Subsistence Scenario

		Utilization Assumptions					
		Same-Low	Same-High	Same-Rising	Varied-Low	Varied-High	Varied-Rising
Kuskokwim Bay	Chinook	3,350	11,357	8,560	9,602	12,623	11,305
	Coho	26,955	51,874	41,661	26,955	59,152	45,568
	Summer Chum	21,149	39,027	31,137	14,574	39,027	27,913
	Sockeye	23,468	46,381	36,015	23,468	50,814	39,316
Lower Kuskokwim	Chinook	1,775	3,702	2,822	3,146	4,100	3,689
	Coho	72,573	149,132	114,063	72,573	164,635	125,342
	Summer Chum	98,745	189,616	149,056	67,082	189,616	153,131
	Sockeye	5,996	13,544	9,959	5,996	15,261	11,122
Lower Yukon	Chinook	31,183	58,849	46,957	51,421	63,916	58,764
	Coho	10,233	18,878	15,858	10,233	20,419	16,264
	Summer Chum	270,506	495,986	395,740	186,845	495,986	356,398
	Fall Chum	41,128	75,381	60,243	28,432	75,381	54,037
Upper Yukon	Chinook	2,290	4,162	3,341	3,673	4,489	4,145
	Coho	2,641	4,858	3,881	2,641	5,251	4,190
	Summer Chum	97,893	179,573	143,631	67,606	179,573	128,962
	Fall Chum	20,848	37,978	30,457	14,435	37,978	27,368
Southern Norton	Chinook	1,190	2,534	1,911	2,140	2,818	2,525
	Coho	7,066	15,990	11,741	7,066	18,024	13,115
	Summer Chum	9,732	21,890	16,173	6,291	21,890	14,215
	Pink	12,715	28,334	21,082	5,043	28,334	16,338
Northern Norton	Coho	1,063	1,900	1,535	1,063	2,044	1,650
	Summer Chum	17,586	33,478	26,395	11,983	33,478	23,597
	Pink	13,125	24,117	19,353	5,796	24,117	15,529

Table B-13. Mean Commercial Harvest, 2011-2050, High Return-High Subsistence Scenario

		Utilization Assumptions					
		Same-Low	Same-High	Same-Rising	Varied-Low	Varied-High	Varied-Rising
Kuskokwim Bay	Chinook	3,995	8,816	6,427	7,402	9,966	8,788
	Coho	25,988	52,098	40,146	25,988	57,237	43,933
	Summer Chum	21,188	39,108	31,206	14,600	39,108	27,998
	Sockeye	23,465	46,398	36,061	23,465	50,837	39,379
Lower Kuskokwim	Chinook	30	98	53	71	125	75
	Coho	63,597	133,175	100,230	63,597	147,608	110,468
	Summer Chum	79,789	159,430	121,394	53,490	159,430	186,781
	Sockeye	6,062	13,690	10,065	6,062	15,425	11,239
Lower Yukon	Chinook	13,808	32,320	23,784	27,555	35,524	31,719
	Coho	9,330	17,469	13,746	9,330	18,947	14,879
	Summer Chum	265,164	488,794	389,510	182,797	488,794	349,000
	Fall Chum	38,772	71,351	56,677	26,745	71,351	50,691
Upper Yukon	Chinook	2,240	4,101	3,281	3,612	4,430	4,085
	Coho	2,462	4,615	3,643	2,462	5,007	3,948
	Summer Chum	90,484	168,279	133,057	62,176	168,279	118,773
	Fall Chum	20,201	37,179	29,648	13,935	37,179	26,557
Southern Norton	Chinook	403	1,015	620	813	1,186	975
	Coho	4,387	10,814	7,339	4,387	12,451	8,317
	Summer Chum	6,211	15,149	10,329	3,932	15,149	8,755
	Pink	7,096	17,106	11,658	2,714	17,106	8,330
Northern Norton	Coho	1,064	1,902	1,536	1,064	2,045	1,651
	Summer Chum	15,664	30,187	23,485	10,628	30,187	20,854
	Pink	13,127	23,960	19,272	5,820	23,960	15,474

Table B-14. Mean Commercial Utilization, 2011-2050, Historic Return-Low Subsistence Scenario

		Utilization Assumptions					
		Same-Low	Same-High	Same-Rising	Varied-Low	Varied-High	Varied-Rising
Kuskokwim Bay	Chinook	40%	80%	62%	69%	88%	80%
	Coho	40%	80%	62%	40%	88%	68%
	Summer Chum	45%	83%	66%	31%	83%	60%
	Sockeye	41%	81%	63%	41%	88%	69%
Lower Kuskokwim	Chinook	37%	78%	59%	66%	86%	77%
	Coho	39%	80%	61%	39%	88%	67%
	Summer Chum	43%	82%	64%	29%	82%	57%
	Sockeye	40%	80%	62%	40%	88%	68%
Lower Yukon	Chinook	44%	83%	66%	73%	90%	83%
	Coho	45%	83%	66%	45%	90%	71%
	Summer Chum	45%	83%	67%	31%	83%	60%
	Fall Chum	45%	83%	67%	31%	83%	60%
Upper Yukon	Chinook	46%	84%	67%	74%	90%	83%
	Coho	45%	83%	67%	45%	90%	72%
	Summer Chum	45%	83%	67%	31%	83%	60%
	Fall Chum	46%	84%	67%	32%	84%	60%
Southern Norton	Chinook	40%	80%	62%	69%	88%	80%
	Coho	36%	77%	58%	36%	86%	64%
	Summer Chum	36%	77%	58%	23%	77%	51%
	Pink	37%	77%	59%	13%	77%	46%
Northern Norton	Coho	47%	84%	68%	47%	91%	73%
	Summer Chum	44%	82%	65%	30%	82%	58%
	Pink	45%	83%	67%	20%	83%	54%

Table B-15. Mean Commercial Utilization, 2011-2050, Historic Return-High Subsistence Scenario

		Utilization Assumptions					
		Same-Low	Same-High	Same-Rising	Varied-Low	Varied-High	Varied-Rising
Kuskokwim Bay	Chinook	39%	79%	61%	68%	88%	79%
	Coho	40%	80%	62%	40%	88%	68%
	Summer Chum	45%	83%	66%	31%	83%	60%
	Sockeye	41%	81%	63%	41%	88%	68%
Lower Kuskokwim	Chinook	12%	41%	13%	29%	54%	31%
	Coho	39%	79%	60%	39%	87%	66%
	Summer Chum	40%	80%	61%	27%	80%	54%
	Sockeye	40%	80%	62%	40%	88%	67%
Lower Yukon	Chinook	40%	80%	60%	69%	88%	79%
	Coho	44%	82%	65%	44%	90%	70%
	Summer Chum	45%	83%	66%	31%	83%	59%
	Fall Chum	45%	83%	66%	31%	83%	59%
Upper Yukon	Chinook	46%	84%	67%	74%	90%	83%
	Coho	44%	82%	65%	44%	89%	70%
	Summer Chum	45%	83%	66%	31%	83%	59%
	Fall Chum	43%	82%	63%	29%	82%	55%
Southern Norton	Chinook	33%	74%	51%	62%	84%	73%
	Coho	32%	74%	53%	32%	84%	60%
	Summer Chum	32%	74%	52%	21%	74%	45%
	Pink	34%	75%	54%	13%	75%	40%
Northern Norton	Coho	47%	84%	68%	47%	91%	73%
	Summer Chum	43%	82%	64%	29%	82%	57%
	Pink	46%	84%	67%	20%	84%	54%

Table B-16. Mean Commercial Utilization, 2011-2050, Low Return-Low Subsistence Scenario

		Utilization Assumptions					
		Same-Low	Same-High	Same-Rising	Varied-Low	Varied-High	Varied-Rising
Kuskokwim Bay	Chinook	38%	79%	60%	67%	87%	79%
	Coho	40%	80%	62%	40%	88%	68%
	Summer Chum	45%	83%	66%	31%	83%	59%
	Sockeye	41%	81%	63%	41%	88%	68%
Lower Kuskokwim	Chinook	38%	79%	61%	67%	87%	79%
	Coho	39%	88%	61%	39%	88%	67%
	Summer Chum	43%	82%	65%	29%	82%	58%
	Sockeye	42%	81%	64%	42%	89%	69%
Lower Yukon	Chinook	46%	84%	67%	74%	90%	83%
	Coho	45%	83%	66%	45%	90%	72%
	Summer Chum	45%	83%	67%	31%	83%	60%
	Fall Chum	45%	83%	67%	31%	83%	60%
Upper Yukon	Chinook	46%	84%	67%	74%	90%	83%
	Coho	45%	83%	67%	45%	90%	72%
	Summer Chum	45%	83%	67%	31%	83%	60%
	Fall Chum	46%	84%	67%	32%	84%	60%
Southern Norton	Chinook	43%	82%	64%	71%	89%	81%
	Coho	38%	79%	60%	38%	87%	66%
	Summer Chum	38%	79%	60%	25%	79%	53%
	Pink	39%	79%	61%	16%	79%	48%
Northern Norton	Coho	47%	84%	68%	47%	91%	73%
	Summer Chum	44%	82%	65%	30%	82%	58%
	Pink	46%	84%	67%	20%	84%	54%

Table B-17. Mean Commercial Utilization, 2011-2050, Low Return-High Subsistence Scenario

		Utilization Assumptions					
		Same-Low	Same-High	Same-Rising	Varied-Low	Varied-High	Varied-Rising
Kuskokwim Bay	Chinook	36%	77%	57%	65%	86%	77%
	Coho	40%	80%	62%	40%	88%	68%
	Summer Chum	45%	83%	66%	31%	83%	59%
	Sockeye	41%	81%	62%	41%	88%	68%
Lower Kuskokwim	Chinook	15%	48%	17%	35%	61%	38%
	Coho	39%	80%	61%	39%	88%	67%
	Summer Chum	42%	82%	64%	29%	82%	57%
	Sockeye	42%	81%	64%	42%	89%	69%
Lower Yukon	Chinook	42%	81%	62%	70%	89%	80%
	Coho	44%	83%	65%	44%	90%	70%
	Summer Chum	45%	83%	66%	31%	83%	59%
	Fall Chum	45%	83%	60%	31%	83%	59%
Upper Yukon	Chinook	46%	84%	67%	74%	90%	83%
	Coho	44%	83%	65%	44%	90%	71%
	Summer Chum	45%	83%	66%	31%	83%	59%
	Fall Chum	40%	80%	59%	27%	80%	50%
Southern Norton	Chinook	38%	79%	59%	67%	87%	78%
	Coho	37%	78%	59%	37%	87%	65%
	Summer Chum	37%	78%	59%	24%	78%	52%
	Pink	38%	78%	60%	16%	78%	46%
Northern Norton	Coho	47%	84%	68%	47%	91%	73%
	Summer Chum	44%	82%	65%	30%	82%	58%
	Pink	46%	84%	67%	20%	84%	54%

Table B-18. Mean Commercial Utilization, 2011-2050, High Return-Low Subsistence Scenario

		Utilization Assumptions					
		Same-Low	Same-High	Same-Rising	Varied-Low	Varied-High	Varied-Rising
Kuskokwim Bay	Chinook	37%	78%	59%	66%	86%	77%
	Coho	40%	80%	62%	40%	88%	68%
	Summer Chum	45%	83%	66%	31%	83%	60%
	Sockeye	41%	81%	63%	41%	88%	68%
Lower Kuskokwim	Chinook	38%	78%	60%	67%	87%	78%
	Coho	38%	79%	61%	38%	87%	66%
	Summer Chum	43%	82%	64%	29%	82%	57%
	Sockeye	33%	75%	55%	33%	85%	62%
Lower Yukon	Chinook	44%	82%	66%	72%	90%	82%
	Coho	45%	83%	66%	45%	90%	72%
	Summer Chum	46%	83%	67%	31%	83%	60%
	Fall Chum	46%	84%	67%	31%	84%	60%
Upper Yukon	Chinook	46%	84%	67%	74%	90%	83%
	Coho	45%	83%	67%	45%	90%	72%
	Summer Chum	46%	83%	67%	31%	83%	60%
	Fall Chum	46%	84%	67%	32%	84%	60%
Southern Norton	Chinook	36%	78%	59%	66%	86%	77%
	Coho	33%	75%	55%	33%	85%	62%
	Summer Chum	33%	75%	56%	22%	75%	49%
	Pink	34%	75%	56%	13%	75%	43%
Northern Norton	Coho	47%	84%	68%	47%	91%	73%
	Summer Chum	43%	82%	65%	29%	82%	58%
	Pink	45%	83%	67%	20%	83%	54%

Table B-19. Mean Commercial Utilization, 2011-2050, High Return-High Subsistence Scenario

		Utilization Assumptions					
		Same-Low	Same-High	Same-Rising	Varied-Low	Varied-High	Varied-Rising
Kuskokwim Bay	Chinook	34%	76%	55%	63%	83%	75%
	Coho	40%	80%	62%	40%	88%	68%
	Summer Chum	45%	83%	66%	31%	83%	60%
	Sockeye	41%	81%	63%	41%	88%	68%
Lower Kuskokwim	Chinook	14%	46%	16%	33%	59%	35%
	Coho	37%	78%	59%	37%	87%	65%
	Summer Chum	40%	80%	61%	27%	80%	54%
	Sockeye	33%	75%	55%	31%	85%	62%
Lower Yukon	Chinook	39%	79%	59%	68%	88%	78%
	Coho	44%	83%	65%	44%	90%	70%
	Summer Chum	45%	83%	66%	31%	83%	59%
	Fall Chum	45%	83%	66%	31%	83%	59%
Upper Yukon	Chinook	46%	84%	67%	74%	90%	83%
	Coho	44%	83%	65%	44%	90%	71%
	Summer Chum	45%	83%	66%	31%	83%	59%
	Fall Chum	45%	83%	66%	31%	83%	60%
Southern Norton	Chinook	27%	69%	41%	54%	79%	65%
	Coho	29%	71%	48%	29%	82%	54%
	Summer Chum	29%	71%	49%	18%	71%	41%
	Pink	29%	70%	48%	11%	70%	34%
Northern Norton	Coho	47%	84%	68%	47%	91%	73%
	Summer Chum	42%	82%	64%	29%	82%	56%
	Pink	46%	84%	67%	20%	84%	54%

Agenda C-2
Mar/Apr 2012

YUKON RIVER PANEL
ALASKA • YUKON

Craig L. Fleener
USA

Co-Chairs

Denis D'Amour
Canada

Yukon River Panel 100 – 419 Range Road Whitehorse, Yukon Y1A 3V1

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22 March 2012

Eric Olson, Chairman
North Pacific Fisheries Management Council
605 W. 4th Ave
Anchorage, AK 99501

Dear Mr. Olson,

The Yukon River Panel, established in accordance with the Yukon River Salmon Act under the Pacific Salmon Treaty, met in Anchorage March 19-23. Among the many topics discussed during our meeting was an informative presentation by Dr. Diana Stram on the bycatch of Chinook and Chum salmon during the pollock fishery in the Bering Sea.

Of particular interest to the Yukon River Panel was the genetic analysis of Chinook salmon indicating much higher proportions of upper and middle Yukon River stocks than previously observed. Although it is recognized this information is based on one year it raised concern amongst Panel members that bycatch of those stocks in previous years may have been higher than reported. Given the implications of this information, the Panel requests the Council consider this new information when reviewing performance measures and results of the implementation of Amendment 91.

Additionally, the Yukon River Panel is reviewing information and providing input on non-Chinook salmon bycatch. The Panel would like to reiterate the importance of chum salmon within the Yukon River Drainage towards subsistence, commercial and recreational fisheries within the U.S. and Canada. It is recognized that Yukon River chum stocks are taken as bycatch within the Bering Sea trawl fishery. The Panel therefore feels that it is incumbent upon the Council to take swift and decisive action to reduce chum bycatch as low as possible.

Craig L. Fleener
U.S. Co-chair

PUBLIC TESTIMONY SIGN-UP SHEET

Agenda Item: C-2a,b Chum Salmon Bycatch

	NAME (PLEASE PRINT)	TESTIFYING ON BEHALF OF:
1	Pollock Simon, Sr. X	marine fishermen
2	Harry Oxfield Sr	
3	Ephrim Thompson	
4	LaMont Albertson 4	KRSMWG
5	Evelyn Thomas 4	
6	Roy Ashenfelter X	Kawerak
7	Verner Wilson X	WWF
8	Craig Fleener / (Virgil) Umphenour X	Yukon R. Panel
9	David Bill Sr. X	BSEG
10	~~Donna Parker~~	~~for The Groundfish~~
11	BRENT PAINE / JOHN GRUVER	UCB
12	~~Kurt Cochran C-4~~	
13	George Plemi Koff	Greenpeace
14	Gerhard Reed	PSPA
15	~~Seth Kantner~~	
16	Paul Peyton	BSFA
17	~~BRENT PAINE~~	~~UCB~~
18	Stephanie Madsen	APA
19	Becca Robbins Gisclair	Yukon River Drainage Fisheries Assoc
20	JOE GARNIE	CITY OF TELLER
21	TIM SMITH	NORTON SOUND BERING STRAIT Regional Aquaculture ASSOCIATION
22		
23		
24		
25		

NOTE to persons providing oral or written testimony to the Council: Section 307(1)(I) of the Magnuson-Stevens Fishery Conservation and Management Act prohibits any person " to knowingly and willfully submit to a Council, the Secretary, or the Governor of a State false information (including, but not limited to, false information regarding the capacity and extent to which a United State fish processor, on an annual basis, will process a portion of the optimum yield of a fishery that will be harvested by fishing vessels of the United States) regarding any matter that the Council, Secretary, or Governor is considering in the course of carrying out this Act.

Council motion
C-2 Chum salmon PSC reduction measures
March 30, 2012

The Council requests the following changes to the draft EA/RIR/IRFA. The intent is to revise the analysis and schedule another initial review prior to final action.

1. Make Alternative 3, Component 1, a separate alternative (new Alternative 3).

2. Create a new Alternative 4 which includes Components 1 – 6 of the current Alternative 3.

   Option: General objectives and goals for the RHS program would be in regulation, but the specific parameters of the RHS program would not be in regulation.

3. Include analysis of specific modifications to the RHS program:
   - Modification of RHS to operate at a vessel level, platform level for mothership coop
   - Prioritize RHS closures to best protect western Alaska origin chum and Chinook salmon using best information available. Use identification tools, for example:
     - Non-genetic identifiers like length and weight;
     - Genetic identification of bycatch on an as close to real time analysis as possible;
     - Use information being developed (i.e. Dr. Guyon's ongoing research to identify areas and times more likely to have higher proportions of Western Alaska chum salmon);
   - Floor on the base rate.
   - Speed up shoreside data flow by obtaining trip chum counts as soon as they become available.
   - Increase chum salmon protection measures during June/July. For example:
     - Weekly threshold amounts that would trigger additional protection measures when bycatch is abnormally high;
     - Initiate "Western Alaska chum core closure areas." These areas would trigger during abnormally high encounters of chums believed to be returning to Western Alaska river systems;
   - Limit weekly base rate increases to 20% of the current base rate.
   - Stop RHS closures in a region (east or west of 168° west Longitude) as Chinook salmon bycatch levels start to increase in the later part of the B season.
   - Improvements to the tier system – consider a range of incentives that would lead to different levels of bycatch reduction.

4. Make the following revisions to the Draft EA/RIR/IRFA:
   - The analysis should provide information and rationale on the necessary provisions or objectives of the RHS that would need to be in regulation under new Alternatives 3 and 4.

- ~~Include worst case impact rates as if entire bycatch is from one stock (i.e. Norton Sound, Kuskokwim, lower Yukon, etc.) in addition to impact rates calculated against an aggregated Western Alaska run size.~~

- **Provide additional qualitative analysis on the use of AEQ and how the impacts to individual river systems may vary annually, depending upon when and where bycatch occurs. While the limitations of the genetic data only allow for large aggregate groupings by region, the composition of the bycatch may not be evenly distributed among the river systems included in a single region, and therefore may have differential impacts within the region that may exceed the average impact rates by region provided in the AEQ analysis.**

- Include information from Wolfe et. al. about projections for future subsistence demand for chum salmon in the AYK region.

- **Under Alternative 4, provide spatial analysis of the combined effect of the triggered area closures and the closures implemented under the RHS to visually display the available fishing areas given the layering of potential chum salmon closures under Alternative 4.**

The Council also recommends that staff incorporate the SSC comments regarding the EA, in particular the comment that the analysts made use of a variable (lambda) to express how the pollock fleet would respond to area closures in June and July by either waiting to fish until later in the season (lambda = 0) or seeking to fish for pollock outside of the closed area (lambda ranging from greater than 0 to 1). The Council recommends that in addition to scenarios with a lambda of zero, scenarios with lambda of 1 be presented in the summary tables that compare outcomes of the alternatives to represent a range of possible reactions of the pollock fleet to the alternatives. The Council recommends that the analysts incorporate the SSC recommendations on the RIR as practicable.

The Council recommends that NMFS continue to prioritize and fund the analysis of the Chinook and chum genetic composition data. The Council also recommends using the pre-2011 observer sampling protocol to obtain salmon length data.

The current chum salmon rolling hot spot program is designed to restrict pollock fishing in areas with the highest encounters of chum salmon bycatch regardless of their origin. Meeting the specific concerns about reducing the bycatch of Western Alaska origin chum and Chinook salmon by the pollock fishery requires revisions to the current RHS program.

Below is a list of revision concepts that would redirect a RHS program toward these goals:

- Run Program at the individual vessel level; platform level for Mothership Coop
- Prioritize RHS closures to best protect Western Alaska origin chum and Chinook salmon using best information available. Use identification tools, for example, such as:
    - Non-genetic fish identifiers like length and weight
    - Genetic identification of bycatch on a close to real time analysis as possible
    - Use information being developed (i.e. Guyon) to identify areas and times thought to be more likely higher in Western Alaskan chum salmon.
- Floor on Base Rate to avoid random RHS closures that only result in shifting fishing effort and no positive reduction in chum bycatch.
- Speed up shoreside data flow by obtaining trip chum counts as soon as it becomes available.
- Increase chum salmon protection measures during June/July. For example:
    - Investigate potential tools such as weekly threshold amounts that would trigger to implementing additional protection measures when bycatch is abnormally high.
    - Initiate "Western Alaska chum core closure areas". These areas would trigger into place during abnormally high encounters of chums believed to be returning to Western Alaska river systems
- Limit weekly Base Rate increases to 20% of current Base Rate.
- Stop chum RHS closures in a Region (east & west of 168° West Longitude as Chinook bycatch levels start to increase in the later part of the B season.

March 23, 2012

North Pacific Fishery Management Council
Eric A. Olson, Chairman

Mr. Chairman,

My name is Harry Wilde, I am a subsistence fisherman.

I am here today not for me, but as a voice for all people who depend on Yukon River Salmon. I also speak for the children who rely on the Yukon River Chinook and most important for their future.

Some Yukon River Chinook Salmon that is harvested in Alaska is of Canadian origin; it is important to keep both Alaskan and Canadian stock count healthy.

Every year, the Bearing Sea/Aleutian Island (BSAI) pollock fishery intercepts chinook and chum salmon bound for Western and Interior Alaska. In 2011, 25,500 Chinook Salmon and 191,446 chum salmon were caught as bycatch in the pollock fishery. After being counted and sampled by observers, this bycatch is either thrown back into the water - dead after hours in the nets – or saved for donation to food banks.

Back in 2007, the deep sea fisheries caught a high number of by-catch. Studies show that 40% of this by-catch was Yukon River Chinook Salmon.

Every year Alaskan Chinook Salmon and chum numbers remain low.

The outlook on subsistence fishing for the summer of 2012 does not look good. On behalf of all subsistence fisherman, woman, and children, I am asking assistance from the North Pacific Fisheries Management Council to help us protect the Chinook and chum salmon stock.

Thank you Mr. Chairman

Enforcement Committee Minutes

March 27, 2012

NPFMC Conference Room, Anchorage, AK

Committee present: Roy Hyder (Chair), LT Anthony Keene, CDR Phil Thorne, Martin Loefflad, Ken Hansen, Garland Walker, Glenn Merrill, Sherrie Myers, Major Steve Bear, and Jon McCracken (staff)

Others present: Sarah Milton, Sally Bibb, John Gauvin, Paul McGregor, Guy Holt, Bob Alverson, Brent Paine, Brad Robbins, Keith Bruton, and Will Ellis

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C-2 Initial review of BSAI chum salmon bycatch measures

Sally Bibb (NMFS) provided an overview of the alternatives included in the initial review draft of the BSAI chum salmon bycatch measures followed by a more comprehensive presentation of the enforcement section of the analysis.

The Committee noted that Amendment 91 monitoring measures have been in place since January 2011 and these monitoring requirements are substantive; in order to support a program designed to provide a full census of Chinook salmon bycatch in the Bering Sea pollock fishery. It was noted there has been good compliance with these monitoring requirements. However, the practice of "deckloading" pollock has created a significant concern during the implementation of Amendment 91, and the Committee expects these concerns to continue under any non-Chinook monitoring program. The Committee recognizes "deckloads" have been a historic practice in the pollock fishery. In practice, some catcher vessel operators set their final haul of a trip to fill their RSW tanks completely. In some cases, this final haul will exceed RSW capacity, resulting in having more fish in the codend than can be placed in the RSW tanks. As discarding of pollock is illegal under IR/IU regulations, the fish are brought in for delivery as a deckload, either in the codend, or dumped into the trawl alley.

In was noted during the Committee meeting, that current regulations require all salmon bycatch to be stored in an RSW tank prior to delivery to a processing plant. The intent of this requirement is to reduce the potential for any sorting of catch and discard of salmon from catch contained on deck. When the final codend cannot completely be placed in the RSW tanks, the result is the possibility of salmon remaining on deck and not being contained in the RSW tanks.

Recognizing this historic practice of deckloads and the requirement to store all salmon in an RSW tank prior to delivery to a processing plant, a compromise procedure to address this problem was developed during the first year of Amendment 91. As long as any fish that remained on deck and that could not be stored in the RSW tanks remained inside the codend and not loose on deck, NOAA considered the intent of the sampling program and regulations were being met. However, significant numbers of catcher vessel deliveries continue to arrive at the processors with large amounts of catch outside of a codend, and loose on deck. Loose fish on deck, which are not contained inside the codend, creates numerous problems. NMFS cannot assure that we have a complete and accurate census of the salmon bycatch when an observer is unable to verify that they were able to census all the salmon in a haul or delivery. The occurrence of significant amounts of loose fish on deck creates a situation whereby it is impossible for observers to assure that no salmon have been discarded at sea.

To address this issue, the Committee recommends the analysis include a discussion concerning the deckloading. The analysis should address the implications of prohibitions of deckloads as well as simply enforcing the existing requirements of delivering to shoreside processors or stationary floating processors all salmon taken as bycatch in trawl operations stored in RSW tanks. The analysis should also address modification of the monitoring program regulations that are currently in place for catcher vessels to allow for example storing salmon bycatch in other secure locations approved in writing by NMFS. This approach could provide industry additional options (i.e., certain live tank set ups and codend deckloads with parameters for the vessel), while also affording NMFS the opportunity to better monitor salmon.

In addition to deckloads, the Committee noted the need to expand the current analysis to accommodate two housekeeping regulatory corrections that will improve monitoring and enforcement of both Chinook and non-Chinook salmon bycatch. The first housekeeping issue needing to be addressed in the analysis is the observer viewing of salmon in storage containers. Current regulations require that all salmon stored in the container must remain in view of the observer at the observer sampling station at all times during the sorting of each haul. The intent of this regulation is to ensure that no salmon are removed from the salmon storage container. However, in the instances where salmon are numerous or in cases where there is only one small salmon in a large salmon storage container, it can be difficult or impossible to see each individual salmon in the container. To better meet the intent of this regulation, the Committee felt that the analysis should describe modifying the regulations to require that the salmon storage container must remain in view of the observer at the observer sampling station at all times during the sorting of each haul would monitoring and enforcement of salmon bycatch.

The second housekeeping issue is the removal of salmon from observer sample area at the end of the haul or delivery. Currently no regulations exist that require all salmon be removed from the observer sampling area and the salmon storage location after the observer has completed their sampling and counting duties at the end of each haul or delivery for catcher processors or shoreside processing facilities. In order to avoid any confusion about which haul or delivery to attribute the salmon and to avoid double counting of salmon, the analysis should address the need to incorporate a requirement in the regulations to ensure that once the observer has completed their sampling of the salmon for the haul or delivery, that those salmon are promptly removed from the observer's area before the sorting of the next haul or delivery can begin.