Discussion paper:

Bering Sea Chinook and chum salmon bycatch management measures

May 2014[1]

Contents

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1 Introduction

In response to heightened concerns over all sources of Chinook salmon mortality, and due to high historical bycatch that has occurred in some years (Fig. 1), the Council took action to reduce bycatch in the pollock fishery by imposing (in 2011) revised management measures via Amendment 91 to the Bering Sea Aleutian Islands Groundfish Fishery Management Plan (NMFS, 2010). Previous bycatch restrictions for Chinook salmon had been addressed through time and area closures (Stram and Ianelli 2009) but these measures did not serve to minimize bycatch in all years. Consequently, new measures were developed which imposed limits on the Chinook salmon bycatch by fishery sector and season. The measures set limits to close fishing by sector and season but also include some flexibility by including a performance standard in combination with the creation of industry-proposed incentive programs to further reduce bycatch below the performance standard. The plans, as reviewed by the Council, are designed to increase incentives for vessels to lower bycatch rates even in years when salmon encounters were low.

Due to continued concerns with extremely low returns to western Alaskan Chinook stocks, and the genetic information regarding high proportions of these stocks in the fishery bycatch (Guthrie et al,2013; Guthrie et al., 2012; Guthrie and Wilmot, 2004; Myers et al., 2004) , the Council reviewed a discussion paper in October 2013 which provided updated Adult Equivalent (AEQ) analysis of the bycatch estimates to aggregate rivers of origin as well as an analysis of fishery and bycatch performance in the first three years of the bycatch management program. These analyses are summarized in this paper with updated analyses of AEQ results and estimates of program efficacy. These updated analyses have been presented at a symposium on fishery dependent data in March 2013 and manuscripts were submitted for the meeting proceedings[2].

Following review in October, the Council moved to request a discussion paper to evaluate several aspects of salmon PSC management in the Bering Sea in order to provide information necessary to initiating modifications to the current management program (Appendix 1). Information on two broad topics was requested: 1) evaluation of the regulatory changes needed to incorporate Bering Sea chum salmon bycatch management into the Chinook salmon Incentive Program Agreements (IPAs); and 2) an evaluation of possible measures to refine the current Chinook salmon bycatch management program either by regulatory measures or through incorporation of additional provisions in the IPAs. The incorporation of chum in the IPA would include an evaluation of necessary changes to the objectives and reporting requirements in regulation as well as IPA requirements and elements of a rolling hot spot (RHS) system that could be considered in regulation.

This paper provides the information requested by the Council in October beginning with a discussion of the bycatch management undertaken in the past and the modifications needed for a combined comprehensive PSC management program for Chinook and chum (Section 2). Following that some updated analyses are included to summarize existing information on Adult Equivalence (AEQ) of salmon bycatch and impact rates to western Alaskan rivers, and updated analyses of sector and vessel-level bycatch performance annually and seasonally under Amendment 91(Section 3). Analysis of potential changes to the Amendment 91 management for Chinook are grouped under broad program impacts (i.e. shortening pollock season, requiring excluders, modifying the base rates, etc.) in order to best characterize the potential savings of salmon and impacts to pollock under these modifications (Section 4). Regulatory issues are summarized by each proposed modification in Section 5. A follow up paper to be made available the week of May 26th, will provide additional information on the proposed changes within each

[2] Ianelli and Stram (In Review); Stram and Ianelli (In Review)

IPA to address the Council's request as well as some indication of the potential efficacy of these measures.

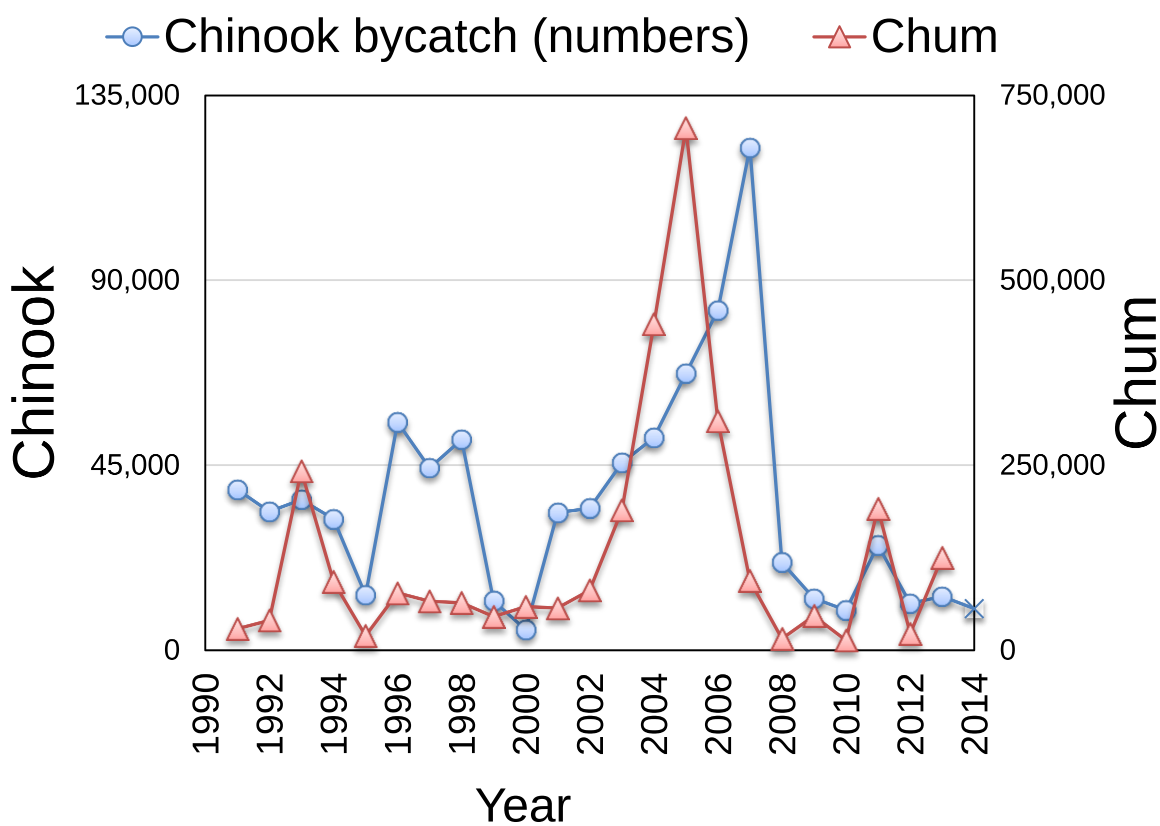

Figure 1. Time series of Chinook and chum salmon bycatch in the pollock fishery, 1991-2013 (and 2014 Chinook salmon numbers for A-season only).

2 Combined Comprehensive PSC management program for chum and Chinook salmon

The Council indicated in October that consideration should be given to incorporating chum salmon into the existing IPAs and in doing so create a combined Bering Sea salmon PSC management system. The Council has been working for many years on how to address chum salmon bycatch in the Bering Sea following implementation of Amendment 91.

2.1 Previous management measures

The Council has previously used triggered time and area closures (Salmon Savings Areas (SSA)) to manage chum and Chinook in the Bering Sea. These closures were designed based on analyses of groundfish observer data collected from 1990-1995. However, the efficacy of these closures was called into question when the fleet began observing that bycatch rates were higher outside of the closures when triggered then inside of the closures. The industry began voluntarily participating in an Inter-cooperative Agreement (ICA) for salmon bycatch in which a private contractual agreement between fleet participants established a rolling hot spot (RHS) program to which the fleet would adhere to short-term (4- to 7-) day closures in discrete areas of the Bering Sea when observed bycatch was high. The RHS program was initially developed to reduce bycatch of Chinook and chum in order to avoid triggering the closures themselves, however eventually it became clear that the SSAs were exacerbating bycatch by moving the fleet in areas of higher rates (NPFMC, 2005). Numerous requests from the pollock industry led to Amendment 84 to exempt the fleet from the SSAs provided they participated in the ICA. Detailed regulations specified all of the provisions in the RHS program from the contractual agreement. This exemption was always intended to be an interim measure while the Council explored alternative bycatch management measures.

2.2 Chum salmon analyses since Amendment 84

Chum salmon PSC peaked in 2005, renewing interest in evaluating alternative measures to time and area closures. While the Council considered complicated alternatives for cap systems for chum and Chinook PSC, the Chinook PSC reached an historic high in 2007 and the Council took action to bifurcate their analysis into separate measures for each species, focusing priority on measures for Chinook. Following final action on Amendment 91 for Chinook, the Council continued to develop alternative measures for Chum salmon PSC. These measures included hard caps, revised area closure systems and a triggered closure with an exemption similar to status quo. The analysis was complicated by issues related to the differential timing in the B-season of chum PSC compared with Chinook PSC (Fig. 2). While chum PSC tends to be caught in higher amounts beginning in late July to early August, Chinook levels ramp up in September to October when Chum salmon PSC tends to be lower. Thus any efforts to reduce chum bycatch earlier in the summer which cause additional fishing pressure later in the B-season have the potential to exacerbate Chinook.

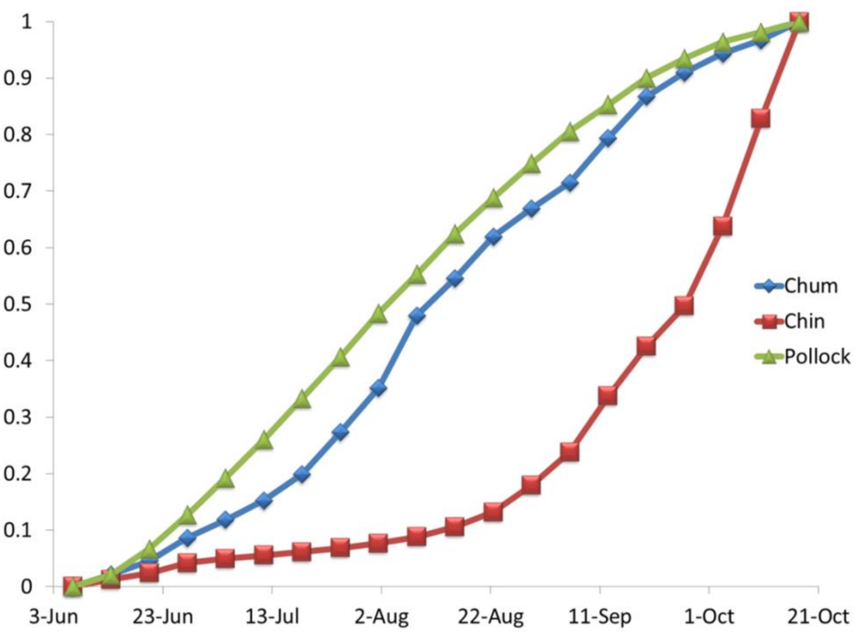

Figure 2. Mean relative values of pollock catch (triangles) compared with catch of chum (diamonds) and Chinook (squares) salmon species in the pollock fishery during the B-season.

2.2.1 Impacts rates on chum runs

Impacts rates (salmon/run size) were estimated based on available genetic break-outs as follows (from NPFMC, 2012). On average (2005-2009 data) 11% of the AEQ came from coastal western Alaska systems and about 6% of the total AEQ bycatch originated from the Upper Yukon fall run of chum salmon. Using conservative run size estimates (river systems with missing run-size information were omitted) indicated that the highest impact rate (chum salmon mortality due to the pollock fishery divided by run-size estimates) was less than 1.7% for the combined western Alaska stocks (Table 1). In only three out of 16 years was the impact rate estimated to be higher than 0.7%. For the Upper Yukon stock, the estimate of the impact is higher with a peak rate of 2.7% estimated on the run that returned in 2006 (with upper 95% confidence bound at 3.7%). For the SW Alaska region (taken to be from Area M) the estimate of impact rate is the lowest for any of the Alaska sub-regions. The average impact rate (2004-2011) by region (with ranges over this period):

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

Table 1. Estimated median impact of the pollock fishery as reported on in NPFMC (2009) for chum salmon assuming run size estimates presented in (with an assumed 10% CV) by broad regions, 1994-2009. WAK includes coastal western Alaska and Upper Yukon (Fall run). Italicized values are extrapolated from 2005-2009 stratum-specific mean bycatch stock composition estimates and as such have higher levels of uncertainty. They do account for the amount of bycatch that occurred within each stratum and the estimates of total run strength. Values in parentheses are the 5th and 95th percentile from the integrated combined AEQ-Genetic-run-size uncertainty model.

	Coastal WAK	Upper Yukon	WAK (coastal + Upper Yukon)	SW Alaska[1]
1994	*0.32% (0.22%, 0.45%)*	*0.61% (0.39%, 0.93%)*	*0.38% (0.27%, 0.5%)*	*0.11% (0.00%, 0.27%)*
1995	*0.07% (0.05%, 0.1%)*	*0.14% (0.08%, 0.23%)*	*0.08% (0.06%, 0.12%)*	*0.03% (0.00%, 0.07%)*
1996	*0.12% (0.09%, 0.17%)*	*0.2% (0.12%, 0.31%)*	*0.14% (0.1%, 0.19%)*	*0.04% (0.00%, 0.09%)*
1997	*0.23% (0.16%, 0.32%)*	*0.36% (0.21%, 0.57%)*	*0.26% (0.19%, 0.34%)*	*0.05% (0.00%, 0.13%)*
1998	*0.21% (0.15%, 0.3%)*	*0.81% (0.48%, 1.28%)*	*0.28% (0.2%, 0.37%)*	*0.02% (0.00%, 0.06%)*
1999	*0.2% (0.14%, 0.28%)*	*0.46% (0.27%, 0.72%)*	*0.24% (0.17%, 0.33%)*	*0.04% (0.00%, 0.08%)*
2000	*0.44% (0.31%, 0.59%)*	*1.05% (0.7%, 1.53%)*	*0.55% (0.42%, 0.71%)*	*0.04% (0.00%, 0.10%)*
2001	*0.21% (0.14%, 0.29%)*	*0.67% (0.43%, 0.96%)*	*0.27% (0.21%, 0.35%)*	*0.03% (0.00%, 0.07%)*
2002	*0.21% (0.15%, 0.29%)*	*0.7% (0.45%, 1.05%)*	*0.27% (0.2%, 0.35%)*	*0.05% (0.00%, 0.12%)*
2003	*0.42% (0.3%, 0.56%)*	*0.8% (0.52%, 1.2%)*	*0.5% (0.38%, 0.65%)*	*0.14% (0.00%, 0.34%)*
2004	*0.92% (0.66%, 1.25%)*	*2.41% (1.59%, 3.43%)*	*1.16% (0.87%, 1.51%)*	*0.25% (0.00%, 0.62%)*
2005	**1.23% (0.93%, 1.6%)**	**1.42% (0.98%, 2.04%)**	**1.28% (1.01%, 1.63%)**	**0.81% (0.39%, 1.47%)**
2006	**0.64% (0.47%, 0.86%)**	**2.63% (1.86%, 3.65%)**	**0.9% (0.7%, 1.16%)**	**0.45% (0.25%, 0.75%)**
2007	**0.31% (0.23%, 0.41%)**	**0.99% (0.71%, 1.37%)**	**0.43% (0.33%, 0.56%)**	**0.09% (0.05%, 0.17%)**
2008	**0.09% (0.07%, 0.13%)**	**0.35% (0.25%, 0.49%)**	**0.13% (0.1%, 0.18%)**	**0.02% (0.01%, 0.07%)**
2009	**0.1% (0.08%, 0.14%)**	**0.23% (0.15%, 0.35%)**	**0.12% (0.1%, 0.16%)**	**0.18% (0.10%, 0.29%)**

[1]SWAK uses escapement only as a proxy for total run size.

2.2.2 *Council action on chum management measures*

The Council eventually dropped the revised triggered area closure system as a viable alternative as not achieving its purpose and need for revised management measures and focused instead on elements of the RHS system that could be analyzed in contrast to hard caps on the fleet. The Council reviewed iterative drafts of the EA for Chum salmon PSC management measures (June 2011, March 2012, December 2012) and although each time the Council modified alternatives to better address the complicated layered management of multiple measures on the same fishery, each alternative was estimated to slow the fishery down in the B-season which thus tended to increase Chinook salmon PSC. Eventually in December 2012 at its third initial review of the modified chum analyses, the Council took the following motion:

> *The Council is concerned that the current suite of alternatives does not provide a solution to the competing objectives outlined in the problem statement and purpose and need, recognizing the overall objective to minimize salmon bycatch in the Bering Sea pollock fishery to the extent practicable, while providing for the ability to achieve optimum yield in the pollock fishery. It is clear from the analysis thus far that measures considered to reduce bycatch of Alaska origin chum have a high likelihood of undermining the Council's previous actions to protect Chinook salmon.*
>
> *The Council requests that each sector provide a proposal that would detail how they would incorporate a western Alaska chum salmon avoidance program, with vessel level accountability, within their existing Chinook IPA for Council review. Upon review and public input, the Council would determine whether to further pursue this potential approach to best meet the multiple objectives outlined in the problem statement.*

A combined proposal for incorporating chum into the IPAs was presented to the Council in October 2013 in conjunction with the staff discussion paper. This proposal is attached as Appendix 2. This appendix provides some concepts for a revised RHS program for chum. However, it is not a final proposal as elements would likely need to be modified in light of updated chum genetics information. It does provide some details for the Council on how the IPAs would include chum into their existing agreements. The proposal has two main objectives: to provide a higher level of bycatch reduction for chum of Alaskan-origin and to provide flexibility to continue to avoid Chinook when Chinook salmon bycatch encounters increase after September 1. The original ICA prior to Amendment 91 included provisions to cease chum closures regardless of the Base Rate when Chinook encounters were high which allowed for maximum flexibility to avoid Chinook late in the B-Season. When the Amendment 84 regulations were revised under Amendment 91, all references to Chinook in the regulations were removed including this flexibility.

2.3 Regulatory changes necessary for a combined management program

From a regulatory standpoint several changes would need to be made to incorporate chum into the existing IPAs to create one combined comprehensive salmon PSC management program in the Bering Sea. The changes and additional considerations in designing a combined bycatch management program are provided below. At a minimum regulations at 679.21(f)(12) must be modified to include ‘chum’ in the description of required elements. These regulations for IPA requirements for Chinook are included in Appendix 3.

It is for the Council to decide in what manner to best combine bycatch management programs to allow the most flexibility in avoiding bycatch of both species. Simply adding 'chum' to where 'Chinook ' is listed may not in fact achieve the Council's stated given the issues as noted regarding the timing of the bycatch. All current regulations at 679.21(g)(2) would need to be revised or either removed altogether or, depending upon the Council's intent, include some provisions of proposed chum management explicitly in regulation. The current non-Chinook salmon ICA regulations in § 679.21(g) are also included in Appendix 3. These regulations specify all the contractual details of the previously voluntary RHS system. In doing so, and noted in the previous Chum EA/RIR analysis, the regulations reduce the flexibility of the RHS to adapt to changing conditions as well as to balancing between bycatch reduction for chum and Chinook simultaneously.

Previously in conjunction with the Chum EA/RIR analysis last reviewed in December 2012, Council and NMFS staff suggested regulatory revisions to the current suite of regulations as detailed above. These revisions may be found on pages 58-60 of the initial review draft (and in Table 2 below) and focus primarily on essential and non-essential provisions should the RHS system remain in the regulations rather than in the IPAs themselves (the consideration of moving chum into the IPAs emerged from the Council motion at the December 2012 meeting but not prior to nor included for that regulatory discussion in the Chum EA).

Table 2. Summary of essential and non-essential regulations in § 679.21(g) based on structure of primary management program: Non-essential regulations represent minimum potential regulations at discretion of the Council.

Essential Regulations	Non-Essential Regulations:
Submission Location, and Deadlines for the proposed non-Chinook bycatch ICA:	Initial Base Rate, and Inseason adjustments to the non-Chinook base rate calculation: § 679.21(g)(2)(iii)(A)
Information Requirements: Participants to the ICA & Identifiers: (§ 679.21(g)(2)):	Maximum or Minimum Chum Salmon Savings Area: § 679.21(g)(2)(iii)(D)
Information Requirements; Third Party: § 679.21 (g)(2)(i)(D)	ICA Chum Salmon Savings Area notices: § 679.21(g)(2)(iii)(D)
NMFS review of the proposed ICA and amendments: 679.21 (g)(3)	Fishing restrictions for vessels assigned to tiers, and Cooperative tier assignments: § 679.21(g)(2)(iii)(E)
ICA Annual Report – Regulatory Detail: The ICA Annual Report at § 679.21(g)(4)	Annual Compliance Audit and Requirement for data dissemination: at § 679.21(g)(2)(iv)
If Regs on notice dates continued, clarify that twice weekly notices are dependent on whether any closure(s) are being implemented: § 679.21(g)(2)(iii)(C)	detailed enforcement provisions from current RHS ICA:§ 679.21(g)(2)(iv)

Additionally in the draft chum EA/RIR, staff suggested some broader provisions that could be included as a more general goals and objectives for the RHS system to be considered by the Council in conjunction with identifying a preferred alternative and prior to developing regulations. These are excerpted below:

In addition to structural provisions of the program, some additional aspects of the revised RHS should be included in regulation to ensure that the aspects of the program which are explicitly structured to meet the Council's objectives are retained. These are the following:

- *Closures*: some information in the regulations to ensure that the closure rules are followed. This could be provisions to ensure the number of closures per week, the rules for the closures or the rate-basis for the closures.
- *WAK chum*: some regulation to indicate that program is structured to prioritize closures for WAK chum over others.
- *Chinook threshold*: This is a critical component of the revised RHS to explicitly tie it to the problem statement and Council objective. Information in the regulations could consider specifying both the threshold employed and the start date for it.

In commenting on the EA draft NMFS noted that the details by which these concepts would be specified in regulation, should the Council wish to retain the RHS program in explicit regulations, would need to be further developed. However for all of these concepts, the intent at that time was not to develop coordinated comprehensive salmon bycatch management program in the Bering Sea but for addressing chum management (only) in the context of not undermining the efficacy of the current Chinook management program. Therefore depending on the direction under taken by the Council in developing this comprehensive bycatch management program, these suggested revisions (both in the 'mandatory provisions' and 'suggested revisions') would need to be revisited in light of the current change in focus and are thus not directly applicable.

2.3.1 FMP changes

The FMP for Bering Sea Aleutian Islands groundfish contains two main sections relevant to Chinook and non-Chinook (chum) salmon PSC management in sections 3.6.2.1.6 (Chinook) and 3.6.2.1.7, 3.6.2.2.4 (Chum)[3]. These sections are excerpted below. All other details of the IPAs and ICAs are contained in the regulations.

3.6.2.1.6 Chinook Salmon

Bering Sea Chinook Salmon Bycatch Management Program: The annual PSC limit for Chinook salmon in the directed fishery for pollock in the Bering Sea subarea is either 47,591 Chinook salmon or 60,000 Chinook salmon. The Chinook salmon PSC limit is a hard cap which may not be exceeded. The PSC limit will be allocated seasonally 70 percent to the A season and 30 percent to the B season. The seasonal apportionments of the Chinook salmon PSC limit will be further allocated among the four AFA sectors: the AFA trawl catcher/processor sector, the AFA mothership sector, the AFA inshore sector, and the CDQ Program based on percentage allocations specified in regulation. Allocations to the inshore sector are further allocated among the inshore cooperatives and the inshore open access fishery. Allocations to the CDQ Program are further allocated among the CDQ groups. Chinook salmon PSC allocated to the sectors, inshore cooperatives, or CDQ groups is transferable under certain circumstances described in regulation.

[3] Note other sections of the FMP refer to Chinook and chum PSC management (summary, appendix etc) but these are the sections which would form the primary amendment revisions for management changes.

The 60,000 Chinook salmon PSC limit is available to the AFA sectors whose members voluntarily participate in an incentive plan agreement (IPA) approved by NMFS and that meet a Chinook salmon bycatch performance standard. An IPA is a voluntary private contractual agreement among vessel owners, CDQ groups, or both that provides incentives to avoid Chinook salmon bycatch at all levels of Chinook salmon abundance and salmon encounters rates. The 47,591 PSC limit will be in effect for all sectors if no IPA is approved by NMFS. The 47,591 PSC limit also will be in effect for any sector that exceeds its Chinook salmon bycatch performance standard. The performance standard requires that, if any sector fishing under the 60,000 Chinook salmon PSC limit exceeds its share of 47,591 Chinook salmon in three of seven consecutive years, that sector will be allocated a portion of the 47,591 PSC limit in all future years.

The process for allocating the Bering Sea Chinook salmon PSC limit among participants in the Bering Sea pollock fishery; requirements governing the transfer and use of these allocations; and requirements for an IPA, the performance standard, annual reporting, and other aspects of the Bering Sea Chinook Salmon Bycatch Management Program are specified in Federal regulations implementing the FMP.

3.6.2.1.7 Other Salmon

When the Regional Administrator determines that 42,000 non-Chinook salmon have been caught by vessels using trawl gear during the time period of August 15 through October 14 in the catcher vessel operational area (see Section 3.5.2.1.5), NMFS will prohibit directed fishing for pollock with trawl gear for the remainder of the period September 14 through October 14 in the chum salmon savings area (see Section 3.6.2.2.4), unless the vessel is operating under a salmon bycatch reduction inter-cooperative agreement. Accounting for the 42,000 fish PSC limit will begin on August 15.

2.4 Purpose and need statement for comprehensive salmon bycatch management program

In drafting a problem statement for merging chum salmon with Chinook in a comprehensive Bering Sea salmon bycatch management program there are several consideration for the Council. Under both current non-Chinook (chum) bycatch management (Amendment 84) and Chinook bycatch management (Amendment 91) the explicit goals and objectives are not specified in the FMP itself but in the regulations. As noted above, specific goals and objectives for Chinook are contained in the items listed under the ‘Description of the incentive plan’ at 679.21(f)(12). For chum the ‘provisions’ section of the ICA are the nearest to goals and objectives.

The Council may wish to explicitly (in regulation or in the FMP) establish goals and objectives for a comprehensive salmon bycatch management program. This could include promoting Chinook salmon bycatch avoidance at all levels of abundance with prevention of high chum salmon bycatch and flexibility on the fleet to balance bycatch avoidance in a more holistic manner. A combined program which addresses both goals concurrently may allow for more flexibility to harvest pollock in times and places that best support these goals. A combined program would also allow for complementary and coordinated management of all salmon bycatch in the Bering Sea and build upon the current management program for Chinook for greater efficacy and efficiency while noting the dual goals of avoidance at all encounter rates for Chinook and avoiding high chum bycatch and thus Alaskan chum salmon stocks where possible.

3 Bycatch performance and impact analysis pre and post implementation of Amendment 91

A discussion paper was prepared by staff in October 2013 per Council request in April 2013. Elements of this paper included updated AEQ analysis with more recent genetic data, estimation of impact rates of bycatch and at cap levels as well as fleet, sector and vessel-level evaluations of bycatch performance since 2011. These results (and expansions from October analysis as noted previously in submitted manuscripts) are summarized below.

3.1 Chinook salmon adult equivalent mortality estimates

3.1.1 Impacts of bycatch on WAK salmon stocks

Analytical methods update

At the October 2013 Council meeting the Council received a working paper which presented updated results of for Chinook salmon mortality analysis due to the EBS pollock fishery. This work developed from earlier studies applied for Chinook salmon in the FEIS (NPFMC/NMFS 2009) and the draft EA for chum salmon (NPFMC 2012). The main differences from the earlier work on Chinook salmon adult equivalent (AEQ) analysis were: 1) additional, genetic data have been collected and used to determine stock of origin for a more representative sampling scheme (for this purpose), 2) the in-river maturity information was updated by ADFG, 3) as was introduced in the draft chum EA, the genetic stock composition estimates were appropriately lagged to coincide with the annual AEQ values (previously the genetic stock composition information from the bycatch was assumed to be static).

AEQ of actual bycatch levels/impact rates

Results presented in October indicated broadly similar patterns of total AEQ values compared with the estimates from the FEIS (NPFMC/NMFS 2009) and since 2008, the AEQ values for Chinook salmon has declined considerably (Fig. 3). Broken out by the nine stock groups available with the genetics, the estimated total numbers of Chinook salmon are presented in Table 3. Also shown in this table is the estimate of the uncertainty in total AEQ and the proportion by regional stock group (RSG) of the AEQ that occurred during the “A” season (Ianelli and Stram, *In Review*).

Introducing run-size information to allow estimation of the impact rates shows very little relationship between AEQ mortality due to the pollock fishery and the size of the runs, especially given the uncertainty in the RSG-estimated impacts and of the run strength (e.g., Fig. 4). Here the focus was on comparing two critical RSG impacts: to coastal western Alaska and to the Upper Yukon. The peak estimated impact for both these regions occurred in 2008 and was estimated at 7.9% and 4.7% of their potential total returns, respectively (Table 3; Fig. 5). As with the AEQ estimates for these RSGs, the uncertainty appears to have decreased considerably under the new genetics sampling protocol.

The earlier methods to estimate impacts of bycatch to western Alaskan Chinook salmon stocks resulted in similar numbers for the period covered yet coarser approximations were required since these studies relied on average proportions as determined from scale-pattern analysis from earlier, foreign and joint-venture fisheries (i.e., from 1979-1982; Witherell et al. 2002). Combining minimal run-size estimates for western Alaska with estimates of AEQ, they obtained an average estimated impact due to the trawl fisheries of about 2.7% for the period 1990-2000 This compares with our estimate from 1994-2000 of 2.4%. The similarity is striking but it should be noted that contemporary run size estimates used here are about one third higher than those applied in the Witherell et al. (2002) study and that the AEQ estimates here were further broken down based on updated GSI information instead of relatively old scale-pattern data. The study leading to the current management regulations failed to examine impact rates due to concerns over the relative uncertainty in run-size strengths for Chinook in western Alaska river systems (NMFS/NPFMC, 2009). This study is also the first to break out the Upper Yukon (Canadian-origin portion) from the western Alaskan stocks for estimating both AEQ and impact rates.

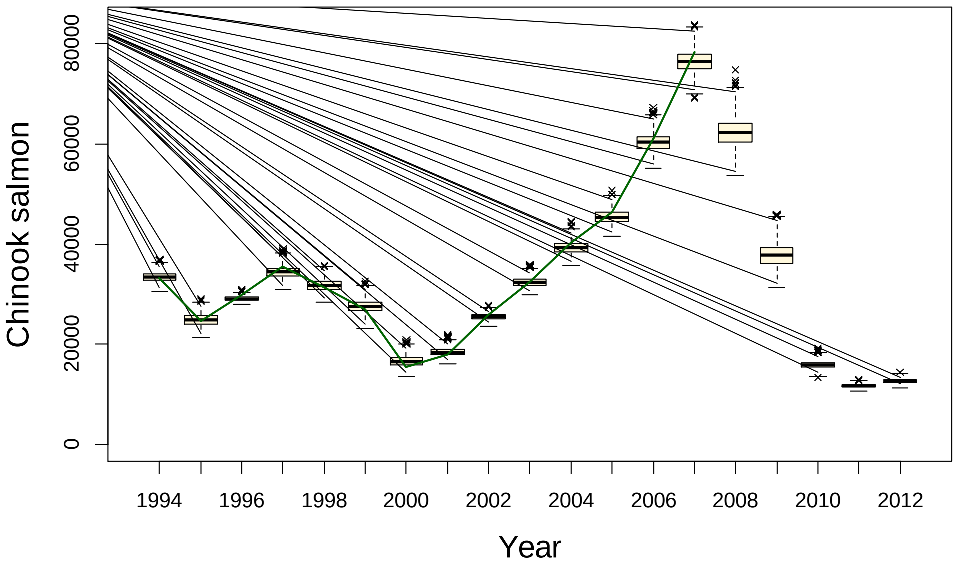

Figure 3. Boxplot showing the posterior distribution of annual total adult equivalent mortality of Chinook salmon from the EBS pollock fishery, 1994-2012. Units are numbers of salmon and height of boxes represent the uncertainty (inter-quartile ranges) due to oceanic survival and other factors that vary within the model. Horizontal lines within the boxes represent the medians of the posterior distribution. Solid thick line from 1994-2007 are the values from the FEIS (NPFMC 2009).

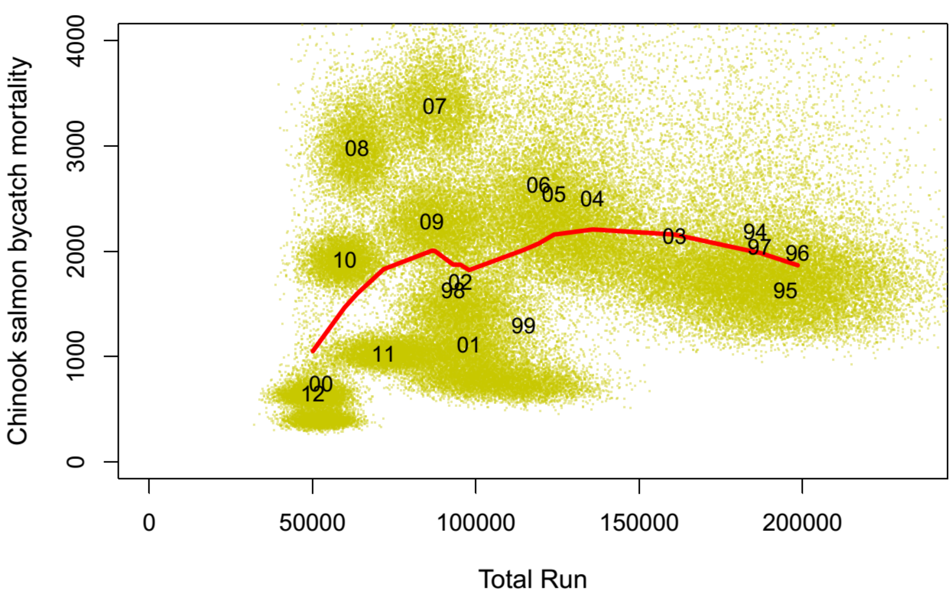

Figure 4. Example comparing the AEQ mortality of Chinook salmon from the EBS pollock fishery attributed to the Upper Yukon (vertical axis) with estimated Upper Yukon total Chinook salmon run size (horizontal axis) for 1994-2012. Units are numbers of Chinook salmon, the

numbers represent the median value by year, dots represent random draws from the posterior distribution, and the line is a smoother through the points.

Table 3. Chinook salmon AEQ estimates (annual mean of the posterior distribution) by regional stock group for the years 1994-2012 (top panel) and the proportion of AEQ for each stock group that occurred during the A season (bottom panel). Last column of the upper panel represents the coefficient of variation (CV) of the estimated total AEQ.

	BC-WA-OR	Coast W AK	Cook Inlet	Middle Yukon	N AK Penin	Other	Russia	SEAK	Upper Yukon	Total	CV
1994	3,693	18,9j69	705	865	5,805	268	542	432	2,185	33,464	2.8%
1995	2,808	14,053	508	598	4,408	201	376	321	1,626	24,899	4.5%
1996	3,115	16,375	505	703	5,476	210	401	372	1,981	29,139	1.3%
1997	4,403	19,585	917	771	5,351	346	612	454	2,043	34,482	3.3%
1998	4,762	18,163	1,099	607	4,056	406	653	431	1,626	31,804	3.4%
1999	4,422	15,780	1,071	480	3,112	393	608	378	1,294	27,538	4.6%
2000	2,804	9,539	676	248	1,812	253	363	231	739	16,666	6.5%
2001	2,130	10,659	517	540	2,704	171	384	242	1,109	18,456	4.6%
2002	2,687	14,483	506	692	4,526	190	410	328	1,704	25,525	2.3%
2003	3,481	18,414	670	875	5,655	251	532	419	2,141	32,438	2.5%
2004	4,468	22,384	907	1,025	6,525	336	682	512	2,497	39,336	2.9%
2005	6,912	24,880	1,149	1,135	7,001	355	938	548	2,544	45,463	2.7%
2006	12,644	27,928	1,337	1,258	12,232	376	1,163	779	2,629	60,346	2.7%
2007	12,244	43,227	1,501	1,740	11,976	305	1,193	870	3,373	76,430	2.8%
2008	6,651	39,373	1,239	1,541	8,851	204	827	664	2,974	62,323	4.4%
2009	2,371	25,427	658	1,123	5,087	104	407	399	2,281	37,857	6.2%
2010	1,622	8,283	222	751	2,604	86	179	229	1,916	15,893	4.6%
2011	1,438	6,555	215	417	1,603	72	118	191	1,026	11,635	2.9%
2012	1,592	7,773	286	279	1,686	96	136	202	648	12,699	3.4%

	BC-WA-OR	Coast W AK	Cook Inlet	Middle Yukon	N AK Penin	Other	Russia	SEAK	Upper Yukon	Total
1994	44%	66%	15%	76%	89%	24%	39%	63%	83%	67%
1995	44%	68%	16%	84%	89%	24%	43%	65%	85%	68%
1996	50%	74%	20%	91%	92%	29%	52%	71%	89%	75%
1997	32%	55%	10%	74%	83%	16%	30%	52%	76%	56%
1998	19%	39%	5%	61%	72%	9%	18%	36%	63%	40%
1999	14%	30%	4%	53%	64%	6%	13%	28%	54%	31%
2000	12%	28%	3%	56%	61%	5%	12%	25%	52%	28%
2001	32%	50%	9%	52%	82%	16%	24%	48%	70%	52%
2002	47%	68%	16%	75%	90%	26%	41%	66%	84%	69%
2003	45%	66%	15%	74%	89%	25%	39%	64%	83%	67%
2004	40%	61%	13%	71%	87%	21%	34%	58%	80%	62%
2005	25%	54%	10%	63%	80%	19%	24%	54%	77%	53%
2006	47%	60%	13%	71%	87%	33%	32%	69%	76%	62%
2007	50%	63%	15%	63%	86%	50%	38%	71%	71%	64%
2008	51%	58%	14%	53%	87%	55%	41%	65%	64%	61%
2009	55%	51%	15%	46%	87%	58%	48%	58%	68%	57%
2010	32%	63%	25%	79%	91%	35%	66%	50%	91%	68%
2011	36%	53%	16%	82%	90%	27%	59%	51%	94%	60%
2012	34%	46%	11%	76%	87%	19%	45%	46%	91%	52%

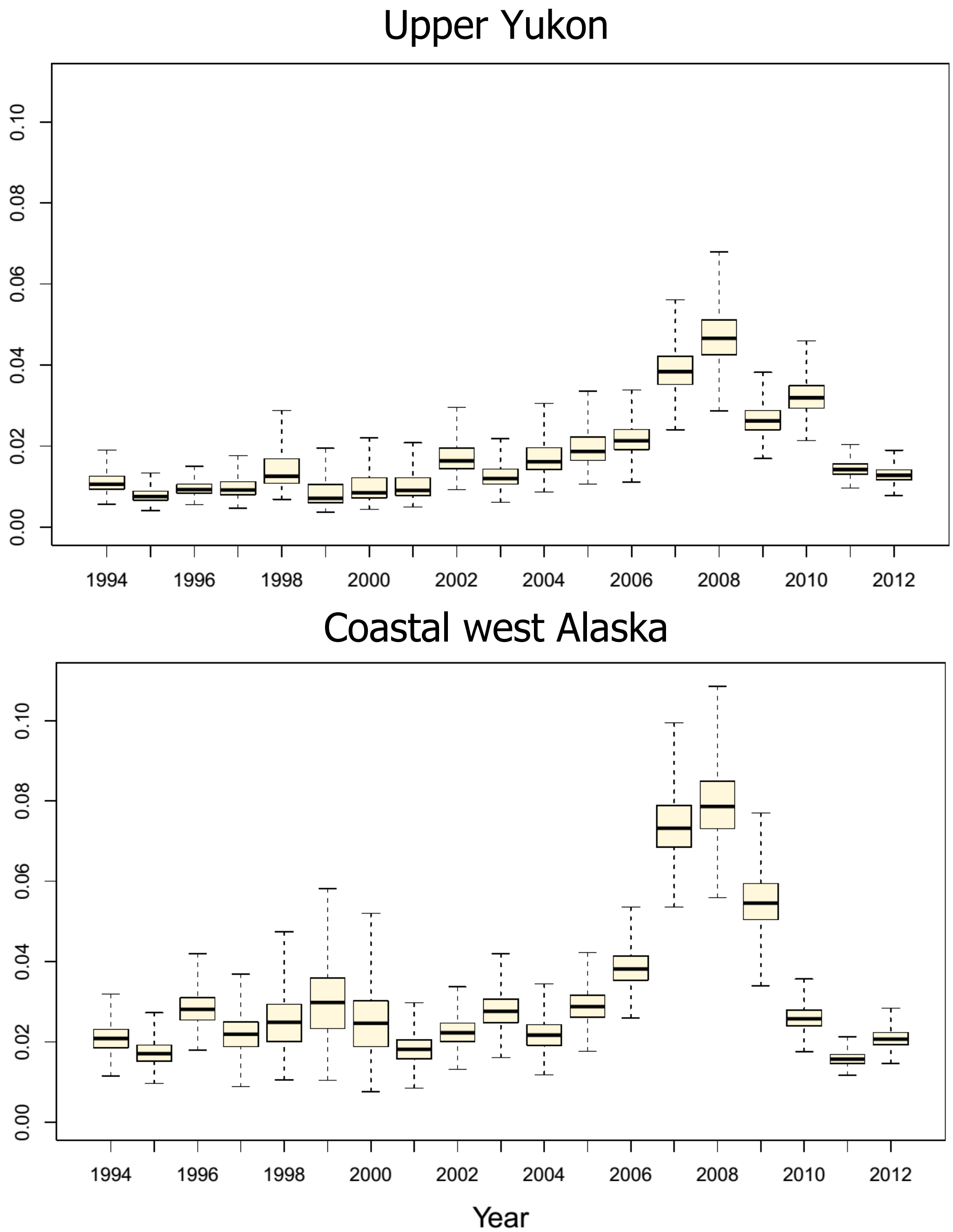

Figure 5. Estimated impact of the EBS pollock fishery on the Upper Yukon stock (top) and coastal west Alaska (which includes the "middle Yukon"; bottom), 1994-2012. Vertical axis is the ratio of AEQ over the point estimates of total run sizes.

3.1.2 Evaluation of impact rates if actual amendment 91 cap levels had been reached (in 2011 and 2012)

In order to better inform fishery managers as to the impacts of their current cap levels, a "what-if" analysis was done where the bycatch was raised (proportional to the observed bycatch timing and locales) to the cap levels of 47,591 and 60,000 Chinook salmon for 2011 and 2012. For simplicity, season and sector-specific limits were ignored and the full annual bycatch limit was attained by proportionally inflating the observed bycatch totals in each sector and season. Hypothetically increasing the 2011 bycatch to its cap of 47,591 resulted in increase from the 2011 estimate of 1.6% to about 2.7% in impact on the coastal west Alaska RSG. Increasing bycatch to cap levels of 47,591 in 2011 and 60,000 in 2012 showed a greater potential impact in 2012, but below the maximum observed for most scenarios (Fig. 6; Table 4). Note that the greater hypothetical impact in 2012 compared to 2011 is due to AEQ being affected by increased catches in two years (both 2011 and 2012). While noting that the full bycatch limits being reached for all sectors in each season is unrealistic (i.e., some sectors would have reached their limit while others could remain below), this analysis suggests had the management caps been reached, the measures of impact rate on some key Alaska stocks at the lower cap levels would likely have been below historical high level estimated for 2008.

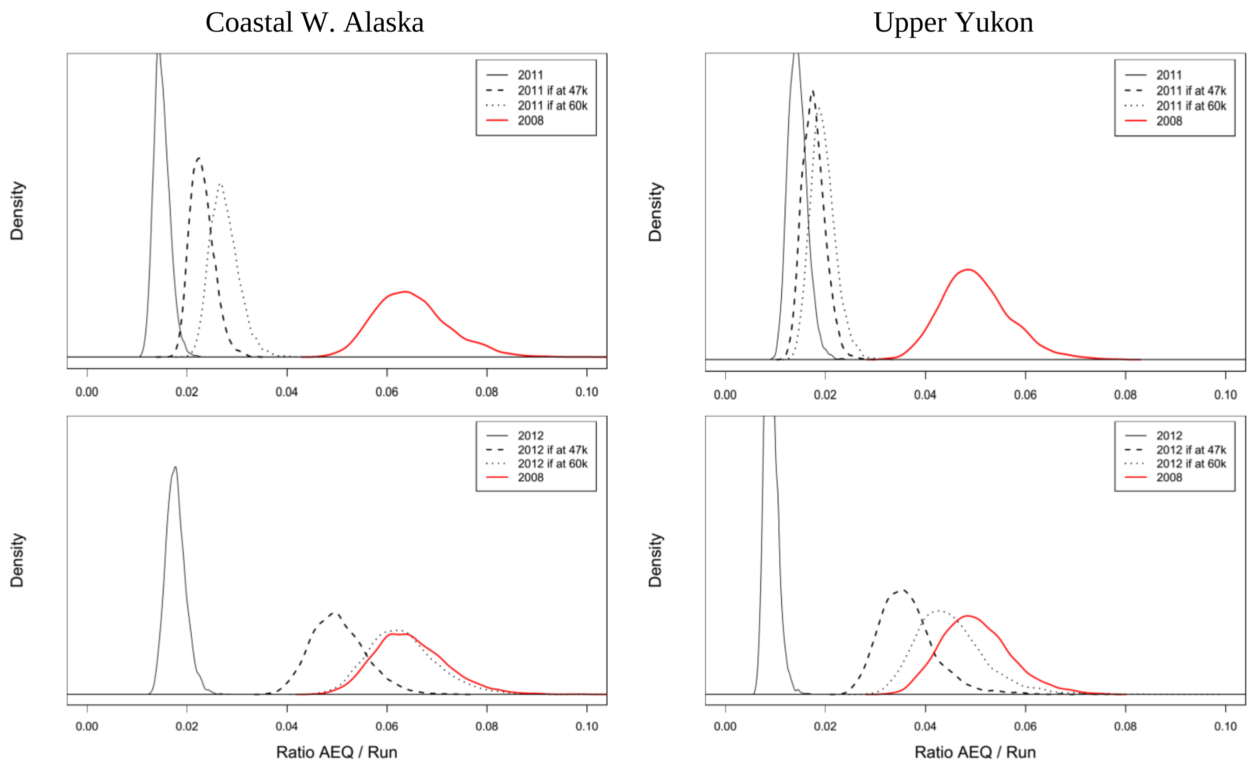

Figure 6. Estimated impact (thin solid line) of the EBS pollock fishery on the coastal west Alaska (which includes the "middle Yukon", left) and the Upper Yukon (right) for 2011 (top) and 2012 (bottom). The height of the shapes is intended to represent the relative probability (density) of impact rates shown on the horizontal scale. Also plotted are densities of impacts estimated for 2008 (the highest year of historical impact) and for 2011 and 2012 had the current sector-specific bycatch limits all been attained.

Table 4. Results of the Chinook salmon AEQ analysis combined with the available genetic data for the years 1994-2012 impact as the ratio of AEQ to estimated ADFG run size. Note that middle Yukon is added to the coastal west Alaska group.

	Coastal West Alaska		
	Estimated	If 47,591 cap	If 60,000 cap
2011	1.6%	2.5%	3.0%
2012	2.0%	5.0%	6.3%
	Upper Yukon		
	Estimated	If 47,591 cap	If 60,000 cap
2011	1.6%	1.9%	2.1%
2012	1.4%	3.9%	4.8%

3.2 Evidence of behavioral changes by the fleet in response to A91

3.2.1 Overall patterns of bycatch

Rate-based (Chinook salmon per ton of pollock) data by sector were compared over years, months, and seasons to characterize performances before and after program implementation in 2011. In addition to fleet level trends, direct NMFS observer program data were queried to allow for vessel-level evaluations on fishing behavior before and after program implementation. For presentation, the vessels in each were selected that were among the five highest and five lowest bycatch rates and their bycatch rates were evaluated over time. Data collected on vessels that had more than 40,000 t of pollock during 2003-2013 were pre-selected as been actively participating in the pollock fishery and included in the dataset. Each vessel was then ranked within each sector and year based on their average annual bycatch rate (Chinook salmon per t of pollock) relative to other vessels. For the shore-based catcher vessel sector (the fleet with the most bycatch and highest rate) the seasonal bycatch pattern was evaluated for the whole period and compared with recent years. This was intended as an approximation of whether individual vessel ranking has improved under the new management program. Thresholds were defined for estimating when a vessel began fishing (25% of quota) and when fishing was near completion (75% of quota).

Bycatch rates (Chinook salmon per t of pollock) have declined overall in all sectors since the 2004-2007 historically high period (Fig. 7). By month, February and March and September and October tend to have the highest rates and numbers across the fleet with some differences amongst sectors. The highest numbers for CPs are in February and March and September and October (Table 5). Bycatch rates in October 2011 were the second highest by month after 2007. For Motherships, October 2011 was also anomalously high over the 2003-2013 period for number by month. By rate, October 2011 was the third highest since 2003. Rates for the mothership sector are generally highest in February and March as well as sporadically in October. For the shore-based CV sector highest numbers are generally in January through March and September to October. The rate in October is high in many more of the years and seems to be the most consistent pattern. Also, the average rates in the shore-based sector are higher than in the other sectors across all years. At the cooperative level, the variability between years is high (Table 6).

A simple comparison of Chinook salmon rates for the three years since Amendment 91 was implemented to the three years previous indicates an 18% reduction (Fig. 8). Comparing to the last decade or since 1991 shows an even more dramatic reduction:

Base year range	Base Year Rate	2011-2013 rate	Post-A91 reduction relative to base period
1991-2010	0.033	0.0137	58%
2001-2010	0.038	0.0137	64%
2008-2010	0.0167	0.0137	18%

Given the indication of higher rates annually in the latter part of the B-season, mean weekly bycatch rates by sector were examined for September and October (Fig. 9). This shows that the fleet specific pollock catches decline later in the season but the Chinook salmon bycatch rate (salmon per t of pollock) increases. The pattern is similar for each sector; however, the shore-based fleet shows the most dramatic increase, particularly from the middle of October onwards (Fig. 9). A closer examination of the shore-based fleet comparing the longer mean pattern with more recent years (when more active vessel-incentives were effectively underway due to the implementation of the shore-based incentive program one year prior to Amendment 91) shows a similar pattern but much lower rates (Fig. 10).

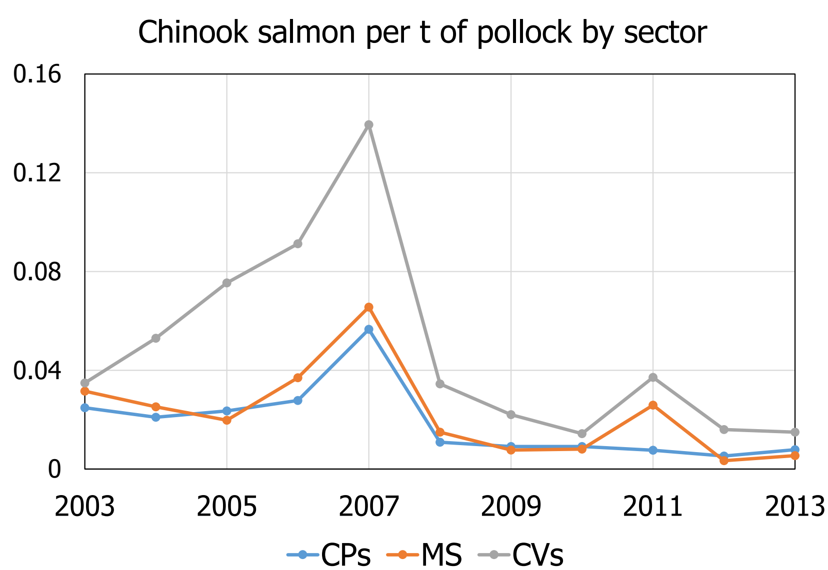

Figure 7. Trends in the annual bycatch rates by sector, 2003-2013.

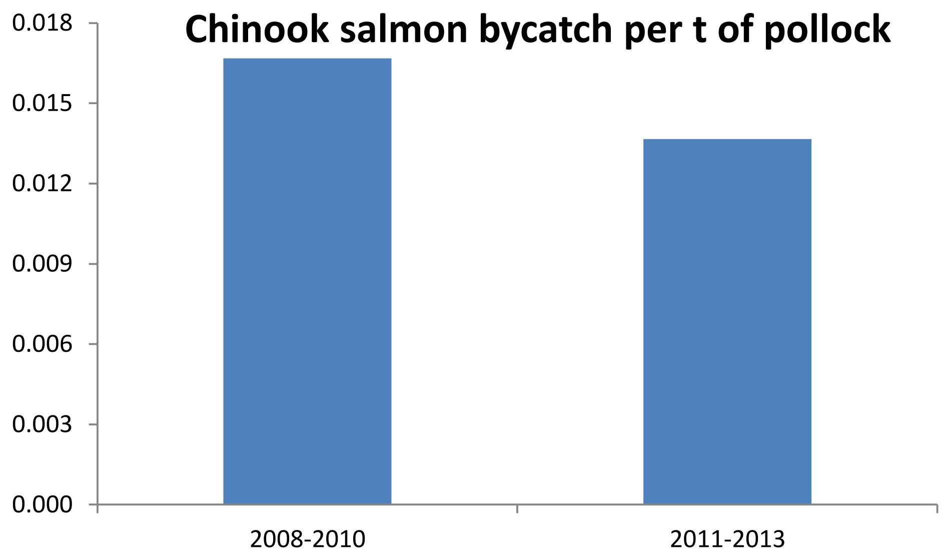

Figure 8. Chinook salmon bycatch rates for the most recent three years compared to the years prior to Amendment 91 (all sectors combined).

Table 5. Annual and monthly pattern of pollock fishing Chinook salmon bycatch (number per t of pollock). Shading represents higher bycatch rates. Note effective pollock season closures are in April, May, November and December.

	Month	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Catcher processors	J	0.06	0.03	0.04	0.06	0.14	0.02	0.07	0.04	0.01	0.02	0.03
	F	0.10	0.03	0.05	0.06	0.14	0.04	0.01	0.03	0.01	0.01	0.02
	M	0.04	0.05	0.03	0.08	0.07	0.02	0.02	0.02	0.01	0.01	0.01
	J	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	J	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	S	0.05	0.02	0.03	0.01	0.03	0.00	0.00	0.00	0.01	0.00	0.00
	O	0.15	0.05	0.03	0.01	0.12	0.01	0.00	0.00	0.02	0.00	0.02
		2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Mothership	J	0.07	0.02	0.03	0.08	0.21	0.11	0.05	0.00	0.02	0.05	0.03
	F	0.06	0.04	0.04	0.10	0.10	0.02	0.02	0.02	0.01	0.01	0.01
	M	0.05	0.05	0.03	0.09	0.05	0.03	0.01	0.02	0.01	0.00	0.01
	J	0.00	0.01	0.01	0.00	0.00		0.00	0.01	0.00	0.00	0.00
	J	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	S	0.02	0.02	0.02	0.00	0.04	0.01	0.01	0.00	0.01	0.00	0.00
	O	0.15	0.08	0.02	0.00	0.18	0.01			0.18		
		2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Shorebased CVs	J	0.05	0.04	0.04	0.12	0.41	0.12	0.32	0.15	0.01	0.02	0.02
	F	0.07	0.04	0.07	0.19	0.16	0.07	0.03	0.05	0.02	0.03	0.01
	M	0.05	0.06	0.03	0.06	0.04	0.02	0.01	0.01	0.02	0.02	0.02
	J	0.00	0.00	0.01	0.03	0.01	0.00	0.01	0.01	0.00	0.00	0.00
	J	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A	0.00	0.02	0.03	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01
	S	0.02	0.06	0.07	0.07	0.14	0.03	0.05	0.03	0.10	0.02	0.05
	O	0.13	0.35	0.44	0.20	0.46	0.22	0.04	0.19	0.24	0.08	0.13

Table 6. Chinook salmon bycatch number per t of pollock by Shorebased CV cooperative 2003-2013.

Coop	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
101	0.033	0.038	0.065	0.075	0.113	0.028	0.028	0.021	0.030	0.015	0.016
102	0.030	0.038	0.049	0.084	0.129	0.031	0.033	0.013	0.037	0.019	0.027
103	0.034	0.044	0.040	0.038	0.095	0.016	0.013	0.014	0.015	0.006	0.010
104	0.033	0.019	0.023	0.042	0.072	0.024	0.015	0.014	0.033	0.006	0.006
105	0.035	0.050	0.062	0.070	0.103	0.013	0.017	0.014	0.009	0.007	0.008
106	0.026	0.030	0.042	0.045	0.071	0.024	0.006	0.007	0.026	0.006	0.004
107	0.027	0.034	0.035	0.048	0.081	0.019	0.010	0.007	0.016	0.008	0.009

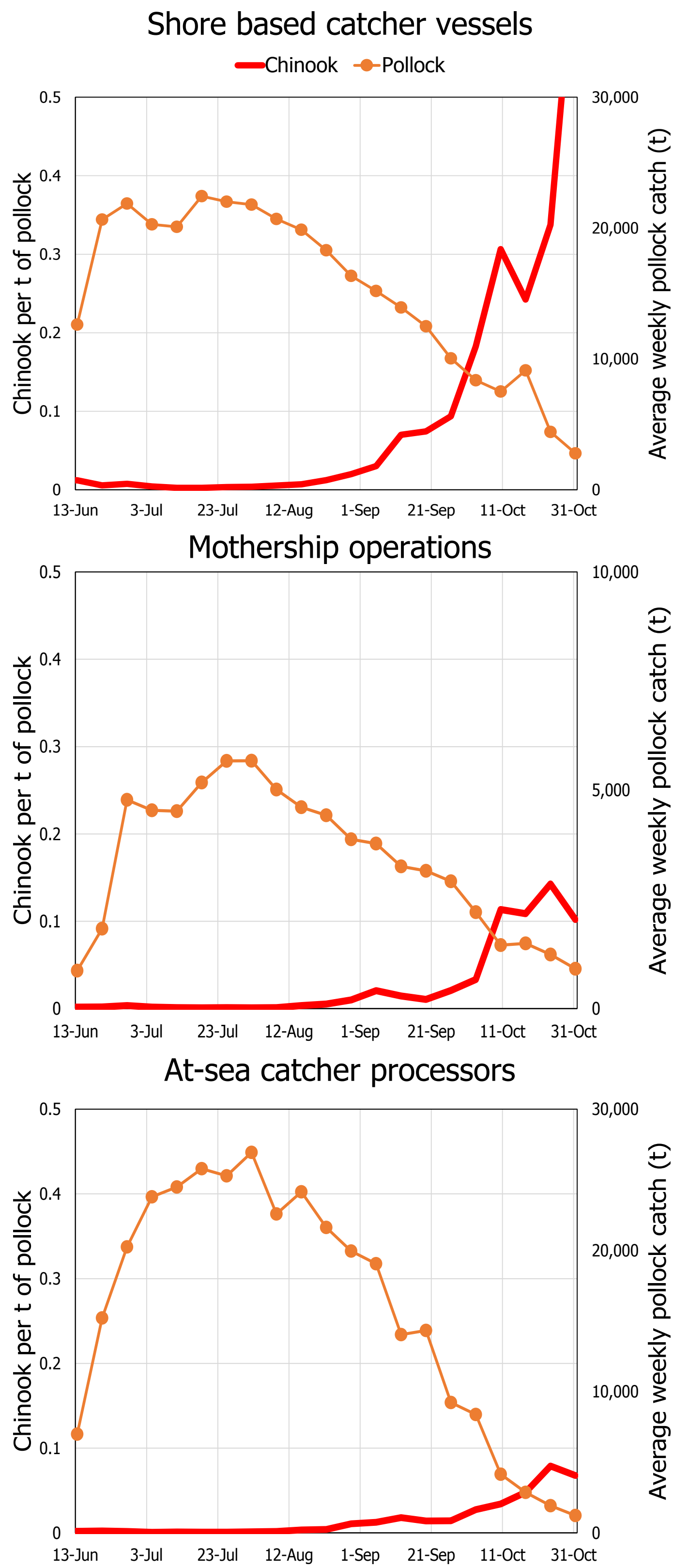
Shore based catcher vessels
Chinook
Pollock
Chinook per t of pollock
Average weekly pollock catch (t)
0.5
0.4
0.3
0.2
0.1
0
30,000
20,000
10,000
0
13-Jun
3-Jul
23-Jul
12-Aug
1-Sep
21-Sep
11-Oct
31-Oct
Mothership operations
Chinook per t of pollock
Average weekly pollock catch (t)
10,000
5,000
0
At-sea catcher processors
Chinook per t of pollock
Average weekly pollock catch (t)
30,000
20,000
10,000
0

Figure 9. Average weekly pollock catch compared to Chinook salmon PSC rate (salmon per t of pollock) by sector from September 1 to October 31st, 2003-2013.

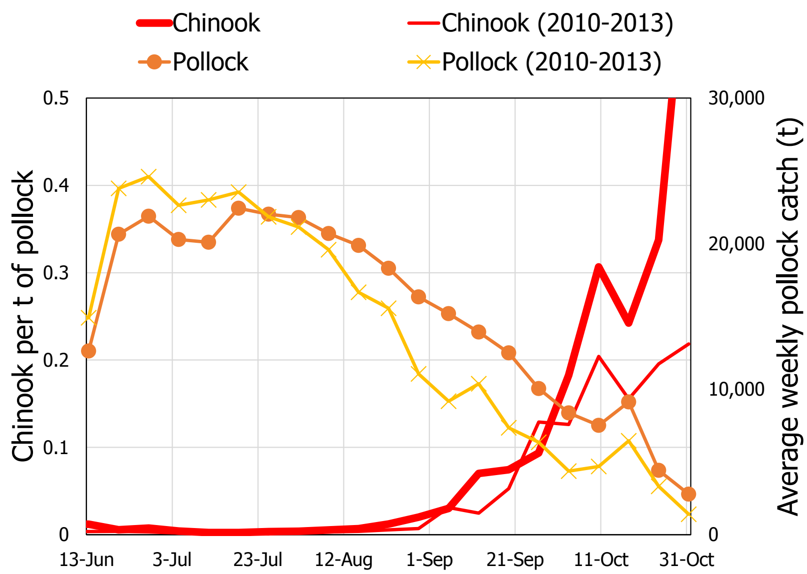

Figure 10. Detail of average Chinook salmon bycatch rates (left axis) compared to pollock catch by week for the B season for the shore-based catcher vessels by week, 2003-2013 compared to a more recent period (2010-2013).

Another examination was to group five vessels with the highest bycatch rates (over the period) and similarly form a second group of the five vessels that had the lowest bycatch rates (by sector). An examination of their relative ranking over time indicated some variability within and between sectors but changes were relatively minor—while the sectors as a whole improved their bycatch by having lower rates (per t of pollock), relative to other vessels within their sector the changes were minor.

3.2.2 Vessel-level bycatch evaluations

Individual vessel rankings within and between sectors shows a relatively large range of performance with shore-based catcher vessels having much higher rates than the other sectors (Fig. 11). Given this, seasonal differences are evaluated for the shore-based fleet to understand factors that have affected bycatch rates. Results show that the winter A-season rates were more similar to each other than the rates by vessels during the B season (Fig. 12, top panel). While some vessels have both high winter and summer season rates, in general the vessels with the highest winter season bycatch rates rank lower due primarily to their lower summer season bycatch rates. An individual vessel's relative ranking across all years appears to be driven primarily by their rates in the summer season (Fig. 12). For comparison with recent years, many of the best performing vessels historically retained their low ranks in recent years. More variability was seen in recent years across average vessels while some worst performing vessels appear to have improved their ranking relative to their historic performance. (Fig. 12, bottom panel). Some of the worst ranking vessels historically have remained in the lower third of the vessels considered in recent years as well. As expected, results for the mothership and catcher-processor sectors had the highest rates uniformly during the A-season (for the full data set, 2003-2013) but in the most recent years some vessels in the mothership sector had some worse rates in the B-season (but were well below the average; Figs. 13 and 14).

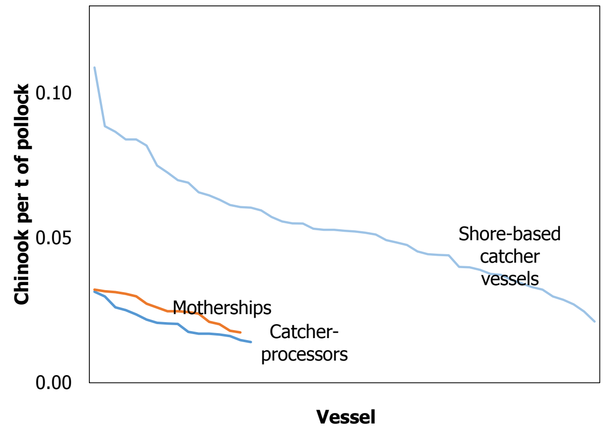

Figure 11. Chinook salmon bycatch rates by sector (2003-2013) where vessels are ranked by “worst” performers to the left and “best” (lowest bycatch rates) to the right. There were 46 shore based catcher vessels selected for this analysis (mothership and catcher-processor fleets are numerically smaller).

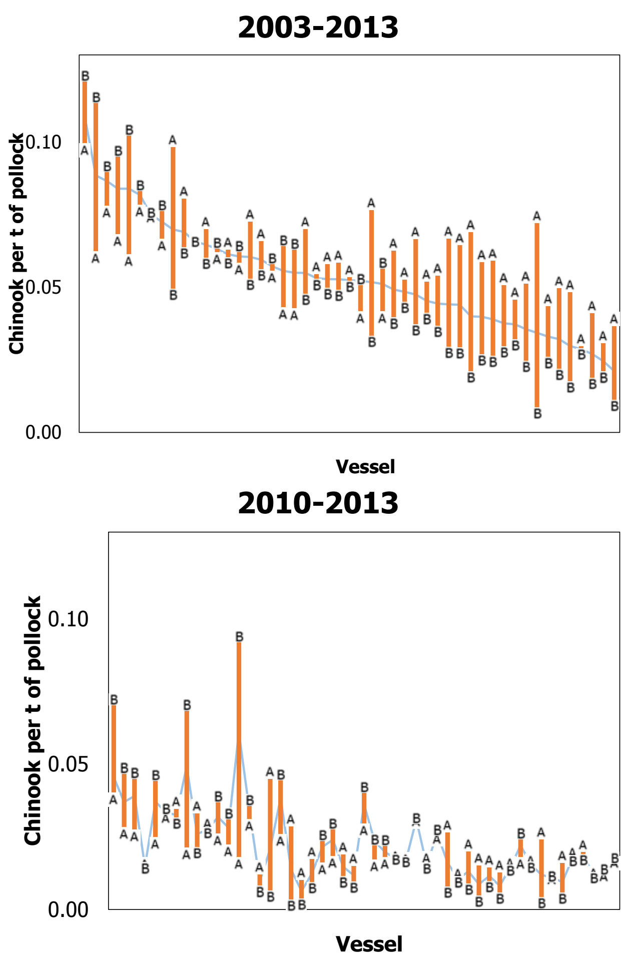

Figure 12. Aggregate annual (line) and “A” and “B” season bycatch rate over all years (2003-2013) for each of the selected “shore-based” fishing vessels. The top panel represents data from 2003-2013, the bottom is just for the recent period (2010-2013).

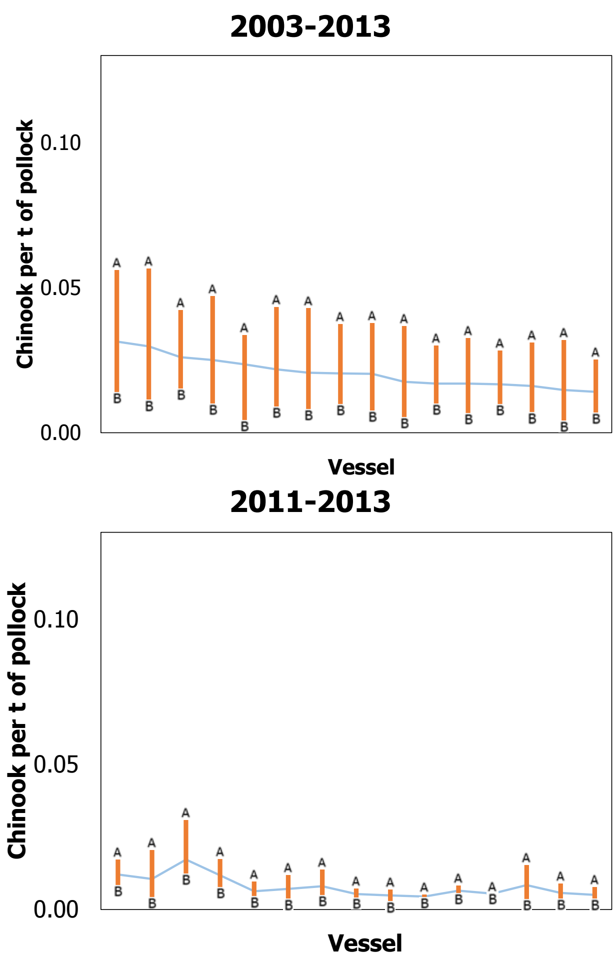

Figure 13. Aggregate annual (line) and "A" and "B" season bycatch rate over all years (2003-2013) for each of the selected at-sea catcher processor vessels. The top panel represents data from 2003-2013, the bottom is just for the recent period (2011-2013).

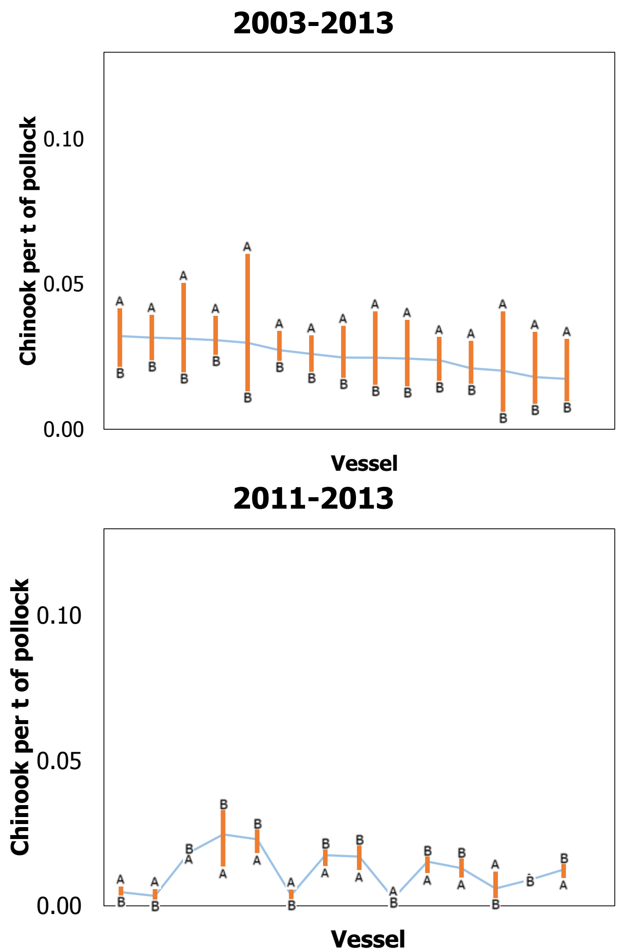

Figure 14. Aggregate annual (line) and "A" and "B" season bycatch rate over all years (2003-2013) for each of the selected Mothership vessels. The top panel represents data from 2003-2013, the bottom is just for the recent period (2011-2013).

Vessel changes based on standard deviation relative to other vessels

An alternative to ranking individual vessel performance by total Chinook salmon bycatch per t of pollock (for the period 2003-2013 as was done above) would be to compare the extent the vessels consistently are below or above the average of the rest of the fleet. This statistic simply shows how consistently the vessels perform relative to the rest of their sector. Any positive value reflects an above average rate within that year, negative would be below average; the higher the value (positive or negative), the greater the change from average within that year. For the three sectors, the average score would change the ranking some (the index in left most columns is ranking by total bycatch over 2003-2013) but generally the measures are consistent (Tables 7, 8, and 9). A comparison among cooperatives is shown in Table 10 and an AFA fishery-wide version is provided in Appendix 4. Generally speaking, evaluation of these shows some patterns that some vessels improved their bycatch rates relative to the rest of their sector. These changes could be driven by shifts in the timing of when they fished (see below).

Table 7. Chinook salmon bycatch rate score (in units of standard deviation between vessels and within years) by vessel (rows) for **at-sea catcher processors,** 2003-2013. Last column is the total bycatch from 2011-2013 by vessel.

Vess ID	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Avg 2003-2013	Avg 2011-2013	2011-2013 bycatch
1	1.79	1.11	1.39	2.7	0.53	1.8	0.43	-0	0.41	1.19	1.97	1.21	1.19	1,022
2	1.64	1.12	0.68	1.11	1.97	1.51	-0.3	-0.4	-0.3	1.81	0.62	0.85	0.71	874
3	-0.7	-0.2	-0.7	-0.5	0.46	-0.9	1.12		2.59	-1.6		-0.03	0.51	38
4	0.69	-1.1	-0.1	-0.1	1.22	-0.1	-0.2	2.73	1.08	1.76	0.59	0.59	1.14	910
5	1.99	1.51	1.73	1	0.59	1.37		0.83	0.03	-0.8	-0.3	0.8	-0.35	851
6	-0.2	1.07	1.25	0.06	-0.3	0.51	-0.6	-0.7	-0.7	0.48	-0.2	0.07	-0.12	962
7	-0.8	0.44	0.29	0.33	0.51	-0.8	-0	-0.4	0.16	0.46	-0.1	0	0.16	926
8	-0.1	0.41	1.12	-0.9	-0.9	0.22	0.64	1.11	-0.6	-0.5	-0.8	-0.02	-0.60	705
9	-0.7	0.19	-0.3	0.24	1.24	-0.9	-0.1	-0.3	-1.3	-1.1	1.55	-0.13	-0.28	435
10	-0.2	-1.4	-1.4	-1.2	-1.5	-0.6						NA	NA	NA
11	-0.5	-1.1	-0.6	0.31	-0.4	-1.3	-1	-0.7	-0.8	-0.6	-1	-0.69	-0.79	589
12	-0.6	1.16	0.08	-0.2	0.14	0.57	-0.7	-0.6	0.24	-0.2	-0.7	-0.07	-0.21	979
13	-0.4	-0.9	-0.2	0.03	-0.8	-1.1	-0.5	-0.7	1.07	-0.6	-1.2	-0.47	-0.24	698
14	-1.2	-0.9	-0.8	-0.9	-1.2	0.82	2.76	-1.1	-0.9	0.38	1.06	-0.19	0.16	1,117
15	0.14	-0.4	-1.4	-1	-0.4	-0.4	-0.5	0.15	-0.2	-0.6	-0.6	-0.48	-0.49	924
16	-0.9	-1	-1.1	-0.9	-1.2	-0.9	-1.1	0.25	-0.8	-0.2	-0.9	-0.79	-0.63	638

Table 8. Chinook salmon bycatch rate score (in units of standard deviation between vessels and within years) by vessel (rows) for **shore-based catcher vessels,** 2003-2013. Last column is the total bycatch from 2011-2013 by vessel.

Vess ID	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Avg 2003-2013	Avg 2011-2013	2011-2013 bycatch
1	3.99	1.25	2.67	0.96	0.44	-0.6	0.93	5.91	-1.3	4.04	0.14	1.68	0.96	1,495
2	0.17	2.77	0.81	0.96	0.76	0.41	0.43	0.88	0.48	1.5	0.83	0.91	0.94	1,527
3	-0.1	-0.1	2.04	1.95	0.62	1	2.09	0.41	1.04	0.96	1.49	1.03	1.16	1,423
4	0.57	2.15	3.9	0.17	0.55	1.59	-0.1	-0.6	0.34	-0.6	-1	0.64	-0.42	848
5	0.22	-0.2	0.86	2.28	1.08	1.94	0.86	0.25	1.7	0.57	0.69	0.93	0.99	1,635
6	-0.8	-0.3	0.43	2.19	2.12	-0.1	0.14	0.41	1.27	-0.1	0.34	0.51	0.51	1,085
7	1.25	-0.2	-0.2	1.78	1.11	0.66	0.67	1.47	0.3	0.01	0.17	0.64	0.16	1,614
8	0.01	-0.4	0.59	0.48	0.21	0.99	0.55	0.57	1.69	0.79	2.97	0.76	1.82	1,192
9	-0.3	0.15	0.49	0.75	0.95	0.58	-0.6	-0.4	0.35	0.4		0.25	0.38	769
10	-0.1	1.74	0.26	-1	2.55	-1.1	-0	-0.2	-0.5	1.25	1.15	0.35	0.63	824
11	-0.5	0.16	0.52	1.15	0.24	0.33	0.24	-0.3	1.1	0.41	0.79	0.38	0.77	421
12	-0.3	-0	-0.6	1.74	1.23	-0.5	0.83	0.37	0.26	-0.3	1.02	0.34	0.32	877
13	-2.1	0.18	-1.1	-0.4	0.42	-0.6	0.47	1.25	2.79	1.27	2.86	0.46	2.31	1,063
14	1.61	-0.8	0.66	0.27	-0.1	0.06	0.11	-0.3	0.72	2.15	0.42	0.44	1.10	748
15	0.22	1.25	0.68	-0.3	0.49	-0.7	1.38	-0.3	-1	-0.8	-0.8	0.02	-0.86	817
16	0	-0	0.52	0.54	0.11	0.32	-0.5	0.25	-1.4	-0.2	1.58	0.11	-0.02	645
17	-0.4	-1.1	-0	1.62	0.01	-0.3	0.7	-0.3	0.73	1.54	1.8	0.39	1.36	491
18	0.85	0.76	0.51	1.25	-0.8	-0.5	-0.5	0.48	-1.3	0.18	-0.9	0	-0.68	648
19	1.97	1.23	0.56	0.07	-0	-1	-0.8	-0.2	-1.6	-0.7	-0.9	-0.12	-1.08	458
20	2.32	-0.3	1.32	0.6	-0.7	-0.8	-0.4	-0.1	-1.1	-0.2	-0.7	-0.01	-0.66	529
21	-1.1	-1	-0.8	0.21	1.07	-0.3	1.55	-0.3	0.57	-1	-0.4	-0.14	-0.27	678
22	-0.6	-0.9	-0.2	-0.1	-0.1	1	0.08	0.23	-0	0.83	-0.5	-0.02	0.13	296
23	-0	0.26	-0.2	-0.4	0.74	-0.3	-0.1	0.6	-0.7	-1.2	-0.6	-0.18	-0.86	471
24	-0.1	0.81	0.03	0.34	-0.1	-1	0.31	0	-1.1	-0.5	-0.6	-0.18	-0.75	437
25	0.67	-0.9	-0	-0.5	-0.3	-0	-0.2	-0.1	1.48	1.03	0.8	0.17	1.10	760
26	-1.2	-1.4	-0.2	-0.1	1.21	-0.2	0.07	0.15	0.21	0.63	-0.6	-0.13	0.08	337
27	-0.6	-0	-0.8	-0.5	-0.8	4.79	-0.7	-0.7	0.17	-0.6	-0.1	0	-0.19	386
28	0.91	3.55	-0.2	-1.4	-0.8	-0.4	-0.6	-0.4	-0.8	-0.5	0.79	0.01	-0.18	1,381
29	0.02	0.51	-0.1	-0.1	-0.7	-0.6	-0.7	-0.6	0.34	-0.3	-0.7	-0.26	-0.24	1,231
30	0.44	-0.2	-0.5	-0.6	-0.3	-0.4	0.06	0	0.26	0.76	1.08	0.06	0.70	564
31	-0.9	-0.2	-1	-0.1	-0.1	1.09	5	-0.5	-1.3	0.17	0.26	0.22	-0.28	591
32	-0.3	-0.4	-1	-1.1	0.88	-0.5	-0.4	0.18	0.47	-0.6	0.5	-0.21	0.13	478
33	-0.6	-0.9	-1.2	-1.2	2.01	-0.5	-0.6	0.3	-0.9	-0.2	-0.3	-0.37	-0.48	436
34	0.48	-0.4	-0.2	-0.2	-0.8	1.06	-0.7	-0.5	-0.5	-0.9	-0.9	-0.32	-0.73	290
35	0.55	0.31	-0.9	-0.3	-0.4	-0.7	-0.6	-0.5	-0.6	-0.3	-0.5	-0.35	-0.48	610
36	-0	-0.5	0.17	-0.2	-0.9	-0.4	-0.7	-0.5	-1	-0.6	-0.9	-0.51	-0.86	289
37	-0.9	-0.7	0.39	-0.4	-0.6	-0.7	-0.5	-0.4	-0.7	-0.3	-1	-0.52	-0.66	278
38	-0.8	-0.7	-0.8	-0.8	1.14	0.79	-0.7	-0.5	-1.2	-0.8	-0.7	-0.45	-0.88	364
39	-0.1	0.2	-0.6	-0.8	-0.8	-0.6	-0.6	-0.6	0.09	-0.6	-0.7	-0.47	-0.41	647
40	0.27	0.05	-0.9	-1.2	-0.9	-0.5	-0.7	-0.7	1.94	-1.3	-0.6	-0.41	0.03	624
41	-0.2	-0.4	-0.9	-0.7	-0.7	0.53	-0.7	-0.6	0.47	-0.7	-0.9	-0.45	-0.38	259
42	-0.7	-0.9	-0.9	-0.3	-1.4	-0.1	-0.7	-0.7	-1	0.01	-0.5	-0.65	-0.49	328
43	-0.2	-0.3	-0.4	-1	-1.1	-0.6	-0.7	-0.5	-0.2	-1.1	-0.9	-0.65	-0.74	311
44	-0.9	-1	-0.5	-1.2	-0.4	-0.3	-0.5	-0.4	-1.2	-0.5	-0.7	-0.69	-0.79	200
45	-0.3	-0.6	-1	-1.2	-1.4	-0.1	-0.6	-0.5	0.45	-0.4	-0.6	-0.57	-0.20	205
46	-0.5	-1	-0.4	-0.9	-1.1	-1.2	-0.6	-0.4	0.29	-0.7	-0.2	-0.61	-0.21	339
47	-0.9	-0.3	-0.9	-1	-1.4	-0.5	-0.7	-0.5	-0.5	-0.8	-0.8	-0.74	-0.68	269
48	0.07	-0.2			-1.3	-0.6	-0.6	-0.6	-0.1	-1.1	-0.7	-0.57	-0.62	211
49	-1	-0.9	-1.1	-1.2	-1.9	-0.6	-0.7	-0.6	0.47	-0.6	-0.9	-0.82	-0.32	140

Table 9. Chinook salmon bycatch rate score (in units of standard deviation between vessels and within years) by vessel (rows) for **vessels delivering to motherships.** 2003-2013. Last column is the total bycatch from 2011-2013 by vessel.

Vess ID	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Avg 2003-2013	Avg 2011-2013	2011-2013 bycatch
1	-0.5	0.42	2.5	1.28	2.81	1.68	1.56	0.37	-1.1	-0.2	0.42	0.84	-0.28	162
2	2.16	1.04	0.67	2.31	-0.5	0.6	0.31	-1	-1	-0.6		0.39	-0.84	46
3	0.36	-0.3	0.24	-0.5	0.6	0.49	0.91	1.15	0.63	2.11	-0.7	0.46	0.69	511
4	0.24	-0.5	-0.1	0.21	0.77	-0.3	0.15	1.5	1.78	2.4	-0.4	0.53	1.27	377
5	-0	-0.9	-0.3	0.18	-0.1	2.02	1.78	-1.4	1.56	0.26	1.68	0.44	1.17	362
6	2.27	3.27	0.41	-0.1	-0.8	-0.8	-0.3	-0.5	-1.1	-1	0.15	0.14	-0.67	90
7	-0.7	-0.2	1.54	0.9	0.27	1.34	-0.8	-0.7	0.59	0.03	0.62	0.26	0.41	551
8	-0.5	-0.4	-0.2	0.04	0.25	-0.2	-1.1	-0.8	0.5	-0.3	0.95	-0.16	0.39	407
9	-0.1	-0.3	-0.4	-0	0.39	-1.1	-1	2.02	-1.1	-0.2	-1.3	-0.28	-0.87	51
10	-0.1	-0.5	-0.6	0.96	0.42	0.17	-1	0.41	0.2	-0.6	0.21	-0.04	-0.07	292
11	-1	0.01	-0.3	-0.4	0.2	-0	0.93	-0	0.04	0.22	-0.7	-0.09	-0.14	323
12	0.16	-0	0.4	-0.4	-0.5	-0.6	-0.6	-0.5	-1	-0.4	1.69	-0.17	0.07	98
13	-1.1	-0.5	-0.6	-0.7	-0.9	-0.7	1.25					-0.46	NA	0
14	-0.5	-0	-0.7	-0.8	-0.7	-0.4	-1	0.12	-0.4	0.08	-0.4	-0.42	-0.23	245
15	-0.8	-0	-0.6	-1.2	-0.6	-0.8	-0.9	-0.6	0.52	-0.8	-0.8	-0.59	-0.34	330
16		-1.1	-1.9	-1.8	-1.7	-1.4	-0.3			-1	-1.5	-1.33	-1.24	6

Table 10. Chinook salmon bycatch rate score (in units of standard deviation between cooperatives and within years) by cooperative (rows), 2003-2013.

Co-operative	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Avg 2003-2013	Chinook salmon
101	0.6	0.2	1.3	1.0	0.8	0.9	1.1	1.7	0.6	1.0	0.6	0.9	15,292
102	-0.4	0.2	0.3	1.4	1.6	1.4	1.6	0.0	1.2	1.8	2.0	1.0	5,462
103	0.8	0.8	-0.3	-1.1	0.0	-0.9	-0.4	0.3	-0.8	-0.6	-0.2	-0.2	5,192
104	0.5	-1.7	-1.5	-0.8	-1.1	0.3	-0.3	0.2	0.9	-0.8	-0.7	-0.5	1,689
105	1.1	1.4	1.1	0.7	0.4	-1.4	-0.1	0.2	-1.4	-0.5	-0.4	0.1	2,712
106	-1.4	-0.6	-0.2	-0.7	-1.1	0.3	-1.2	-1.2	0.2	-0.6	-0.9	-0.7	7,867
107	-1.2	-0.2	-0.7	-0.5	-0.6	-0.5	-0.7	-1.2	-0.8	-0.3	-0.4	-0.6	11,733

Evaluating a subset of vessels bycatch contributions

To gain some appreciation of the impact the poorer performing vessels (in terms of bycatch per t of pollock) the vessels that contributed historically to 30% of all the bycatch from 2011-2013 were selected and re-examined. By sector, this resulted in highlighting 7 vessels for the shore-based catcher vessels (CVs), 5 CPs, and 3 mothership (MS) vessels (Table. 11). Across all AFA vessels, 13 vessels contributed to 30% of the bycatch during the post A91 period (Table 12). Comparing these groups with the other boats (again just for illustration) indicates that these 13 vessels had bycatch rates that were almost 3 times higher than the rest of the fleet:

Category	CVs	MS	CP	Fishery-wide
Highest 30%	0.0450	0.0214	0.0104	0.0407
Remaining 70%	0.0209	0.0096	0.0059	0.0124
Lowest 30%	0.0134	0.0069	0.0052	0.0072
Total	0.0227	0.0117	0.0069	0.0139

Table 11. Chinook salmon bycatch by sector (2011-2013) and vessels (ranked in order of highest bycatch *rate*). Shaded area represents the vessels selected for sensitivity comparisons.

	Shore-based CVs		Catcher-processors		Motherships	
Vessel	Chinook salmon	Cum %	Chinook salmon	Cum %	Chinook salmon	Cumulative %
A	1,495	5%	38	0%	377	10%
B	1,527	9%	1,022	9%	362	19%
C	1,423	14%	910	17%	511	32%
D	848	16%	874	24%	551	47%
E	1,635	21%	1,117	34%	407	57%
F	1,085	25%	926	42%	292	65%
G	1,614	30%	962	50%	323	73%
H	1,192	33%	979	59%	330	82%
I	769	36%	851	66%	245	88%
J	824	38%	924	74%	98	91%
K	421	39%	698	80%	162	95%
L	877	42%	705	86%	90	97%
M	1,063	45%	638	91%	46	99%
N	748	48%	435	95%	51	100%
O	817	50%	589	100%	6	100%
P	645	52%				
Q	491	54%				
R	648	56%				
S	458	57%				
T	529	59%				
U	678	61%				
V	296	62%				
W	471	63%				
X	437	65%				
Z	760	67%				
AA	337	68%				
AB	386	69%				
…	1,381	73%				
	1,231	77%				
	564	79%				
	591	81%				
	478	82%				
	436	84%				
	290	84%				
	610	86%				
	289	87%				
	278	88%				
	364	89%				
	647	91%				
	624	93%				
	259	94%				
	328	95%				
	311	96%				
	200	96%				
	205	97%				
	339	98%				
	269	99%				
	211	100%				
	140	100%				

Table 12. Chinook salmon bycatch during 2011-2013 for the pollock vessels with the highest bycatch rate during this period (AFA fishery-wide). Shaded area represents the vessels selected for sensitivity comparisons.

Vessel	Chinook salmon	Cumulative %
A	1,495	3%
B	1,527	6%
C	1,423	9%
D	848	11%
E	1,635	14%
F	1,085	16%
G	1,614	19%
H	1,192	22%
I	769	23%
J	824	25%
K	421	26%
L	877	27%
M	1,063	30%
N	748	31%
O	817	33%
P	645	34%
Q	491	35%
R	648	36%
S	458	37%
T	377	38%
U	529	39%
…	…	…

Changes in timing of pollock fishing

Operationally the decision on when to begin fishing in the summer season appears to drive a vessels relative rank (Fig. 15). Vessels which began fishing earlier, finished earlier in the summer and had the lowest relative rank for Chinook bycatch. In contrast those who were still fishing into October had higher rates and correspondingly consistently ranked worse. Some behavioral changes have been observed in the relative timing of fishing in these vessels since program inception and an improvement in their relative ranking (Fig. 15).

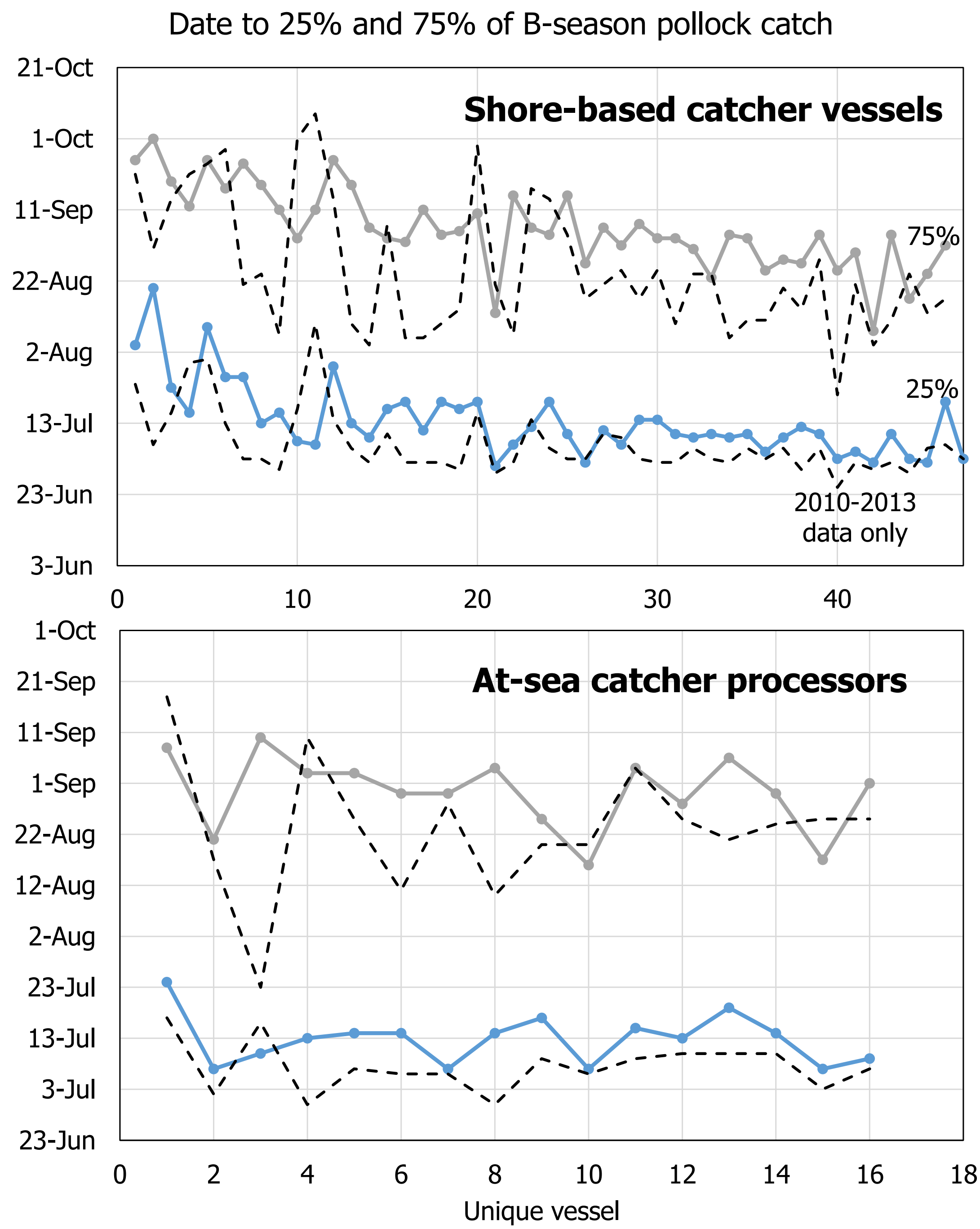

Figure 15. Average fishing dates (from June 10 through October 1) when 25% and 75% of "B" season pollock catch by individual vessels for the entire 2003-2013 period (solid lines) and for the 2010-2013 period separately (dashed lines). Data from shore-based catcher vessels are represented in the top pane and at-sea catcher processors on the bottom.

3.2.3 Some possible biological consequences of bycatch measures on the pollock stock

The Council is challenged in developing measures to minimize bycatch to the extent practicable with consequences related to the directed fishery impacts from biological and economic perspectives. For example, evaluating how the Chinook salmon bycatch measures under Amendment 91 have impacted the eastern Bering Sea pollock fishery is relevant. Recent assessment of the pollock resource indicates that in 2012, the abundant 2008 year class of pollock appears to be much smaller than average in the fishery. The extent that this is due to population-level density dependent effects or due to fleet movement from traditional fishing grounds (which may have had higher Chinook salmon bycatch rates) to areas where smaller and younger pollock are available is an open question. A general pattern has been to shift fishing to be earlier in the year when the “half-way” point of the B-season is nearly two months earlier in the past several years (Fig. 16). This would likely continue should opportunities to fish later in the season were eliminated due to either formal season closures, the implementation of other incentives to avoid Chinook, or simply due to the knowledge that higher bycatch rates of Chinook salmon occur in October.

Generally the average body weight of pollock during the B-season is around 650 grams and tends to decrease as the B-season progresses followed by a late season increase (Fig. 17). The reason for this has mostly to do with the spatial aspect of the fishery with more fishing north of the Pribilof Islands during the first several months of the summer and then as the offshore fleet finishes their catch allocation (typically in late September) the fleet composition shifts towards a higher percentage of shore-based catcher boats that fish in the more southern areas where pollock are generally bigger. The pattern during 2011-2013 indicated smaller fish but this could be a combination of more offshore fishing and the population characteristics (a strong 2008 year class has been estimated which would have been age 3-5 during this period and affected the mean sizes). Previous public comment to the Council in conjunction with the development of incentive plans for Amendment 91 has indicated the economic issues with shifting fishing effort earlier in the B-season (on smaller fish for less efficient product recovery and therefore lower profits) rather than later in the B-season (with larger fish, higher product recovery and thus higher profits).[4]

[4] “Fishing during early October yields recovery of 0.316 pounds of edible product per pound of fish, with a value, at current prices, of $1,111.86 per metric ton. Fishing during the second week of June yields 0.3034 pounds of edible product per pound of fish, with a value of $980.34 per metric ton. This means that for every metric ton of pollock harvested in June rather than in October, the value of the finished products is $131.52 less than if the fish had been harvested in October. If a catcher vessel shifts one trip catching 500 metric tons of pollock from October to June, there is a loss of $65,760.” From Kochin et al. 2009 proposal to the NPFMC for an incentive-based Chinook bycatch avoidance plan. Available at: http://www.npfmc.org/wp-content/PDFdocuments/bycatch/SalmonAvoidProposal209.pdf

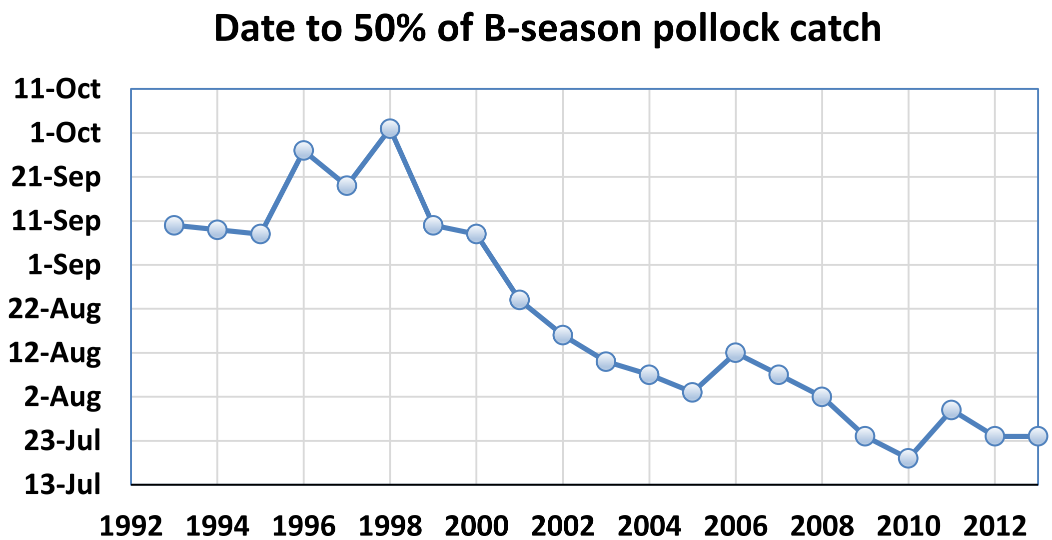

Figure 16. Changes in the B-season date at which 50% of the B-season pollock is taken (all sectors combined), 1993-2013.

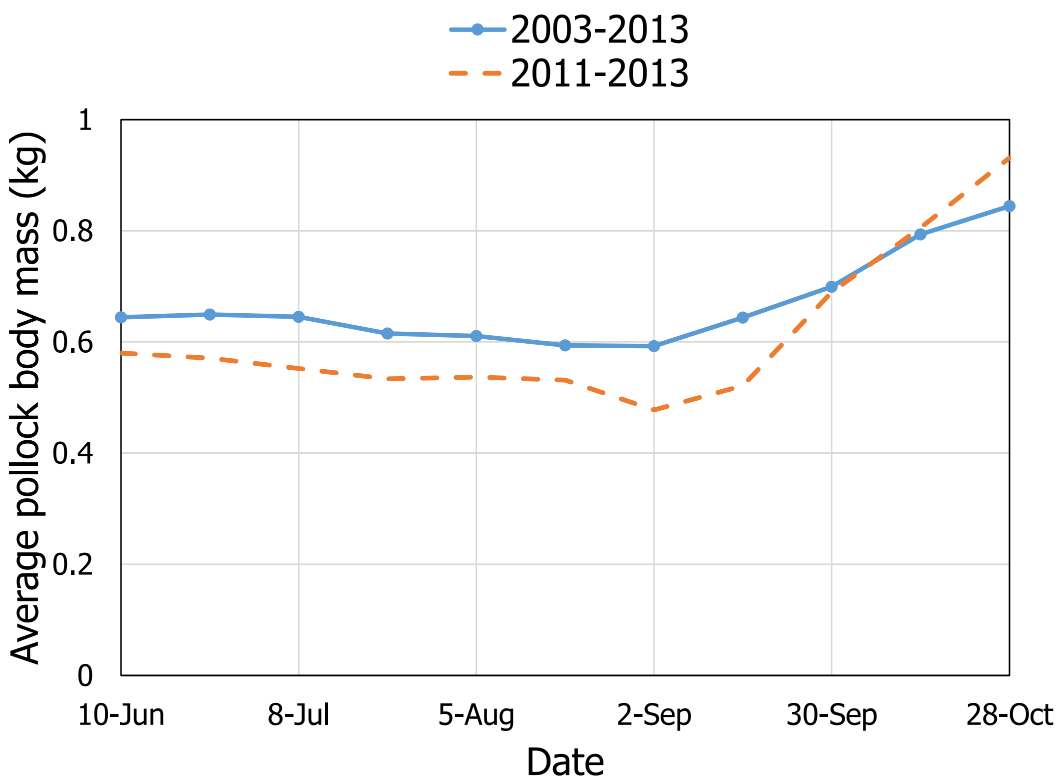

Figure 17. Seasonal pattern in mean pollock body mass at age by 2-week period during the summer for different sets of years.

4 Changes to fishing practices under consideration

The Council specifically requested a list of modifications that could be made to current management (either through regulatory measures or within IPAs) that would potentially provide increased incentives to reduce salmon from the current levels under Amendment 91. Specific requests are included in the Council motion with the regulatory issues noted in Section 4. Here we group the evaluation into four broad categories for evaluation of potential impacts: close fishing earlier in the B-season, require salmon excluder devices, modify the provisions of the rolling hot spot program, and modify the PSC accounting period. To the extent possible, the intent of each (and whether it applied by sector or vessel) is described below with evaluation (in salmon saved and pollock forgone) is indicated with additional qualitative discussion of additional potential issues that may arise from implementing a specific change.

4.1 Close fishing earlier?

Given indications of highest bycatch rates (particularly given low pollock catches at that time) in the end of the B-season typically (see Figure 9 and Figure 10), the Council's October motion focusses specifically on measures that would either impose penalties and restrictions on vessels with highest rates compared with vessels fishing at the same time, fishery closures for sectors or cooperatives above a specified rate threshold in September and provisions to close the fishery earlier when catch rates decline and bycatch increases (in October). Each of these considerations would impose some form of closure to vessels or to sectors or cooperatives primarily in the September to October time frame.

In the interest of providing information on relative impacts (in salmon savings and pollock foregone) tables below indicate the sector-level PSC and pollock catch by week as well as the vessel level catch and PSC (after screening for low catches). An examination of potential alternative closure dates, the historical seasonal fishing pattern for the B-season for the Chinook salmon bycatch and pollock catch by week and sector is shown in Tables 13 and 14, respectively.

In order to address potential rate-based thresholds and resulting impacts, a companion table (Table 15) shows the sector-level rates by week. Once a desired rate-based threshold is created, these tables can be used to see which week any given sector would have exceeded that rate and estimate the number of salmon and pollock from that week forward. Additional information is provided in Appendix 4 regarding the within sector vessel rates by season and annually (2011-2013).

Table 13. Chinook salmon bycatch remaining by different dates (representing the week of closure), years, and sectors. The bottom panel is summed over all sectors.

Chinook salmon

CP	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
5Sep	1,474	2,054	2,231	1,096	5,281	239	145	23	1,631	6	404
12Sep	1,214	1,608	1,331	652	4,896	224	100	15	1,444	3	325
19Sep	1,007	911	631	603	4,591	175	94	15	1,302	1	259
26Sep	897	613	362	461	4,192	153	82	8	1,158	0	226
3Oct	447	131	24	294	3,292	153	69	3	1,064	0	154
10Oct	79	3	0	205	2,682	118	69	0	900	0	17
17Oct	0	0	0	15	1,804	10	0	0	739	0	0
24Oct	0	0	0	0	338	4	0	0	565	0	0
31Oct	0	0	0	0	0	0	0	0	0	0	0
MS											
5Sep	1,487	1,423	486	104	2,871	120	36	0	2,364	0	8
12Sep	1,455	1,300	271	96	2,758	106	36	0	2,359	0	3
19Sep	1,403	1,190	221	60	2,714	100	4	0	2,329	0	0
26Sep	1,330	977	143	48	2,474	90	0	0	2,297	0	0
3Oct	1,039	748	119	45	2,275	42	0	0	2,285	0	0
10Oct	327	722	95	27	1,689	26	0	0	1,855	0	0
17Oct	96	580	8	24	867	4	0	0	1,382	0	0
24Oct	0	421	0	24	157	4	0	0	414	0	0
31Oct	0	0	0	0	0	0	0	0	0	0	0
Shorebased catcher vessel											
5Sep	6,627	18,832	29,081	18,605	38,409	3,366	824	1,253	12,804	2,912	2,731
12Sep	6,192	16,917	28,379	16,303	34,639	2,948	665	1,194	12,247	2,623	2,610
19Sep	5,569	15,241	27,297	14,023	32,217	2,712	320	1,088	11,207	2,285	2,546
26Sep	4,911	14,275	25,216	12,450	30,781	2,534	162	817	9,584	2,069	1,381
3Oct	3,044	12,053	22,205	10,308	25,949	2,146	47	802	8,423	1,787	634
10Oct	980	9,484	15,563	7,109	19,249	1,888	0	544	5,742	1,284	252
17Oct	23	6,173	9,286	3,520	14,399	582	0	451	2,286	934	149
24Oct	0	4,283	7,899	345	7,514	153	0	175	783	268	0
31Oct	0	0	0	0	0	0	0	0	0	0	0
Combined											
5Sep	9,588	22,309	31,798	19,805	46,561	3,725	1,005	1,276	16,799	2,918	3,143
12Sep	8,861	19,825	29,981	17,051	42,293	3,278	801	1,209	16,050	2,626	2,938
19Sep	7,979	17,342	28,149	14,686	39,522	2,987	418	1,103	14,838	2,286	2,805
26Sep	7,138	15,865	25,721	12,959	37,447	2,777	244	825	13,039	2,069	1,607
3Oct	4,530	12,932	22,348	10,647	31,516	2,341	116	805	11,772	1,787	788
10Oct	1,386	10,209	15,658	7,341	23,620	2,032	69	544	8,497	1,284	269
17Oct	119	6,753	9,294	3,559	17,070	596	0	451	4,407	934	149
24Oct	0	4,704	7,899	369	8,009	161	0	175	1,762	268	0
31Oct	0	0	0	0	0	0	0	0	0	0	0
Total Chinook Salmon PSC (all year)	**45,586**	**51,696**	**67,362**	**82,695**	**121,770**	**21,480**	**12,369**	**9,697**	**25,499**	**11,344**	**13,033**

Table 14. Pollock catch remaining by different dates (representing the week of closure), years, and sectors. The bottom panel is summed over all sectors. Units are metric tons.

Pollock

CP	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
5Sep	72,795	65,720	72,714	87,075	68,550	61,288	29,101	11,748	89,894	19,382	39,009
12Sep	50,049	43,705	50,817	68,715	54,850	51,439	19,577	6,208	76,477	12,319	28,735
19Sep	29,714	24,773	28,522	49,198	44,945	29,563	9,615	3,430	63,874	3,524	18,107
26Sep	15,578	12,602	15,472	33,580	37,257	16,656	3,551	2,398	52,258	2,731	11,692
3Oct	4,414	2,393	2,827	17,170	28,429	8,411	786	813	39,669	1,029	5,681
10Oct	151	601	0	8,205	21,859	5,703	242	86	27,039	137	1,953
17Oct	0	0	0	989	12,909	4,058	0	57	16,211	127	166
24Oct	0	0	0	0	4,297	1,950	0	34	7,000	0	139
31Oct	0	0	0	0	0	0	0	0	0	0	0
M											
5Sep	23,369	36,062	22,054	24,992	27,243	21,546	2,589	1,426	19,672	1,691	2,162
12Sep	18,586	27,294	16,310	20,822	23,979	18,758	1,020	0	19,044	231	954
19Sep	14,009	20,029	13,107	15,413	20,845	12,208	242	0	16,469	0	0
26Sep	9,289	12,686	7,763	11,299	15,950	9,983	0	0	13,296	0	0
3Oct	5,644	3,889	6,133	8,816	12,772	6,855	0	0	11,871	0	0
10Oct	2,296	3,449	5,381	5,576	10,177	5,239	0	0	7,886	0	0
17Oct	984	3,025	2,068	3,379	6,504	2,181	0	0	5,472	0	0
24Oct	0	2,422	0	1,189	3,258	296	0	0	2,840	0	0
31Oct	0	0	0	0	0	0	0	0	0	0	0
S											
5Sep	108,331	96,303	109,995	129,959	90,420	29,297	13,563	16,934	69,204	51,927	38,974
12Sep	82,154	71,544	93,432	111,346	76,291	21,386	9,990	12,482	58,420	40,206	24,466
19Sep	56,152	54,533	75,999	86,061	64,543	15,085	5,736	8,205	51,562	30,643	15,819
26Sep	36,870	41,218	58,668	62,460	58,865	11,280	3,705	4,399	41,258	24,451	10,713
3Oct	22,765	32,727	43,896	42,848	45,824	9,177	1,323	4,277	31,733	18,776	8,578
10Oct	12,088	24,557	29,775	27,100	34,297	6,925	0	1,814	20,008	15,144	7,671
17Oct	731	9,875	16,307	13,482	19,039	822	0	1,015	7,692	8,235	1,926
24Oct	0	5,644	12,211	739	6,324	56	0	341	2,738	2,534	0
31Oct	0	0	0	0	0	0	0	0	0	0	0
Combined											
5Sep	204,495	198,085	204,763	242,026	186,213	112,131	45,253	30,108	178,770	73,000	80,145
12Sep	150,789	142,543	160,559	200,883	155,120	91,583	30,587	18,690	153,941	52,756	54,155
19Sep	99,875	99,335	117,628	150,672	130,333	56,856	15,593	11,635	131,905	34,167	33,926
26Sep	61,737	66,506	81,903	107,339	112,072	37,919	7,256	6,797	106,812	27,182	22,405
3Oct	32,823	39,009	52,856	68,834	87,025	24,443	2,109	5,090	83,273	19,805	14,259
10Oct	14,535	28,607	35,156	40,881	66,333	17,867	242	1,900	54,933	15,281	9,624
17Oct	1,715	12,900	18,375	17,850	38,452	7,061	0	1,072	29,375	8,362	2,092
24Oct	0	8,066	12,211	1,928	13,879	2,302	0	375	12,578	2,534	139
31Oct	0	0	0	0	0	0	0	0	0	0	0

Table 15. Chinook salmon bycatch number per t of pollock by week and sector (and combined over the whole fleet), 2003-2013.

CP	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
5 Sep	0.031	0.020	0.012	0.002	0.038	0.001	0.008	0.000	0.006	0.001	0.001
12 Sep	0.011	0.020	0.041	0.024	0.028	0.001	0.005	0.001	0.014	0.000	0.008
19 Sep	0.010	0.037	0.031	0.002	0.031	0.002	0.001	0.000	0.011	0.000	0.006
26 Sep	0.008	0.024	0.021	0.009	0.052	0.002	0.002	0.006	0.012	0.001	0.005
3 Oct	0.040	0.047	0.027	0.010	0.102	0.000	0.005	0.003	0.007	0.000	0.012
10 Oct	0.086	0.071	0.008	0.010	0.093	0.013	0.000	0.004	0.013	0.000	0.037
17 Oct	0.524	0.005		0.026	0.098	0.066	0.285	0.000	0.015	0.000	0.010
24 Oct				0.015	0.170	0.003		0.000	0.019	0.000	0.000
31 Oct					0.079	0.002		0.000	0.081		0.000
Mothership operations											
5 Sep	0.020	0.036	0.018	0.012	0.046	0.014	0.000	0.002	0.002	0.006	0.006
12 Sep	0.007	0.014	0.037	0.002	0.035	0.005	0.000	0.000	0.008	0.000	0.004
19 Sep	0.011	0.015	0.016	0.007	0.014	0.001	0.041		0.012	0.000	0.003
26 Sep	0.015	0.029	0.015	0.003	0.049	0.005	0.017		0.010		
3 Oct	0.080	0.026	0.015	0.001	0.063	0.015			0.008		
10 Oct	0.213	0.059	0.032	0.006	0.226	0.010			0.108		
17 Oct	0.176	0.335	0.026	0.001	0.224	0.007			0.196		
24 Oct	0.098	0.264	0.004	0.000	0.219	0.000			0.368		
31 Oct		0.174		0.020	0.048	0.013			0.146		
Shorebased catcher vessels											
5 Sep	0.004	0.032	0.052	0.036	0.053	0.016	0.027	0.005	0.045	0.006	0.048
12 Sep	0.017	0.077	0.042	0.124	0.267	0.053	0.045	0.013	0.052	0.025	0.008
19 Sep	0.024	0.099	0.062	0.090	0.206	0.037	0.081	0.025	0.152	0.035	0.007
26 Sep	0.034	0.073	0.120	0.067	0.253	0.047	0.078	0.071	0.158	0.035	0.228
3 Oct	0.132	0.262	0.204	0.109	0.371	0.185	0.048	0.120	0.122	0.050	0.350
10 Oct	0.193	0.314	0.470	0.203	0.581	0.115	0.036	0.105	0.229	0.138	0.421
17 Oct	0.084	0.226	0.466	0.264	0.318	0.214		0.116	0.281	0.051	0.018
24 Oct	0.031	0.447	0.339	0.249	0.542	0.561		0.409	0.303	0.117	0.077
31 Oct		0.759	0.647	0.467	1.188	2.709		0.514	0.286	0.106	
Combined											
5 Sep	0.017	0.028	0.028	0.013	0.045	0.008	0.015	0.001	0.019	0.003	0.020
12 Sep	0.014	0.045	0.041	0.067	0.137	0.022	0.014	0.006	0.030	0.014	0.008
19 Sep	0.017	0.057	0.043	0.047	0.112	0.008	0.026	0.015	0.055	0.018	0.007
26 Sep	0.022	0.045	0.068	0.040	0.114	0.011	0.021	0.057	0.072	0.031	0.104
3 Oct	0.090	0.107	0.116	0.060	0.237	0.032	0.025	0.012	0.054	0.038	0.101
10 Oct	0.172	0.262	0.378	0.118	0.382	0.047	0.025	0.082	0.116	0.111	0.112
17 Oct	0.099	0.220	0.379	0.164	0.235	0.133	0.285	0.112	0.160	0.051	0.016
24 Oct	0.069	0.424	0.226	0.200	0.369	0.092		0.396	0.157	0.114	0.076
31 Oct		0.583	0.647	0.191	0.577	0.070		0.467	0.140	0.106	0.000

4.2 Require excluders

The pollock industry since 2003 has been working to develop effective salmon excluder devices in the Bering Sea pollock fishery. Excluders are being used more frequently by the fleet now in an effort to avoid bycatch. These devices are rely on an opening in the pelagic trawl net through which salmon may escape the net before it is hauled back, ideally without a significant loss of pollock. Design changes over the years of experimentation have been influenced by EFP tests and feedback from fishermen who are employing the various designs (Gauvin et al., 2013). Recent reported that the latest design tested, the ‘flapper excluder” resulted in escapement rates of Chinook salmon at rates of approximately 38% (with 95% confidence intervals ranging from 24-50%) and approximately 11% chum escapement (Gauvin et al., 2013). The industry continues to test various excluder devices to continue to improve upon the escapement rates and pollock loss (Gauvin, 2013).

It is not currently required to report excluder usage in the Bering Sea pollock fishery. However in 2013 the Council requested that information be compiled on the voluntary usage of excluder devices within the individual sectors and whether that trend had increased since the implementation of Amendment 91.

Results of that survey were presented in the staff discussion paper in October 2013. Results and methods for estimation varied by sector but in general across all sectors the usage currently is very high (in the mothership sector nearly 100% of the time) and has increased in all sectors in recent years[5].

The Council requested that consideration be given (by regulatory measures or within IPAs) to requiring excluder usage during time of the year when rates are particularly high (January/February and September/October are the highest rate months annually, see Table 5). Managing and enforcing excluder usage present a number of difficulties (detailed in Section 5). Analytically, estimating salmon numbers escaping (and surviving) from excluders poses other challenges since data are unavailable. Information on an individual vessel basis on haul-by-haul excluder usage would minimally be necessary. With these data, statistically testing for the effectiveness (and for differences in types) of excluders might also be possible but likely subject to a high degree of uncertainty.

It should be understood that without reporting requirements (voluntary or mandatory) detailing excluder use such data would only be available on request. For example, results following a Council request (in April 2013) were summarized in the October 2013 discussion paper which reported on several years of fishing practices to qualitatively describe trends in excluder device usage since 2010. Should the Council wish to have this information reported regularly a more explicit request to the fleet to record when excluders are used (and on a tow-by-tow) basis would be necessary.

4.3 Require a lower Base Rate

The Council requested that consideration be given to requiring a lower Base Rate (associated with their respective RHS program) beginning September 1 either through regulatory measures or within the IPAs themselves. Provisions for including this within each IPA proposal will be summarized in the follow-up discussion paper but here we characterize some of the issues related to requiring this and to the extent possible the likely impact on resulting bycatch levels. Additional regulatory concerns are noted in Section 5.

The current Chinook IPAs for each sector contain a rolling hotspot (RHS) provision, under which the closures or advisory areas are also referred to as bycatch advisory areas (BAA). The Chinook RHS programs in the different sectors have many similarities but also distinct characteristics. All of the RHS programs function at the individual level and contain a base rate of 0.035 Chinook / MT so that closures are not implemented when aggregate bycatch rates are below this level.

Under the IPAs, the base rate is determined over a period of several weeks. The base rate is based on the most recently available 2-week period for the inshore sector and a 3-week period for the mothership and CP sectors. For the inshore sector, there is a several-day delay after fishing occurs as it takes time for vessels to arrive at the plant and for Chinook to be counted and reported. When implemented, closures are announced only once per week.

The Chinook IPA reports to the Council have provided some information on what closures are in place and how many vessels they impact. Unlike with the chum bycatch RHS information or with the Chinook

[5] See October 2013 staff discussion paper at: http://www.npfmc.org/wp-content/PDFdocuments/bycatch/BSAIChinookDiscPaper913.pdf

RHS program prior to Amendment 91, the reports provided to the fleet on Chinook PSC during the season are not provided to the Council or NMFS at the time the closures are implemented.

The reason for having a minimum rate (a "floor") on when hotspot closures would be implemented is that a small amount of bycatch does not necessarily appear to be a good indication that a bycatch hotspot will occur in that area in the near future. Closing an area based on there being a few Chinook could close a good low-PSC fishing area the following week. This could lead to more fishing occurring in higher bycatch areas and/or pollock fishing could be slowed down so that more fishing would occur later in October when on average Chinook PSC encounter rates are higher.

The Catcher Processor IPA[6] has an extensive discussion of why BAA are not declared in low-bycatch periods. The IPA notes that "… where Chinook abundance is uniformly low, vessel bycatch is mainly determined by random factors associated with changes in weather, winds, water temperatures, and currents."

Potential changes in the base rate would interact with several other aspects of the IPAs. Under the Inshore SSIP, the RHS program is suspended once "SSIP Chinook bycatch exceeds 25% of the aggregate Base Cap Credits available for any given season." Thus in PSC years such as 2011, rolling hotspot closures would not be in effect for September and October, because other features of the SSIP, namely the hard cap and the opportunity to earn salmon credits, are expected to provide a sufficient incentive to reduce bycatch.

As shown in Table 16, below, Chinook bycatch usually but not always arrives suddenly. Table 16 displays the weekly Chinook bycatch rates for August – October since the implementation of Amendment 91.

[6] http://alaskafisheries.noaa.gov/sustainablefisheries/bycatch/salmon/chinook/ipa/chinook_salmon_ipa_2010.pdf

Table 16. Weekly Chinook bycatch rates (Chinook/t pollock) by sector, 2011-2013, August-October

	Catcher Processor			Mothership			Inshore CV		
	2011	2012	2013	2011	2012	2013	2011	2012	2013
8-Aug	0.0004	0.0002	0.0003	-	0.0003	-	0.0046	0.0004	0.0055
15-Aug	0.0021	0.0003	0.0004	0.0012	0.0006	0.0002	0.0065	0.0023	0.0045
22-Aug	0.0021	0.0002	0.0012	0.0037	0.0003	0.0011	0.0081	0.0078	0.0036
29-Aug	0.0033	0.0003	0.0032	0.0030	0.0008	0.0008	0.0054	0.0067	0.0104
5-Sep	0.0059	0.0009	0.0009	0.0017	0.0056	0.0063	0.0447	0.0058	0.0484
12-Sep	0.0139	0.0004	0.0077	0.0080	-	0.0041	0.0517	0.0247	0.0083
19-Sep	0.0113	0.0002	0.0062	0.0117	-	0.0031	0.1516	0.0353	0.0074
26-Sep	0.0124	0.0013	0.0051	0.0101			0.1575	0.0349	0.2282
3-Oct	0.0075		0.0120	0.0084			0.1219	0.0497	0.3498
10-Oct	0.0130		0.0367	0.1079			0.2287	0.1385	0.4214
17-Oct	0.0149		0.0095	0.1960			0.2806	0.0507	0.0179
24-Oct	0.0189		-	0.3677			0.3034	0.1168	0.0774
31-Oct	0.0807			0.1458			0.2860	0.1058	

Note: Shaded areas are weeks with a Chinook bycatch rate above the 0.035 base rate. The sector bycatch rates used by Sea State to actually implement closures are calculated weekly based on 2-week (inshore) or 3-week rolling averages when the data are available, thus the closures implemented are not based exactly on these data.

Several inferences can be drawn from Table 16:

- Chinook tend to arrive suddenly rather than gradually.
- For the Catcher Processor sector, the following inferences can be drawn.
    - In 2011, there were two closures in the sector, so the data utilized must have spanned weeks differently to lead to the rate being above the base rate.
    - In 2013, there was a week (October 10) above the base rate that could have led to a closure across a 3-week average if there had been a lower base rate. However, the PSC rate was very low the following week so the fleet was able to avoid bycatch without a closure in place.
- For the Mothership sector, the following inferences can be drawn.
    - In 2011, bycatch arrived suddenly with a weekly rate above 0.10 for the week of October 10.
    - The mothership sector fished early in 2012 and 2013 and the change in base rate would not have impacted their operations in September and October.
- For the Inshore catcher vessel sector, several inferences can be drawn.
    - In 2011, Chinook PSC increased dramatically above the base for the inshore sector at the start September.
    - In 2012, the Inshore CV rate persisted for several weeks near the base rate. A lower base rate here would have ensured that closures were in place.
    - In 2013, there was an early-September high-PSC period and then several weeks of lower PSC.

Relevant results from the December 2012 Chum rolling hotspot analysis

December 2012 analysis of the chum RHS program indicated that chum PSC was not reduced when closures were put in place in low-bycatch periods. Additionally, in historical simulations from the 1990s, simulated closures at lower levels did not significantly reduce PSC. While at times bycatch was reduced by the closures, at other times vessels moved out of the closed areas to areas with higher bycatch.

4.3.1 Sector-specific discussion of base rates

Inshore CVs

Currently the rolling hotspot-program for the inshore sector is no longer in place when 25 percent of the Chinook have been caught for a season. Therefore, any change in base rate would have to be considered in combination with a provision that would not suspend the RHS for the inshore sector.

This and the following paragraph describe how the base rate is utilized in deciding whether to close an area. "Other than as provided in Section 9.4, below, the Monitoring Agent shall calculate the average weekly rate of Chinook salmon taken as bycatch per metric ton of pollock by vessels harvesting pollock from the inshore sector allocation for the last 2 weeks, as of each Thursday. The Base Rate shall be the greater of (i) the average bycatch rate calculated by the Monitoring Agent, or (ii) the rate of 0.035 Chinook salmon PSC per metric ton of pollock."

More from IPA: "9.6.1 Savings Area Designation Criteria. To qualify as a Chinook Savings Area, (a) an amount of pollock that the Monitoring Agent in its sole discretion determines to be substantial must have been taken in the Chinook Savings Area during the period on which its designation as a Chinook Savings Area is based, or the area must have been designated a Chinook Savings Area for the prior notification period and there must be evidence satisfactory to the Monitoring Agent in its sole discretion that suggests that Chinook bycatch rates in the area are not likely to have changed, and (b) the Chinook salmon bycatch rate in the area for the period on which its definition as a Savings Area is based must exceed the Base Rate. For purposes of (a), above, the Monitoring Agent shall consider a pollock harvest of two percent {2%) of the total amount of pollock harvested by vessels harvesting from the inshore allocation during the period on which a Savings Area designation is based to be indicative of, but not dispositive of, whether a substantial amount of pollock has been harvested in an area."

From the 2013 SSIP report: "The SSIP RHS program is suspended once SSIP Chinook bycatch exceeds 25% of the aggregate Base Cap Credits available for any given season. The 25% threshold was not reached in neither the 2013 A Season or in the 2013 B Season. Therefore, the SSIP RHS component was active for the entire year." The inshore SSIP fleet did not trigger the 25% suspension for the 2011 A season. It was triggered beginning Sept. 15th for the 2011 B season. The suspension was triggered on March 8, 2012 for the A season, and again on October 11th for the 2012 B season (pers. comm. J. Gruver).

Mothership Sector

The mothership RHS program applies to the platform rather than the individual catcher vessels. During the B-season, no bycatch avoidance areas were identified in 2012 and 2013. In 2011, there was one Mothership BAA implemented in the B-season.

Catcher Processor Sector

From the 2012 CP IPA report: "The 2011 year was the first for the Chinook CP IPA program. The program identified relatively few bycatch avoidance areas (BAA) during both seasons, and most were selected based on the bycatch performance at shore-plant and mothership catcher-vessel fishing locations… the 2012 B-season bycatch ratio was exceedingly low and no BAA were identified." In 2013, no BAA were reported for B-season. For 2011, according to the CP IPA Report, there were RHS in place during two reporting periods beginning on September 22 and 29. These closures each directly impacted one vessel with CDQ fishing rights. Later in October there were advisory BAA over the same area, and the IPA report notes that vessels avoided the area despite good fishing there.

While there were no BAA in the B-season for 2013, the CP IPA report shows the number of vessels impacted by each of the Chinook BAA in the A-Season.

From the 2013 Chinook IPA Report:

Table 5. Number of CP vessels excluded from designated bycatch avoidance areas during the 2013 A-season.

Week	1/31	2/7	2/14	2/21	2/28	3/7	3/14	3/21	3/28	4/4
Number of CPs excluded from BAAs	4	4	1	4	9	1	3	3	1	5

This information could be useful in the future to have from all sectors when BAA are in effect.

Discussion

Lowering the base rate would primarily matter in relatively low-PSC years. Because the inshore SSIP suspends RHS closures after 25 percent of salmon is caught, closures may not be impacted by the base rate. In the high-PSC period in 2011, closures would have been in place if they had not been suspended for the inshore sector, one was implemented for the Mothership Sector, and 2 for the CP sector.

Analysis presented to the Council on the Chum RHS in December 2012 indicated that lowering the base rate would be unlikely to significantly reduce PSC. In low salmon bycatch conditions, relative hotspots do not seem to consistently persist.

The potential advantages of lowering the base rate would occur when Chinook suddenly appears on the grounds where a lower rate would allow the multi-week rolling average of bycatch to be sufficiently high to implement closures. In 2012, this would have occurred earlier for the Inshore CV sector.

An alternative to eliminating the bycatch floor would be to implement closures as a result of an area exceeding the current bycatch floor for a 1-week (or shorter) period.

Note that a change in the base rate policy would interact with other potential changes in an IPA. If other incentives encourage more effort earlier in the B-season, then the impact of a change in the base rate should be considered in combination with those potential changes.

The Chinook RHS programs for each sector utilize the data from the other sectors in closure design. One additional topic to examine (or to require in reporting requirements) is whether the closed areas would be more effective if based on the activity for each sector or based on the activity of other sectors. For example, for 2011, the closures for CPs were based on the CV PSC rates so they did not directly restrict where much of the CP fleet was fishing, although the areas were in fact the highest bycatch areas and did restrict CDQ fishing in those areas. The Council could request that more specific information be available on the information utilized for designing the closures and for the number of vessels who had been active in closed areas prior to their being closed.

4.4 Modification of the PSC accounting period

The Council requested consideration of a modification in the PSC accounting period. The current PSC accounting period used for the groundfish fisheries (to accrue against current Chinook and chum PSC limits) is on the calendar year January-December. Options requested for consideration by the Council include the following: Start of the pollock B-season (June 10) through the end of the A-season (June 9), September 1 through August 31st, October 1 through September 30th.

Modifying the PSC accounting period was considered by the Council in conjunction with the development of alternatives for the Chinook salmon bycatch management measures action which eventually led to Amendment 91. As with the development of alternatives for any analysis, multiple measures are considered initially and not carried forward for analysis for a variety of reasons that are described in a final analysis[7].

The intention of this option initially was that it more closely tracks the salmon biological year whereby juvenile salmon (those primarily taken as bycatch) likely enter the Bering Sea in the fall to feed and remain on the grounds throughout the winter. This group then migrates to other locations during the summer months prior to beginning their return to their natal streams (those that are of spawning age) in the summer. Thus, the same cohort of salmon that are being caught in the B season remain on the grounds in the A season and any closure potentially triggered by high B season Chinook catch would protect the same age class of salmon from additional impacts in the A season. There could therefore be additional conservation benefits conferred on the same cohort of salmon by the same cap level when applied in this manner versus the identical cap level over the course of the calendar year.

At the time of consideration (April 2008 staff discussion paper), seasonal allocation of annual caps was not considered in conjunction with the cap limits. Preliminary analysis of this option indicated that under many cap levels there was a high likelihood of the fleet being closed out of fishing in as early as the first few weeks of the A season. As the A season is the more lucrative roe-bearing fishing season, the Council searched for different solutions that might allow for incentives to reduce bycatch in both A and B season, and provide a limit seasonally to protect individual cohorts of salmon within and across years, while still allowing the opportunity to achieve optimum yield in the pollock fishery. As a result the Council removed the PSC accounting period option from the analysis and instead replaced it with a range of options for seasonal allocation from A to B season and the option to rollover unused bycatch from A to B season. The range considered (% A season: % B season) was 70:30, 58:42, 55:45, 50:50. The preferred alternative implemented under Amendment 91 has a seasonal allocation of 70:30 A:B season with an unrestricted rollover of unused salmon from the A to B season.

Under the current structure of the Amendment 91, with caps divided by season, sector and within IPAs to vessels, it is highly unlikely that modifying the PSC accounting period would result in the previously estimated A-season constraints and thus additional salmon conservation on the same cohort. Instead it is far more likely that while there would be a higher incentive to conserve B-season salmon than under

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[7] Each amendment analysis (EA or EIS) contains a section entitled "Alternatives considered and not carried forward for analysis"

present conditions, the first option (to begin June 10 and continue through to the end of the A-season quota) would likely result in a relaxation of any constraint in the A-season. The A-season is the more lucrative season and as vessel-based rankings across sectors and within season have shown (in Section 3.2.2 above) rates are far more uniform in the A-season suggesting both more limited fishing opportunities (due to ice cover) and a uniform intent to balance the necessity of salmon bycatch usage to obtain higher value fish. If the A-season was prosecuted under a full rollover from any B-season allocation, there would be limited, if any, incentive to conserve salmon outside of not reaching the individual limit itself while pursuing more valuable roe-bearing fish. Thus it is highly unlikely this option, under the current allocation and IPA programs would achieve any additional conservation benefits from the status quo PSC accounting. Significant modification in the cap structure, seasonal allocations and rollover provisions would be necessary to best structure the cap to retain any incentive measures currently in place. This change could provide additional economic benefits to the pollock fishery which would be able to pursue high-value roe without fear of being shut out of the B-season pollock fishery. As noted, however, this would occur at the expense of greater Chinook PSC.

Further discussion of additional regulatory constraints of modifying the PSC accounting period and the three proposed options is contained in the following section.

5 Management and regulatory considerations

The Council requested a discussion of the management constraints associated with the items requested in the motion from October 2013. The section above details the potential advantages and disadvantages from an operational and efficacy standpoint of modifying the current management program for the broad goals as outlined (shorten or otherwise constrain the season, require excluders, changes the PSC accounting period). Regulatory issues in order to make these modifications to the existing regulatory language are described below including in-season management concerns, modifications to the IPA regulations and whether specific actions would be feasible from a management perspective. How these items (#1-#6 in the Council's motion as attached in Appendix 1 and listed below) would be proposed to be addressed within the IPAs themselves will be summarized in the second paper to be made available prior to the Council meeting. Specific comments from discussions with Council staff, NMFS Regional Office Sustainable Fisheries staff, NOAA GC and NOAA GC enforcement are summarized below with each category from the Council's motion.

5.1 Requiring modification of IPAs to include restrictions or penalties targeted at vessels that consistently have the highest Chinook salmon PSC rates relative to other vessels fishing at the same time.

This is the one item of the six requested for discussion that would be included only through the IPAs. Some modification of the IPA required provisions under § *679.21(f)(12)* would be needed to identify this as a required provision for IPA approval. There is also some ambiguity in what is intended by 'vessels fishing at the same time' with respect to whether this is related to within the sectors themselves or across all sectors in the same season.

5.2 Requiring use of salmon excluder devices at times of year in which Chinook salmon encounter rates are relatively high (regulatory or through IPAs).

This is extremely problematic from a regulatory standpoint for a variety of reasons. Gear requirements are always difficult to prescribe in regulation as well as difficult to enforce. There would need to be some explicit definition of 'an excluder', to define what 'usage' entails and a means to enforce when one is being used which is problematic on a trawl net. Requiring an excluder (and associated definition thereof) has a high potential to discourage innovation in the industry which has clearly been extremely aggressive and continuous as exemplified by the current Salmon excluder EFP application for 2015 (Gauvin et al., 2014). As noted in Section 4.2, no data collection is mandated on excluder usage currently and while likewise problematic in the sense of consistently in defining what type of excluder is being used, it would be useful even in a broad 'check box' type reporting requirement to obtain haul-by-haul data on the use of excluders by the fleet. Operationally requiring their usage through regulation is not likely to obtain the desirable outcome of encouraging innovative techniques to improve excluder design, operation and thus achieve the goal of encouraging increased overall usage by the fleet.

5.3 Requiring a lower base rate beginning September 1 (regulatory or through IPAs).

Feasibly this would only work under regulation to include in the requirements for the IPA provisions that a lower base rate must be enacted starting September 1 (i.e. rather than stating in regulations what that rate must be). Regulations could be generally worded such that an RHS was a mandatory aspect to an IPA with provisions that the Base Rate be lower in those months. The IPA could be then structured to indicate how their application would increase incentives (e.g. lower base rate in September/October) as well as increased reporting requirements to determine how well these measures are increasing incentives. Consideration should be given to demonstrating in the annual report to the Council an auditing mechanism to verify that vessels are increasing their avoidance measures in the latter part of the B-season.

However this raises many questions regarding not only IPA operation but regulatory flexibility.

First with respect to the IPAs themselves, there is no one single RHS system in operation across the sectors for Chinook. The CVSSIP program for example has a threshold level of Chinook catch (25%) after which the RHS system is suspended for the remainder of the B season. Given this, the RHS system would not be in operation later in many B-seasons and thus any provision to lower the base rate would have no impact. Further, how base rates and closures are applied across IPAs is also not equivalent between the programs.

The second issue relates to regulatory flexibility. For this (and other IPA provisions), the intent of keeping requirements generally written was to allow maximum flexibility and adaptability for innovative approaches to improving incentives with the IPA structure. There is an inherent dichotomy between removing regulations for chum to allow for greater adaptability and flexibility in the development of appropriate management measures and decreasing the flexibility of the IPAs to create and manage appropriate incentive structures for Chinook. While the intent of evaluating these measures is clear (i.e., to further reduce bycatch and to increase the vessel-based incentives at all levels of abundance of salmon), balancing the downstream impacts of fixing aspects in regulation that might later need revisions as occurred with Amendment 84 regulations with attempts to improve the performance of the program as a whole should be a high priority.

Provisions to shorten the pollock season to end when pollock catch rates significantly decline and Chinook salmon PSC rates increase in October (regulatory or through IPAs). This is a simple regulatory modification. The pollock season in the FMP and in regulation would be modified to close earlier than November 1. There would likely need to be an informal consultation on Steller Sea Lions (as with almost every Council action addressing modifications to the harvest of SSL prey items). Some positive management benefits of closing the pollock fishery earlier however would include the ability of NMFS in-season management to open Bering Sea Pacific Ocean Perch (POP) earlier as this has typically been delayed due to the need to account for bycatch of these species in the Bering Sea pollock fishery. This fishery is generally not opened to directed fishing until after the Bering Sea pollock season has closed at the end of the B-season.

5.4 Closing the fishery to a sector (or cooperative) if the sector's (or cooperative's) weekly Chinook salmon PSC rate exceeds a specified rate in September and/or October (regulatory or through IPAs).

This is only feasible if the mechanism were to occur within the IPA structure itself and only general requirements were listed in regulation. Some of the reasons why it would be difficult to implement the closure in regulations include: what rate would be used and how and on what data would this be determined? It would be very difficult for in-season management to use a weekly sector or cooperative rate to determine a management action given that these data are often revised upwards or downwards soon thereafter. Simply tracking weekly sector or cooperative PSC rates on a weekly basis would also be a large increase in workload for in-season management staff. In addition it can take several days to issue an in-season action so a regulatory closure mechanism might be slower than closures implemented through the IPA structure.

5.5 Changing the accounting of the Chinook salmon PSC limit to begin with:

a. <u>the start of the pollock B season (June 10) and continue through the A season of the subsequent year;</u>
b. <u>October 1 and continue through September 30th of the subsequent year; and</u>
c. <u>September 1 and continue through August 31stof the subsequent year</u>.

This is extremely problematic for a variety of reasons. These include (and are not limited to) the following:

- PSC caps under Amendment 91 are structured to rollover from A to B season. Under this framework and option (a) there would be 30% of the cap allocated to the A-season, 70% to the B season and absent an FMP amendment otherwise no ability to rollover from one season to the next
- Under options (b) and (c) some portion of the B-season caps would need to be allocated to begin at that portion of the B-season start date for accounting purposes. Similar issues with respect to the rollover as above.
- Salmon PSC is allocated to the sector and cooperative level prior to the start of the A season. Vessels may switch from one cooperative to another from one year to another. If PSC were allocated to a cooperative based on participation in one year and then this participation in a cooperative changed the following year there would have to be some mechanism to withdraw the associated salmon PSC allocation from the change.

5.6 Reporting requirements

As the Council begins to develop potential alternatives for a comprehensive Salmon PSC management Program in the Bering Sea, consideration should also be given to what additional reporting requirements will be necessary to best evaluate the performance of the system. These specific requirements will be considered further as the alternative set for analysis is developed and laid out in more specifics in an initial review draft of those alternatives. However, based on experience in the first few years of Amendment 91 as well as evaluations of Amendment 84 and the current reporting requirements some general recommendations can be noted for further considerations. These include:

- Explicit reporting requirements for when an excluder is being used by a vessel on a haul-by-haul basis. Some consideration must be given to designing this requirement to reflect the utility in obtaining these data and the difficulties as expressed previously in determining excluder types.
- Combined reporting requirements for chum and Chinook which best demonstrate the balance between the timing and issues regarding innovative salmon avoidance plans and reducing bycatch of both species by season and sector.
- Depending upon how chum PSC avoidance is incorporated into the IPAs (e.g., via comprehensive RHS across fleets) specific reporting requirements should be developed which would allow for transparency and evaluation of the efficacy of fleet movements and balancing between avoidance of chum and Chinook. Some of these were previous summarized in the Chum EA (NPFMC 2012) and included below. Note these are examples based on the alternatives considered for chum (only) at that time:

Table 17. Suggested reporting requirements in conjunction with selection of a RHS-based management program (from Chum Management Measures EA/RIR, December 2012 draft). Requirements are for annual reporting unless indicated otherwise.

	Requirement	Rationale for requirement	Details and frequency
1	Dates and areas of Chinook closures under IPAs	Better understand relative constraints already imposed	As done by SeaState. Annual or in-season (see further explanation below)
2	Date and area Chinook threshold invoked and relative Chinook rates in other stat areas over time frame	To see whether threshold seems appropriate in when and why invoked based on relative rates in other stat areas	Detailed information on when the chum closures are suspended and based on what Chinook data
3	Sea State summary of closure decision-making	Provide transparency to why a particular area was closed	When closures are modified or extended during the B Season
4	Continue publication of any chum RHS reports sent to the pollock fleet	Continued transparency of reports and closed areas	Following A84, as issued.
5	Listing of advisory closure areas	Additional incentive provided by advisory areas	Need some measure of who fished in test fishing areas
6	Consolidate reporting requirements for both salmon species		To be developed further in conjunction with further action by the Council on this analysis. See below.

Discussion of additional reporting requirements to be considered in analyzing alternatives put forward by the Council.

In conjunction with analyzing alternatives staff would compile draft reporting requirements to address best analyzing the efficacy of alternative management measures as well as improvements to current reporting requirements. Furthermore staff in analyzing the status quo programs would develop a template for analysis of each IPA in order to inform any modification in reporting requirements in the future and facilitate the annual reports providing consistent comparison and calculations for future annual 'savings' reports from IPAs.

6 Council action

At this meeting the Council will review this discussion paper as well as the forthcoming one on details of the IPA proposals to address the Council's requests. The Council will then consider whether to initiate an amendment analysis and if so, the relative scope of that analysis. Some things the Council may wish to consider in doing so are:

- Development of a Problem Statement for a comprehensive Bering Sea Salmon Bycatch Management Program;
- Development of a suite of alternatives for modifications to the current Amendment 91 Chinook bycatch program and Chum bycatch management;
- The scope of the analytical document needed for this analysis (NEPA);
- Time frame for the analysis; and
- Discussion of outreach on the forthcoming analysis.

The Council has already indicated its intent to pursue additional outreach efforts on Bering Sea salmon bycatch but deferred further discussion until such a time that an analysis was initiated in order to better inform the public in these meetings as to the scope of Council action and intent. Staff will be prepared to provide a brief overview of potential outreach efforts and schedule that could be considered over the next year depending upon the wishes of the Council as well as to initiate involvement of the Council's Outreach Committee to further discuss the specific outreach plan.

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Appendix 1: Council motion: October 2013

C-6(b) and (c) Bering Sea salmon bycatch

Council motion

The Council requests a discussion paper that evaluates the regulatory changes needed to incorporate Bering Sea chum salmon bycatch avoidance into the Chinook salmon Incentive Plan Agreements (IPAs). The objectives of this action are to prioritize Chinook salmon bycatch avoidance, while preventing high chum salmon bycatch and focusing on avoidance of Alaska chum salmon stocks, and allowing flexibility to harvest pollock in times and places that best support those goals. The paper should include an evaluation of the necessary changes to the IPA objectives and reporting requirements in regulation, and identify both the effects of such a change and whether there are elements of a rolling hotspot system (RHS) that the Council should consider retaining or adding to the regulations that define IPA requirements (such as, institutionalizing fleet-wide information sharing; requiring an RHS within the IPA; establishing an adjustable floor on the base rate, etc).

The Council requests the discussion paper also evaluate possible measures to refine Chinook salmon bycatch controls in the Bering Sea pollock fisheries. These include:

1) Requiring modification of IPAs to include restrictions or penalties targeted at vessels that consistently have the highest Chinook salmon PSC rates relative to other vessels fishing at the same time.
2) Requiring use of salmon excluder devices at times of year in which Chinook salmon encounter rates are relatively high (regulatory or through IPAs).
3) Requiring a lower base rate beginning September 1 (regulatory or through IPAs).
4) Provisions to shorten the pollock season to end when pollock catch rates significantly decline and Chinook salmon PSC rates increase in October (regulatory or through IPAs).
5) Closing the fishery to a sector (or cooperative) if the sector's (or cooperative's) weekly Chinook salmon PSC rate exceeds a specified rate in September and/or October (regulatory or through IPAs).
6) Changing the accounting of the Chinook salmon PSC limit to begin with:
   a. the start of the pollock B season (June 10) and continue through the A season of the subsequent year;
   b. October 1 and continue through September 30th of the subsequent year; and
   c. September 1 and continue through August 31st of the subsequent year.

This evaluation should also include information on potential revisions to the annual reporting requirements, combined for chum and Chinook salmon measures, based on suggestions in the Council's October staff report, such as, frequency of excluder use, variability in individual vessel bycatch rates over the season and years, and numbers and rates of bycatch by month.

The Council requests that the AEQ and impact rate analysis be conducted on a regular basis, using updated genetic information and actual bycatch levels, and presented to the Council as a regular report. The Council also recommends that the observer program evaluate and implement ways to improve the sample size of Chinook salmon length data, to improve the confidence in estimates of salmon ages spatially and temporally for AEQ analyses.

Appendix 2: Industry proposal on incorporation of chum into existing IPAs (October 2013)

Chum Salmon Bycatch Avoidance Measures for addition to Existing Chinook Salmon IPAs

The following chum salmon IPA program has been developed in cooperation by all 3 IPA groups for universal implementation in each of the three Amendment 91 Chinook salmon Incentive Plan Agreements. Consistent with chum protection measures currently in place, the industry has modified the current RHS program with two primary objectives in mind.

I. Provide a higher level of bycatch reduction for mature chum salmon during the months of June and July than provided by the current Amendment 84 RHS program.

II. From August 1st on, the IPA/RHS program continues to provide chum salmon bycatch avoidance while allowing for increased pollock harvest opportunities intended to reduce the bycatch of Chinook salmon that normally increases on or around September 1st of each B season.

The chum salmon IPA/RHS elements, along with reference comparisons to the current Amendment 84 RHS program, are as follows:

1. A modified rolling hot spot (RHS) program that utilizes industry-wide pollock harvest and chum salmon bycatch data with closure area classifications that are applied at the coop level.

   - *Both the IPA chum program and the current Amendment 84 program operate using industry-wide data with closures applied at the coop level. There has been much discussion regarding coop vs. individual vessel application of closure area assignments. On one hand there is a concern that some vessels in coops not closed out of areas (Tier One) could fish in high bycatch areas under the "clean fishing cover" provided by other coop members. On the other hand, a program run at the individual vessel level offers an opportunity for Tier One vessels within a coop to rotate their fishing between clean and dirty areas in a manner that always maintains their Tier One status.*

     While there are offsetting gaming possibilities under both scenario, in practice vessels generally avoid high bycatch areas regardless of their Tier assignment. Therefore, the single best reason to run an RHS program at the coop level is to avoid confusion within the fleet regarding closure areas and to what vessels the closures are applied. It is far easier for a captain to maintain awareness of closures when all vessels within the cooperative are managed similarly.

2. Closure announcements begin on June 17th of each B season.

   - *Under A-84 there is no set start date; the addition of a "date certain" for the commencement of RHS announcements assures a set start to the program.*

3. Tier Level assignments.

    a. The program would operate with two Tier levels; Tier 1 coops are able to fish inside a closure for an entire week. Tier 2 coops are not allowed to fish in closures for the entire week.
    b. Coops assigned to Tier 1 have a 2 week average bycatch that is less than 75% of Base Rate,
    c. Coops assigned to Tier 2 have a 2 week average bycatch at or above 75% of Base Rate.

    - *This is a more conservative Tier assignment measure than found in the current A-84 program which utilizes a 3 Tier system. Tier 1 coops in both programs have the same qualifications; a bycatch rate that is less than 75% of the Base Rate. Currently Tier 2 coops, those coops with a bycatch rate between 75% and 125% of the Base Rate, are closed out of the closure areas for 4 days each week. Tier 3 coops, those with a bycatch rate above 125% of the Base Rate, are closed out for the entire week. Under this proposed IPA chum RHS program, all coops are closed out of the areas <u>for the entire week</u> unless they meet the 75% qualification for Tier 1.*

4. All coops are initially assigned to Tier 2 (those closed out for an entire week) until they have accumulated and maintained 2 consecutive weeks of fishing data.

    - *The current Amendment 84 rules allow coops to initially start in Tier 1, and retain Tier 1 status until they have accumulated 2 consecutive weeks of bycatch data. This reversal of initial Tier assignment status requires a cooperative to meet the Tier 1 qualification (bycatch below 75% of Base Rate) before being assigned to it.*

5. Bering Sea chum bycatch is managed by 2 regions; the portion of the Bering Sea east of 168° west longitude is the East Region and the portion of the Bering Sea west of 168° west longitude is the West Region.

    - *No change from current RHS program.*

6. June and July Base Rate Characteristics.

    a. The Base Rate is calculated using industry-wide chum salmon bycatch numbers (numerator) and pollock harvest data (denominator).

        - *Consistent with the current RHS program.*

    b. Initially set at 0.19 until 2 full weeks of data is available, the Base Rate is then calculated as a 2 week rolling average.

- *Both programs utilize an initial predetermined Base Rate of 0.19, however the current RHS program is calculated as a 3 week rolling average. This change has been made in response to NMFS analysis of the RHS program.*

c. From June 17th through July 31st the Base Rate shall not increase by more than 20% from one week to the next (Base Rate Collar).

- *Under the current A-84 RHS rules the Base Rate is a straight forward calculation of current fleet bycatch as determined by recent chum and pollock catch. During times of increasing chum salmon bycatch, as typically encountered in June and July, rates may climb so quickly that some coops will qualify for Tier 1 simply due to a rapidly increasing Base Rate. Additionally, a rapidly rising Base Rate may fail to qualify an appropriate range of areas be considered for closure. The "Collar" keeps the Base Rate lower than it may have otherwise been resulting in a more conservative bycatch reduction program.*

d. From June 17 through July 31, the Base Rate may not go below 0.1 (the "floor").

- *The addition of a 0.1 floor to the Base Rate will eliminate ineffective closures from occurring during times of low chum encounters by the fleet. Without the floor, low encounter closures simply move the fleet away from the best pollock fishing with little to no gain in chum conservation.*
- *Maximizing pollock harvest during times of low chum encounters in June and July plays a key role in reducing Chinook bycatch in the B season.*

7. On August 1st the RHS/IPA chum salmon bycatch reduction program shifts from maximized mature chum salmon protection to a program aimed at minimizing high chum bycatch while increasing pollock fishing CPUE.

a. Beginning August 1st the 20% Base Rate Collar is dropped. Future Base Rate calculations will be the 2 week rolling average of the coops' actual bycatch rate.

i. *Eliminating the "Collar" restores the IPA/RHS back in line with the A-84 chum RHS program, directs closures to areas of high chum encounters while allowing higher pollock harvest opportunities.*

b. Base Rate Floor Adjustments for identifying closure area candidates.

1. From Aug. 1 until Sept. 1st, for the purpose of determining areas eligible for closure, the Base Rate floor limit is raised to 0.5

Appendix 3: Regulations associated with Incentive Program Agreements (IPAs) under Amendment 91 and Inter-cooperative Agreement (ICA) under Amendment 84

7.1 Current Chinook Incentive Program Agreement description of required elements:

§ 679.21(f)(12)(B) Proposed IPA. The proposed IPA must contain the following information:

(3) Description of the incentive plan. The IPA must contain a written description of the following:

(i) The incentive(s) that will be implemented under the IPA for the operator of each vessel participating in the IPA to avoid Chinook salmon bycatch under any condition of pollock and Chinook salmon abundance in all years;

(ii) The rewards for avoiding Chinook salmon, penalties for failure to avoid Chinook at the vessel level, or both;

(iii) How the incentive measures in the IPA are expected to promote reductions in a vessel's Chinook salmon bycatch rates relative to what would have occurred in absence of the incentive program;

(iv) How the incentive measures in the IPA promote Chinook salmon savings in any condition of pollock abundance in a manner that is expected to influence operational decisions by vessel operators to avoid Chinook salmon' and

(v) How the IPA ensures that the operator of each vessel governed by the IPA will manage his or her Chinook salmon bycatch to keep total bycatch below the performance standard described in paragraph (f)(6) of this section for the sector in which the vessel participates.

7.2 Current non-Chinook salmon ICA regulations

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

(i) *Application*. The ICA representative identified in paragraph (g)(2)(i)(B) of this section must submit a signed copy of the proposed non-Chinook salmon bycatch reduction ICA, or any proposed amendments to the ICA, to NMFS at the address in paragraph (b)(6) of this section.

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

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

(i) Participants.

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

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

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

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

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

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

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

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

(C) ICA Chum Salmon Savings Area notices.[8] On each Thursday and Monday after June 10 of each year for the duration of the pollock B season, the entity identified under paragraph (g)(2)(i)(C) of this section must provide notice to the parties to the salmon bycatch reduction ICA and NMFS identifying one or more areas designated "ICA Chum Savings Areas" by a series of latitude and longitude coordinates. The Thursday notice must be effective from 6 p.m. A.l.t. the following Friday through 6 p.m. A.l.t. the following Tuesday. The Monday notice must be effective from 6 p.m. A.l.t. the following Tuesday through 6 p.m. A.l.t. the following Friday. For any ICA Salmon Savings Area notice, the maximum total area closed must be at least 3,000 square miles for ICA Chum Savings Area closures.

(D) Fishing restrictions for vessels assigned to tiers. For vessels in a cooperative assigned to Tier 3, the ICA Chum Salmon Savings Area closures announced on Thursdays must be closed to directed fishing for pollock, including pollock CDQ, for seven days. For vessels in a cooperative assigned to Tier 2, the ICA Chum Salmon Savings Area closures announced on

[8] Note that previous comments were submitted to NMFS from the United Catcher Boats on this paragraph.

Thursdays must be closed through 6 p.m. Alaska local time on the following Tuesday. Vessels in a cooperative assigned to Tier 1 may operate in any area designated as an ICA Chum Salmon Savings Area.

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

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

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

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

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

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

(4) ICA Annual Report.

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

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

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

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

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

Appendix 4

Table A1. Chinook salmon bycatch rate (Chinook salmon per t of pollock) standard deviation relative to the rest of the fleet (all sectors combined), 2003-2013. Vessel column represents the sector and within-sector rank.

Vessel	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Avg 2003-2013	Avg 2011-2013	Chinook salmon
CV_1	4.3	1.7	3.3	1.4	0.9	-0.3	1.4	7.2	-0.9	4.7	0.4	2.2	1.4	421
CV_2	0.3	3.4	1.3	1.4	1.2	0.8	0.8	1.2	0.8	2.0	1.2	1.3	1.3	769
CV_3	0.0	0.2	2.6	2.3	1.1	1.5	2.7	0.6	1.3	1.4	2.0	1.4	1.6	848
CV_4	0.7	2.7	4.6	0.7	1.0	2.1	0.2	-0.5	0.7	-0.2	-0.9	1.0	-0.1	564
CV_5	0.3	0.1	1.4	2.6	1.5	2.5	1.3	0.4	2.0	1.0	1.1	1.3	1.4	1,085
CV_6	-0.7	0.0	0.9	2.5	2.5	0.2	0.4	0.6	1.6	0.3	0.7	0.8	0.8	824
CV_7	1.4	0.1	0.2	2.2	1.6	1.1	1.0	1.9	0.6	0.4	0.5	1.0	0.5	648
CV_8	0.1	-0.1	1.1	1.0	0.7	1.5	0.9	0.8	2.0	1.3	3.7	1.2	2.3	1,527
CV_9	-0.1	0.5	1.0	1.2	1.4	1.0	-0.4	-0.3	0.7	0.8		0.6	0.8	1,063
CV_10	0.0	2.3	0.7	-0.4	2.9	-0.9	0.2	-0.1	-0.2	1.7	1.6	0.7	1.0	748
CV_11	-0.4	0.5	1.0	1.6	0.7	0.7	0.5	-0.2	1.4	0.8	1.2	0.7	1.1	1,192
CV_12	-0.2	0.3	-0.1	2.1	1.7	-0.2	1.2	0.6	0.6	0.1	1.4	0.7	0.7	817
CV_13	-2.0	0.6	-0.7	0.1	0.9	-0.4	0.8	1.6	3.0	1.8	3.6	0.8	2.8	1,495
CV_14	1.8	-0.5	1.2	0.8	0.4	0.4	0.4	-0.2	1.0	2.7	0.7	0.8	1.5	1,614
CV_15	0.3	1.7	1.2	0.3	1.0	-0.4	1.9	-0.2	-0.7	-0.4	-0.7	0.4	-0.6	339
CV_16	0.1	0.3	1.0	1.0	0.6	0.7	-0.4	0.4	-1.1	0.2	2.1	0.5	0.4	337
CV_17	-0.3	-0.9	0.4	2.0	0.5	0.0	1.1	-0.2	1.0	2.0	2.3	0.7	1.8	1,423
CV_18	1.0	1.2	1.0	1.7	-0.3	-0.2	-0.4	0.7	-0.9	0.6	-0.8	0.3	-0.4	311
CV_19	2.2	1.7	1.1	0.6	0.5	-0.8	-0.7	-0.1	-1.2	-0.3	-0.8	0.2	-0.8	140
CV_20	2.5	0.1	1.9	1.1	-0.2	-0.6	-0.3	0.1	-0.7	0.2	-0.5	0.3	-0.4	259
CV_21	-1.0	-0.8	-0.4	0.7	1.5	0.0	2.1	-0.3	0.9	-0.6	-0.2	0.2	0.0	529
CV_22	-0.6	-0.6	0.3	0.4	0.4	1.5	0.3	0.4	0.3	1.3	-0.3	0.3	0.5	678
CV_23	0.1	0.6	0.3	0.1	1.2	0.0	0.1	0.9	-0.4	-0.8	-0.5	0.2	-0.6	200
CV_24	0.0	1.2	0.5	0.8	0.4	-0.8	0.6	0.1	-0.8	-0.2	-0.4	0.1	-0.4	328
CV_25	0.8	-0.6	0.4	0.0	0.2	0.3	0.0	0.0	1.8	1.5	1.2	0.5	1.5	1,635
CV_26	-1.2	-1.2	0.2	0.4	1.7	0.1	0.3	0.3	0.5	1.1	-0.4	0.2	0.4	296
CV_27	-0.5	0.3	-0.4	0.0	-0.3	5.8	-0.6	-0.6	0.5	-0.2	0.1	0.4	0.1	458
CV_28	1.1	4.3	0.3	-0.8	-0.2	-0.2	-0.5	-0.3	-0.5	-0.1	1.2	0.4	0.2	386
CV_29	0.1	0.9	0.4	0.5	-0.1	-0.3	-0.6	-0.6	0.7	0.1	-0.6	0.0	0.0	1,381
CV_30	0.6	0.1	0.0	-0.1	0.2	-0.1	0.3	0.1	0.6	1.2	1.5	0.4	1.1	877
CV_31	-0.8	0.2	-0.6	0.4	0.4	1.6	6.2	-0.4	-0.9	0.6	0.6	0.7	0.1	478
CV_32	-0.2	-0.1	-0.6	-0.5	1.3	-0.2	-0.3	0.4	0.8	-0.2	0.8	0.1	0.5	491
CV_33	-0.5	-0.6	-0.8	-0.6	2.4	-0.2	-0.5	0.5	-0.6	0.2	-0.1	-0.1	-0.2	610
CV_34	0.6	-0.1	0.3	0.3	-0.3	1.5	-0.7	-0.5	-0.1	-0.5	-0.8	0.0	-0.5	624
CV_35	0.7	0.7	-0.4	0.3	0.2	-0.4	-0.4	-0.5	-0.3	0.1	-0.4	0.0	-0.2	436
CV_36	0.1	-0.2	0.6	0.3	-0.3	-0.1	-0.6	-0.4	-0.7	-0.3	-0.8	-0.2	-0.6	269
CV_37	-0.8	-0.4	0.9	0.2	-0.1	-0.4	-0.4	-0.4	-0.4	0.2	-0.9	-0.2	-0.4	364
CV_38	-0.7	-0.4	-0.3	-0.2	1.6	1.2	-0.6	-0.4	-0.8	-0.4	-0.5	-0.1	-0.6	211
CV_39	0.0	0.6	-0.2	-0.2	-0.3	-0.4	-0.5	-0.6	0.4	-0.2	-0.6	-0.2	-0.1	591
CV_40	0.4	0.4	-0.5	-0.6	-0.4	-0.2	-0.6	-0.6	2.2	-0.9	-0.4	-0.1	0.3	645
CV_41	-0.1	-0.1	-0.5	-0.1	-0.2	0.9	-0.6	-0.6	0.8	-0.3	-0.8	-0.1	-0.1	1,231
CV_42	-0.6	-0.6	-0.5	0.3	-0.9	0.2	-0.6	-0.7	-0.6	0.4	-0.3	-0.4	-0.2	289
CV_43	-0.1	0.0	0.0	-0.4	-0.5	-0.4	-0.6	-0.5	0.1	-0.8	-0.7	-0.4	-0.5	647
MS_1	-0.6	-0.2	-0.4	0.1	0.8	0.4	-0.2	-0.3	-1.1	-0.8	-0.5	-0.3	-0.8	162
CV_44	-0.9	-0.7	-0.1	-0.6	0.1	0.0	-0.3	-0.3	-0.8	-0.1	-0.6	-0.4	-0.5	205
MS_2	2.5	0.1	-0.6	0.6	-1.0	-0.1	-0.4	-0.6	-1.1	-0.9		-0.1	-1.0	46
CP_1	0.8	-0.4	-0.4	-0.3	-0.7	-0.2	-0.2	-0.2	-0.9	-0.2	0.4	-0.2	-0.2	1,022
MS_3	0.5	-0.6	-0.7	-0.9	-0.4	-0.2	-0.3	-0.1	0.5	-0.3	-0.8	-0.3	-0.2	511
MS_4	0.3	-0.7	-0.7	-0.5	-0.3	-0.5	-0.4	0.0	1.6	-0.2	-0.7	-0.2	0.2	377
MS_5	0.1	-1.0	-0.8	-0.5	-0.8	0.5	-0.2	-0.7	1.4	-0.7	-0.2	-0.3	0.2	362
CP_2	0.7	-0.4	-0.5	-0.7	-0.3	-0.3	-0.5	-0.4	-1.0	-0.1	-0.1	-0.3	-0.4	874

Table A1. Chinook salmon bycatch rate (Chinook salmon per t of pollock) standard deviation relative to the rest of the fleet (all sectors combined), 2003-2013. Vessel column represents the sector and within-sector rank.

Vessel	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Avg 2003-2013	Avg 2011-2013	Chinook salmon
CV_45	-0.2	-0.4	-0.6	-0.5	-0.8	0.3	-0.5	-0.5	0.8	0.0	-0.5	-0.3	0.1	437
CV_46	-0.4	-0.8	0.0	-0.3	-0.6	-1.0	-0.5	-0.4	0.6	-0.3	0.0	-0.3	0.1	471
MS_6	2.6	1.5	-0.7	-0.7	-1.2	-0.7	-0.5	-0.5	-1.2	-1.0	-0.5	-0.3	-0.9	90
CV_47	-0.8	0.0	-0.5	-0.4	-0.8	-0.2	-0.6	-0.5	-0.2	-0.4	-0.6	-0.4	-0.4	278
CP_3	-0.8	-0.7	-0.8	-1.1	-0.7	-0.8	0.0		-0.5	-1.1		-0.7	-0.8	38
MS_7	-0.7	-0.6	-0.5	-0.1	-0.6	0.2	-0.5	-0.5	0.5	-0.8	-0.4	-0.4	-0.2	551
CP_4	0.1	-0.8	-0.7	-1.0	-0.5	-0.7	-0.4	1.3	-0.8	-0.1	-0.1	-0.3	-0.3	910
MS_8	-0.5	-0.7	-0.8	-0.6	-0.6	-0.5	-0.6	-0.6	0.4	-0.8	-0.3	-0.5	-0.3	407
MS_9	-0.1	-0.7	-0.8	-0.6	-0.5	-0.9	-0.6	0.1	-1.2	-0.8	-0.9	-0.6	-1.0	51
CV_48	0.2	0.1			-0.7	-0.3	-0.5	-0.5	0.2	-0.7	-0.6	-0.3	-0.3	290
MS_10	0.0	-0.8	-0.8	-0.1	-0.5	-0.3	-0.6	-0.3	0.1	-0.9	-0.5	-0.4	-0.5	292
MS_11	-1.0	-0.5	-0.8	-0.9	-0.6	-0.4	-0.3	-0.4	-0.1	-0.7	-0.8	-0.6	-0.5	323
CP_5	0.9	-0.3	-0.3	-0.7	-0.7	-0.3		0.3	-1.0	-0.8	-0.4	-0.3	-0.7	851
CP_6	-0.5	-0.4	-0.4	-0.9	-0.9	-0.5	-0.5	-0.5	-1.1	-0.5	-0.4	-0.6	-0.6	962
CV_49	-1.0	-0.6	-0.7	-0.6	-1.3	-0.3	-0.6	-0.6	0.8	-0.2	-0.7	-0.5	0.0	760
MS_12	0.2	-0.5	-0.7	-0.8	-1.0	-0.7	-0.5	-0.5	-1.1	-0.9	-0.2	-0.6	-0.7	98
CP_7	-0.9	-0.5	-0.6	-0.9	-0.7	-0.8	-0.4	-0.4	-0.9	-0.5	-0.4	-0.6	-0.6	926
CP_8	-0.5	-0.5	-0.4	-1.2	-1.1	-0.6	-0.1	0.4	-1.1	-0.7	-0.6	-0.6	-0.8	705
CP_9	-0.9	-0.6	-0.7	-0.9	-0.5	-0.8	-0.4	-0.3	-1.2	-0.9	0.2	-0.6	-0.6	435
MS_13	-1.2	-0.8	-0.8	-1.0	-1.2	-0.7	-0.2					-0.8		0
MS_14	-0.5	-0.5	-0.8	-1.0	-1.1	-0.6	-0.6	-0.3	-0.5	-0.8	-0.7	-0.7	-0.6	245
CP_10	-0.5	-0.9	-0.9	-1.3	-1.2	-0.8						-0.9		0
MS_15	-0.8	-0.5	-0.8	-1.2	-1.0	-0.7	-0.6	-0.5	0.4	-1.0	-0.8	-0.7	-0.5	330
CP_11	-0.7	-0.8	-0.8	-0.9	-0.9	-1.0	-0.7	-0.5	-1.1	-0.8	-0.7	-0.8	-0.9	589
CP_12	-0.8	-0.4	-0.6	-1.0	-0.8	-0.5	-0.6	-0.5	-0.9	-0.6	-0.6	-0.7	-0.7	979
CP_13	-0.7	-0.8	-0.7	-0.9	-1.0	-0.9	-0.5	-0.5	-0.8	-0.8	-0.8	-0.8	-0.8	698
CP_14	-1.1	-0.8	-0.8	-1.2	-1.1	-0.5	0.6	-0.7	-1.1	-0.5	0.1	-0.7	-0.5	1,117
CP_15	-0.3	-0.7	-0.9	-1.2	-0.9	-0.7	-0.5	-0.1	-1.0	-0.8	-0.5	-0.7	-0.8	924
CP_16	-1.0	-0.8	-0.9	-1.2	-1.1	-0.8	-0.7	0.0	-1.1	-0.7	-0.6	-0.8	-0.8	638

Table A2. Chinook salmon bycatch number per t of pollock by coop 2003-2013.

Co-op	date	2011	2012	2013			2011	2012	2013
	5-Sep	0.04	0.02	0.04		5-Sep	0.00	0.01	0.00
	12-Sep	0.04	0.05	0.01		12-Sep	0.01	0.00	0.00
	19-Sep	0.08	0.08	0.01		19-Sep	0.01	0.00	0.00
	26-Sep	0.09	0.08	0.22		26-Sep	0.01		
1	3-Oct	0.08	0.06	0.33	4	3-Oct	0.00		
	10-Oct	0.16	0.06	0.16		10-Oct	0.15		
	17-Oct	0.13	0.05	0.02		17-Oct	0.21		
	24-Oct	0.17	0.12	0.05		24-Oct	0.37		
	31-Oct	0.20	0.08			31-Oct	0.09		
	5-Sep	0.05	0.00	0.04		5-Sep	0.01	0.00	
	12-Sep	0.07	0.04	0.03		12-Sep	0.05		
	19-Sep	0.21	0.05	0.01		19-Sep	0.02		
2	26-Sep	0.20	0.07	0.28		26-Sep	0.06		
	3-Oct	0.11	0.05	0.30	5	3-Oct	0.00		
	10-Oct	0.29	0.28	1.15		10-Oct	0.04	0.00	
	17-Oct	0.15	0.06	0.02		17-Oct	0.12	0.00	
	24-Oct	0.31	0.10	0.26		24-Oct	0.24		
	31-Oct	0.26	0.21			31-Oct	0.14		
	5-Sep	0.02	0.00	0.04		5-Sep	0.03	0.00	0.01
	12-Sep	0.02	0.01	0.00		12-Sep	0.02	0.01	0.00
	19-Sep	0.03	0.00	0.01		19-Sep	0.06	0.00	0.00
	26-Sep	0.05	0.02	0.12		26-Sep	0.11	0.00	0.02
3	3-Oct	0.06	0.04	0.00	6	3-Oct	0.04	0.00	0.00
	10-Oct	0.05	1.26	0.43		10-Oct	0.09	0.00	0.00
	17-Oct	0.04	0.03			17-Oct	0.30		
	24-Oct	0.08				24-Oct	0.17		0.00
	31-Oct	0.11		0.00		31-Oct	0.05		0.00
						5-Sep	0.01	0.00	0.00
						12-Sep	0.03	0.00	0.01
						19-Sep	0.04	0.00	0.01
						26-Sep	0.06	0.00	0.01
					7	3-Oct	0.04	0.00	0.01
						10-Oct	0.08	0.00	0.02
						17-Oct	0.10	0.00	0.01
						24-Oct	0.10	0.00	
						31-Oct	0.10		