# Bering Sea Chinook Salmon Report for Council: Stock status, AEQ analysis and PSC rate analysis

NPFMC/NMFS Staff discussion paper
October 2013



## 1 Introduction

In April the Council tasked staff to provide a report on Chinook salmon bycatch in the Bering Sea pollock fishery which includes the following:

1. A review of the status of Alaska Chinook salmon stocks, including subsistence, sport, and commercial fishery restrictions and whether escapement goals have been met.

2. A report of genetic stock identification (2011) along with stock-based adult-equivalency (AEQ), run reconstruction, and PSC harvest rate analyses for Chinook salmon stocks. The AEQ analysis should include an estimate of the impacts to each specific stock grouping of bycatch at the current cap levels (47,591 and 60,000) and actual bycatch levels in 2011 and 2012.

3. In order to evaluate fishing and bycatch performance under Amendment 91, the following items should be included from 2003 - 2013 (to date):
   - Numbers and rates of bycatch taken by month, by sector
   - Use of salmon excluders, by sector and season (or month if available)
   - Variability between bycatch rates per vessel within each sector (2011 – 2012),
     - consistency year-to-year in vessels ranking relatively high and relatively low in performance rankings

This information is requested in order to best evaluate the efficacy of the current Chinook salmon bycatch management program in the context of the status of directed salmon fisheries and with updated analyses of bycatch impact rates by region of origin using recent genetic information. The Council requested that information be provided on the incentive mechanisms contained within the industry-run Incentive Program Agreements (IPAs). This information will be provided separately by each sector at the October Council meeting.

# 2 Status of Alaskan Chinook salmon stocks

The following sections contain information relating to Alaskan Chinook salmon stock status including whether stocks are classified as 'stocks of concern", whether escapement goals are established and met, and whether or not catch restrictions were in place in 2012. This information has been provided by staff at ADF&G per Council request in order to provide a context for the discussion of Chinook salmon PSC in the pollock fishery. A discussion of the State's Sustainable Salmon Fisheries Policy (SSFP), definitions for different escapement goals and objectives are provided in addition to updated information on individual stock status.

The Alaska State Constitution, Article VII, Section 4, states that "Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial users." In 2000, the Alaska Board of Fisheries (board) adopted the Sustainable Salmon Fisheries Policy (SSFP) for Alaska, codified in 5 AAC 39.222. The SSFP defines sustained yield to mean an average annual yield that results from a level of salmon escapement that can be maintained on a continuing basis; a wide range of average annual yield levels is sustainable and a wide range of annual escapement levels can produce sustained yields (5 AAC 39.222(f)(38)).

The SSFP contains five fundamental principles for sustainable salmon management, each with criteria that are used by ADF&G and the board to evaluate the health of the state's salmon fisheries and address any conservation issues and problems as they arise. These principles are (5 AAC 39.222(c)(1-5):

- Wild salmon populations and their habitats must be protected to maintain resource productivity;
- Fisheries shall be managed to allow escapements within ranges necessary to conserve and sustain potential salmon production and maintain normal ecosystem functioning;
- Effective salmon management systems should be established and applied to regulate human activities that affect salmon;
- Public support and involvement for sustained use and protection of salmon resources must be maintained;
- In the face of uncertainty, salmon stocks, fisheries, artificial propagation, and essential habitats must be managed conservatively.

This policy requires that ADF&G describe the extent salmon fisheries and their habitats conform to explicit principles and criteria. In response to these reports the board must review fishery management plans or create new ones. If a salmon stock concern is identified in the course of review, the management plan will contain measures, including needed research, habitat improvements, or new regulations, to address the concern.

A healthy salmon stock is defined as a stock of salmon that has annual runs typically of a size to meet escapement goals and a potential harvestable surplus to support optimum or maximum yield. In contrast, a depleted salmon stock means a salmon stock for which there is a conservation concern. Further, a stock of concern is defined as a stock of salmon for which there is a yield, management, or conservation concern (5 AAC 39.222(f)(16)(7)(35)). Yield concerns arise from a chronic inability to maintain expected yields or harvestable surpluses above escapement needs. Management concerns are precipitated by a chronic failure to maintain escapements within the bounds, or above the lower bound of an established goal. A conservation concern may arise from a failure to maintain escapements above a sustained escapement threshold (defined below). The current and historical stocks of concern are shown in Table 1.

Table 1. Historical and current Chinook salmon stocks of concern in Alaska.

| Region | Area | Stock | Level of Concern | Year Initiated | Year Removed |
|---|---|---|---|---|---|
| Central | Cook Inlet | Anchor River | Management | 2001 | 2004 |
| | Cook Inlet | Alexander River | Management | 2011 | ongoing |
| | Cook Inlet | Theodore River | Management | 2011 | ongoing |
| | Cook Inlet | Lewis River | Management | 2011 | ongoing |
| | Cook Inlet | Chuitna River | Management | 2011 | ongoing |
| | Cook Inlet | Willow Creek | Yield | 2011 | ongoing |
| | Cook Inlet | Goose Creek | Yield | 2011 | ongoing |
| AYK | Kuskokwim | Kuskokwim River | Yield | 2001 | 2007 |
| | Yukon | Yukon River | Yield | 2001 | ongoing |
| | Norton Sound | Norton Sound SD 5/6 | Yield | 2004 | Ongoing |
| Westward | Kodiak | Karluk River | Management | 2011 | Ongoing |

The State of Alaska manages subsistence, sport/recreational (used interchangeably), commercial, and personal use harvest on lands and waters throughout Alaska. The Alaska Department of Fish and Game (ADF&G) is responsible for managing subsistence, commercial, sport, and personal use salmon fisheries. The first priority for management is to meet spawning escapement goals in order to sustain salmon resources for future generations. The highest priority use is for subsistence under both state and federal law. Salmon surplus above escapement needs and subsistence uses are made available for other uses. The Alaska Board of Fisheries (BOF) adopts regulations through a public process to conserve and allocate fisheries resources to various user groups. Subsistence fisheries management includes coordination with the Federal Subsistence Board and Office of Subsistence Management, which also manages subsistence uses by rural residents on federal lands and applicable waters under Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA). Yukon River salmon fisheries management includes obligations under an international treaty with Canada. Salmon fisheries management in southeast Alaska also includes international obligations under the Pacific Salmon Treaty.

Escapement is defined as the annual estimated size of the spawning salmon stock. Quality of the escapement may be determined not only by numbers of spawners, but also by factors such as sex ratio, age composition, temporal entry into the system, and spatial distribution within salmon spawning habitat ((5 AAC 39.222(f)(10)). Scientifically defensible salmon escapement goals are a central tenet of fisheries management in Alaska. It is the responsibility of ADF&G to document, establish, and review escapement goals, prepare scientific analyses in support of goals, notify the public when goals are established or modified, and notify the board of allocative implications associated with escapement goals.

The key definitions contained in the SSFP with regard to scientifically defensible escapement goals and resulting management actions are: biological escapement goal, optimal escapement goal, sustainable escapement goal, and sustained escapement threshold. Biological escapement goal (BEG) means the escapement that provides the greatest potential for maximum sustained yield. BEG will be the primary management objective for the escapement unless an optimal escapement or in-river run goal has been adopted. BEG will be developed from the best available biological information and should be scientifically defensible on the basis of available biological information. BEG will be determined by

ADF&G and will be expressed as a range based on factors such as salmon stock productivity and data uncertainty (5 AAC 39.222(f)(3)).

Sustainable escapement goal (SEG) means a level of escapement, indicated by an index or an escapement estimate, which is known to provide for sustained yield over a five to ten year period. An SEG is used in situations where a BEG cannot be estimated or managed for. The SEG is the primary management objective for the escapement, unless an optimal escapement or in-river run goal has been adopted by the board. The SEG will be developed from the best available biological information and should be scientifically defensible on the basis of that information. The SEG will be stated as a range (SEG Range) or a lower bound (Lower Bound SEG) that takes into account data uncertainty. The SEG will be determined by ADF&G and the department will seek to maintain escapements within the bounds of the SEG Range or above the level of a lower Bound SEG (5 AAC 39.222(f)(36)).

Sustained escapement threshold means a threshold level of escapement, below which the ability of the salmon stock to sustain itself is jeopardized. In practice, SET can be estimated based on lower ranges of historical escapement levels, for which the salmon stock has consistently demonstrated the ability to sustain itself. The SET is lower than the lower bound of the BEG and also lower than the lower bound of the SEG. The SET is established by ADF&G in consultation with the board for salmon stocks of management or conservation concern (5 AAC 39.222(f)(39)).

Optimal escapement goal (OEG) means a specific management objective for salmon escapement that considers biological and allocative factors and may differ from the SEG or BEG. An OEG will be sustainable and may be expressed as a range with the lower bound above the level of SET (5 AAC 39.222(f)(25)).

The Policy for Statewide Salmon Escapement Goals is codified in 5 AAC 39.223. In this policy, the board recognizes ADF&G's responsibility to document existing salmon escapement goals; to establish BEGs, SEGs, and SETs; to prepare scientific analyses with supporting data for new escapement goals or to modify existing ones; and to notify the public of its actions. The Policy for Statewide Salmon Escapement Goals further requires that BEGs be established for salmon stocks for which the department can reliably enumerate escapement levels, as well as total annual returns. Biological escapement goals, therefore, require accurate knowledge of catch and escapement by age class. Given such measures taken by ADF&G, the board will take regulatory actions as may be necessary to address allocation issues arising from new or modified escapement goals and determine the appropriateness of establishing an OEG. In conjunction with the SSFP, this policy recognizes that the establishment of salmon escapement goals is the responsibility of both the board and ADF&G. A listing of escapement goals by river system and escapements 2004-2012 is included in Table 2. Additional information detailing whether or not management goals were met from 2004-2012 and whether catch restrictions were recently imposed (in 2011 and 2012 only) is shown in Table 3.

Chinook stock status in many rivers in western Alaska has been in a decline in recent years. In the AYK region, catch restrictions and closures have been enacted in all three major river systems (Kuskokwim, Yukon and Norton Sound). In the Kuskokwim Area, several tributaries had subsistence restrictions and closures in the last two years, no commercial fishing in Kuskokwim River, limited fishing in Kuskokwim Bay, and multiple tributaries closed to sport fishing in both years (Table 3). In the Yukon River there have been subsistence schedule restrictions for multiple years, no directed commercial fisheries and restrictions and bag limits in the sport fisheries (Table 3). Similarly in Norton Sound subsistence fishing has been restricted, there have been no commercial fisheries and sport fish restrictions (Table 3). Status and catch restrictions for other areas of the State are all contained within Table 3.

Table 2. Chinook salmon escapement goals and escapements in Alaska, 2004 to 2012.

| | | 2012 Goal Range | | | Year | Escapement | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Region | System | Lower | Upper | Type | Implemented | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| SEAK[a] | Blossom River | 150 | 300 | BEG | 2012 | 333 | 445 | 339 | 135 | 257 | 123 | 363 | 147 | 205 |
| | Keta River | 175 | 400 | BEG | 2012 | 376 | 497 | 747 | 311 | 363 | 219 | 475 | 223 | 241 |
| | Unuk River | 1,800 | 3,800 | BEG | 2009 | 3,963 | 4,742 | 5,645 | 5,668 | 3,104 | 3,157[b] | 3,835[b] | 3,195[b] | 956[c] |
| | Chickamin River | 450 | 900 | BEG | 1997 | 798 | 924 | 1,330 | 893 | 1,111 | 611 | 1,156 | 852 | 444 |
| | Andrew Creek | 650 | 1,500 | BEG | 1998 | 2,991 | 1,979 | 2,124 | 1,736 | 981 | 628 | 1,205 | 936 | 587 |
| | Stikine River | 14,000 | 28,000 | BEG | 2000 | 48,900 | 39,833 | 24,405 | 14,560 | 18,352 | 12,810[b] | 15,180[b] | 14,469[b] | 22,671[b] |
| | King Salmon River | 120 | 240 | BEG | 1997 | 135 | 143 | 150 | 181 | 120 | 109 | 158 | 192 | 155 |
| | Taku River | 19,000 | 36,000 | BEG | 2009 | 75,032 | 38,725 | 42,296 | 14,854 | 27,383[b] | 22,801[b] | 29,302[b] | 27,523[b] | 19,429[b] |
| | Chilkat River | 1,850 | 3,600 | inriver[d] | | 3,422 | 3,366 | 3,039 | 1,445 | 2,905 | 4,429[b] | 1,815[b] | 2,688[b] | 1,627[b] |
| | | 1,750 | 3,500 | BEG | 2003 | | | | | | | | | |
| | Klukshu (Alsek) River | 1,100 | 2,300 | BEG | 1998 | 2,451 | 1,034 | 568 | 676 | 466 | 1,466 | 2,159 | 1,667[b] | 693[b] |
| | Situk River | 450 | 1,050 | BEG | 2003 | 698 | 599 | 695 | 677 | 413 | 902 | 166[e] | 240 | 322 |
| Central | ***Bristol Bay*** | | | | | | | | | | | | | |
| | Nushagak River | 40,000 | 80,000 | SEG | 2007 | 107,591 | 163,506 | 117,364 | 50,960 | 91,364 | 74,781 | 27,526 | 44,749 | 102,000 |
| | Togiak River | 9,300 | | lower-bound SEG | 2007 | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| | Naknek River | 5,000 | | lower-bound SEG | 2007 | 12,878 | NS | NS | 5,498 | 6,559 | 3,305[f] | NS | NS | NS |
| | Alagnak River | 2,700 | | lower-bound SEG | 2007 | 6,755 | 5,084 | 4,278 | 3,455 | 1,825 | 1,957 | NS | NS | NS |
| | Egegik River | 450 | | lower-bound SEG | 2007 | 579 | 335 | 196 | 458 | 162 | 350[g] | NS | NS | NS |
| | ***Upper Cook Inlet*** | | | | | | | | | | | | | |
| | Alexander Creek | 2,100 | 6,000 | SEG | 2002 | 2,215 | 2,140 | 885 | 480 | 150 | 275 | 177 | 343 | 181 |
| | Campbell Creek | 380 | | lower-bound SEG | 2011 | 964 | 1,097 | 1,052 | 588 | 439 | 554 | 290 | 260 | NS |
| | Chuitna River | 1,200 | 2,900 | SEG | 2002 | 2,938 | 1,307 | 1,911 | 1,180 | 586 | 1,040 | 735 | 719 | 502 |
| | Chulitna River | 1,800 | 5,100 | SEG | 2002 | 2,162 | 2,838 | 2,862 | 5,166 | 2,514 | 2,093 | 1,052 | 1,875 | 667 |
| | Clear (Chunilna) Creek | 950 | 3,400 | SEG | 2002 | 3,417 | 1,924 | 1,520 | 3,310 | 1,795 | 1,205 | 903 | 512 | 1,177 |
| | Crooked Creek | 650 | 1,700 | SEG | 2002 | 2,196 | 1,903 | 1,516 | 964 | 881 | 617 | 1,088 | 654 | 631 |
| | Deshka River | 13,000 | 28,000 | SEG | 2011 | 57,934 | 37,725 | 31,150 | 18,714 | 7,533 | 11,967 | 18,594 | 19,026 | 14,010 |
| | Goose Creek | 250 | 650 | SEG | 2002 | 417 | 468 | 306 | 105 | 117 | 65 | 76 | 80 | 57 |
| | Kenai River - Early Run | 5,300 | 9,000 | OEG | 2005 | 11,855 | 16,387 | 18,428 | 12,504 | 11,732 | 9,771 | NA[h] | NA[h] | NA[h] |
| | | 4,000 | 9,000 | SEG | 2011 | | | | | | | | | |
| | Kenai River - Late Run | 17,800 | 35,700 | SEG | 2011 | 40,198 | 26,046 | 24,423 | 32,618 | 24,144 | 17,158 | NA[i] | NA[i] | NA[i] |
| | Lake Creek | 2,500 | 7,100 | SEG | 2002 | 7,598 | 6,345 | 5,300 | 4,081 | 2,004 | 1,394 | 1,617 | 2,563 | 2,366 |
| | Lewis River | 250 | 800 | SEG | 2002 | 1,000 | 441 | 341 | 0[j] | 120 | 111 | 56 | 92 | 107 |
| | Little Susitna River | 900 | 1,800 | SEG | 2002 | 1,694 | 2,095 | 1,855 | 1,731 | 1,297 | 1,028 | 589 | 887 | 1,154 |
| | Little Willow Creek | 450 | 1,800 | SEG | 2002 | 2,227 | 1,784 | 816 | 1,103 | NC | 776 | 468 | 713 | 494 |
| | Montana Creek | 1,100 | 3,100 | SEG | 2002 | 2,117 | 2,600 | 1,850 | 1,936 | 1,357 | 1,460 | 755 | 494 | 416 |
| | Peters Creek | 1,000 | 2,600 | SEG | 2002 | 3,757 | 1,508 | 1,114 | 1,225 | NC | 1,283 | NC | 1,103 | 459 |
| | Prairie Creek | 3,100 | 9,200 | SEG | 2002 | 5,570 | 3,862 | 3,570 | 5,036 | 3,039 | 3,500 | 3,022 | 2,038 | 1,185 |
| | Sheep Creek | 600 | 1,200 | SEG | 2002 | 285 | 760 | 580 | 400 | NC | 500 | NC | 350 | 363 |
| | Talachulitna River | 2,200 | 5,000 | SEG | 2002 | 8,352 | 4,406 | 6,152 | 3,871 | 2,964 | 2,608 | 1,499 | 1,368 | 847 |
| | Theodore River | 500 | 1,700 | SEG | 2002 | 491 | 478 | 958 | 486 | 345 | 352 | 202 | 327 | 179 |
| | Willow Creek | 1,600 | 2,800 | SEG | 2002 | 2,840 | 2,411 | 2,193 | 1,373 | 1,255 | 1,133 | 1,173 | 1,061 | 756 |
| | ***Lower Cook Inlet*** | | | | | | | | | | | | | |
| | Anchor River | 3,800 | 10,000 | SEG | 2011 | 12,016 | 11,156 | 8,945 | 9,622 | 5,806 | 3,455 | 4,449 | 3,547 | 4,509[b] |
| | Deep Creek | 350 | 800 | SEG | 2002 | 1,075 | 1,076 | 507 | 553 | 205 | 483 | 387 | 696 | 447 |
| | Ninilchik River | 550 | 1,300 | SEG | 2008 | 679 | 1,259 | 1,013 | 543 | 586 | 528 | 605 | 668 | 555[b] |
| | ***Prince William Sound*** | | | | | | | | | | | | | |
| | Copper River | 24,000 | | lower-bound SEG | 2003 | 30,628 | 21,528 | 58,454 | 34,565 | 32,487 | 27,787 | 16,771 | 27,994 | 29,600[k] |

| Region | System | 2012 Goal Range | | Type | Year | Escapement | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lower | Upper | | Implemented | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| AYK | ***Kuskokwim Area*** | | | | | | | | | | | | | |
| | North (Main) Fork Goodnews River | 640 | 3,300 | SEG | 2005 | 7,462 | NS | 4,159 | NS | 2,155 | NS | NS | 853 | NS |
| | Middle Fork Goodnews River | 1,500 | 2,900 | BEG | 2007 | 4,388 | 4,633 | 4,559 | 3,852 | 2,161 | 1,630 | 2,244 | 1,861 | 513 |
| | Kanektok River | 3,500 | 8,000 | SEG | 2005 | 28,375 | 14,202 | 8,433 | NS | 3,659 | NS | 1,228 | NS | NA |
| | Kogrukluk River | 5,300 | 14,000 | SEG | 2005 | 19,651 | 22,000 | 19,414 | 13,029 | 9,730 | 9,702 | 5,690 | 6,891 | NA |
| | Kwethluk River | 6,000 | 11,000 | SEG | 2007 | 28,604 | NA | 17,618 | 12,927 | 5,275 | 5,744 | 1,669 | 4,076 | NA |
| | Tuluksak River | 1,000 | 2,100 | SEG | 2007 | 1,475 | 2,653 | 1,043 | 374 | 701 | 362 | 201 | 286 | 560 |
| | George River | 3,100 | 7,900 | SEG | 2007 | 5,207 | 3,845 | 4,357 | 4,883 | 2,698 | 3,663 | 1,500 | 1,571 | 2,267 |
| | Kisaralik River | 400 | 1,200 | SEG | 2005 | 5,157 | 2,206 | 4,734 | 692 | 1,074 | NS | 235 | NS | 610 |
| | Aniak River | 1,200 | 2,300 | SEG | 2005 | 5,362 | NS | 5,639 | 3,984 | 3,222 | NS | NS | NS | NS |
| | Salmon River (Aniak R) | 330 | 1,200 | SEG | 2005 | 2,177 | 4,097 | NS | 1,458 | 589 | NS | NS | 79 | 49 |
| | Holitna River | 970 | 2,100 | SEG | 2005 | 4,051 | 1,760 | 1,866 | NS | NS | NS | 587 | NS | NS |
| | Cheeneetnuk River (Stony R) | 340 | 1,300 | SEG | 2005 | 918 | 1,155 | 1,015 | NS | 290 | 323 | NS | 249 | 229 |
| | Gagaryah River (Stony R) | 300 | 830 | SEG | 2005 | 670 | 788 | 531 | 1,035 | 177 | 303 | 62 | 96 | 178 |
| | Salmon River (Pitka Fork) | 470 | 1,600 | SEG | 2005 | 1,138 | 1,801 | 862 | 943 | 1,305 | 632 | 135 | 767 | 670 |
| | ***Yukon River*** | | | | | | | | | | | | | |
| | East Fork Andreafsky River | 2,100 | 4,900 | SEG | 2010 | 8,045 | 2,239 | 6,463 | 4,504 | 4,242 | 3,004 | 2,413 | 5,213 | 2,517 |
| | West Fork Andreafsky River | 640 | 1,600 | SEG | 2005 | 1,317 | 1,492 | 824 | 976 | NS | 1,678 | 858 | 1,173 | NS |
| | Anvik River | 1,100 | 1,700 | SEG | 2005 | 3,679 | 2,421 | 1,876 | 1,529 | 992 | 832 | 974 | 642 | 722 |
| | Nulato River (forks combined) | 940 | 1,900 | SEG | 2005 | 1,321 | 553 | 1,292 | 2,583 | 922 | 2,260 | 711 | 1,401 | 1,374 |
| | Gisasa River | | eliminated | | 2010 | 731 | 958 | 843 | 593 | 487 | 515 | 264 | | |
| | Chena River | 2,800 | 5,700 | BEG | 2001 | 9,645 | NS | 2,936 | 3,806 | 3,208 | 5,253 | 2,382 | NS | 2,200[l] |
| | Salcha River | 3,300 | 6,500 | BEG | 2001 | 15,761 | 5,988 | 10,679 | 6,425 | 5,415 | 12,774 | 6,135 | 7,200[m] | 7,165 |
| | Canada Mainstem | 42,500 | 55,000 | agreement[n] | annual | 48,469 | 67,985 | 62,630 | 34,904 | 33,883 | 65,278 | 31,818 | 46,017 | 32,456[b] |
| | ***Norton Sound*** | | | | | | | | | | | | | |
| | Fish River/Boston Creek | 100 | | lower-bound SEG | 2005 | 112 | 46 | NS | NS | NS | NS | NS | NS | NS |
| | Kwiniuk River | 300 | 550 | SEG | 2005 | 663 | 342 | 195 | 258 | 237 | 444 | 135 | 57 | 54 |
| | North River (Unalakleet R) | 1,200 | 2,600 | SEG | 2005 | 1,125 | 1,015 | 906 | 1,948 | 903 | 2,355 | 1,256 | 864 | 996 |
| | Shaktoolik River | 400 | 800 | SEG | 2005 | 91[o] | 74[p] | 150[o] | 412 | NS | NS | NS | 106 | NS |
| | Unalakleet/Old Woman River | 550 | 1,100 | SEG | 2005 | 398[o] | 510[p] | NS | 821 | NS | 1,368 | NS | 105 | NA |
| Westward | ***AK Peninsula*** | | | | | | | | | | | | | |
| | Nelson River | 2,400 | 4,400 | BEG | 2004 | 6,959 | 4,993 | 2,516 | 2,492 | 5,012 | 2,048 | 2,767[q] | 1,704[q] | 992[q] |
| | ***Chignik*** | | | | | | | | | | | | | |
| | Chignik River | 1,300 | 2,700 | BEG | 2002 | 7,633 | 6,037 | 3,175 | 1,675 | 1,620 | 1,590 | 3,515[r] | 2,482[r] | 1,449[r] |
| | ***Kodiak*** | | | | | | | | | | | | | |
| | Karluk River | 3,000 | 6,000 | BEG | 2011 | 7,228 | 4,684 | 3,673 | 1,697 | 752 | 1,306 | 2,917 | 3,420 | 3,197[s] |
| | Ayakulik River | 4,000 | 7,000 | BEG | 2011 | 24,425 | 8,175 | 2,937 | 6,232 | 3,071 | 2,615 | 5,197 | 4,252[t] | 4,760[t] |

*Note*: NA = data not available; NC = no count; NS = no survey.
[a] Goals are for large (≥660 mm MEF, or fish age 1.3 and older) Chinook salmon, except the Alsek River goal, which is germane to fish age 1.2 and older and can include fish <660 mm MEF.
[b] Preliminary data.
[c] 2012 Unuk River Chinook salmon escapement estimate based on expanded aerial survey index because mark-recapture experiment failed.
[d] Chilkat River Chinook salmon inriver goal accounts for inriver subsistence harvest, which averages <100 fish.
[e] Incomplete weir count due to inseason problems with weir (e.g., breach of weir).
[f] In 2009, aerial surveys were only flown on Big Creek (2,834 Chinook salmon) and King Salmon River (471 Chinook salmon). Mainstem Naknek River and Paul's Creek were not surveyed in 2009.
[g] Aerial surveys were conducted in the Egegik and King Salmon River systems on August 5, 2009 to provide escapement indices for Chinook and chum salmon. Resulting counts were 350 Chinook, and 277 chum salmon. Water conditions were poor; high and turbid conditions prevented observation on most of the surveyed systems. Chinook escapement indices were well below average in streams surveyed, but should be considered minimum counts due to the poor water conditions. Based on carcass distribution and observed presence, the survey was likely conducted after peak spawning.
[h] TS-based escapement estimate deemed unreliable or not available. Refer to McKinley and Fleischman (2013) for recent escapement estimates.
[i] TS-based escapement estimate deemed unreliable or not available. Refer to Fleischman and McKinley (2013) for recent escapement estimates.
[j] Lewis River diverged into swamp 1/2 mi. below bridge. No water in channel.
[k] The Copper River Chinook salmon spawning escapement estimate is preliminary. The estimate is generated from a mark-recapture project run by the Native Village of Eyak and LGL Consulting. The spawning escapement estimate is generated by subtracting the upper Copper River state and federal subsistence, state personal use, and sport fishery harvest estimates from the mark-recapture estimate of the inriver abundance. The estimates for the federal and state subsistence and the state personal use fishery harvests are generally not available for about 6 months after the fishery is closed. Additionally, the sport fishery harvest estimate is based on the mail-out survey and is generally available about 12 months after the fishery ends.
[l] 2012 Chena River Chinook salmon escapement estimate includes an expansion for missed counting days based on two DIDSON sonars used to assess Chinook salmon passage.
[m] 2011 Slacha River Chinook escapement is based on an aerial survey because high water prevented tower counting most of the season; therefore, aerial survey represents best estimate of escapement for the year.
[n] Canadian Yukon River Mainstem Chinook salmon IMEG (Interim Management Escapement Goal) of 42,500-55,000 was implemented for 2010, 2011, and 2012 seasons by the United States and Canada Yukon River Joint Technical Committee (JTC). Estimates from 2005-2012 represent escapement after subtraction of Canadian harvest.
[o] 2004 and 2006 Shaktoolik River surveys and combined Unalakleet and Old Woman rivers surveys (2004) are not considered complete as they were conducted well before peak spawn. Surveys during these years were rated as acceptable, but the observer noted difficulty enumerating Chinook salmon due to large numbers of pink salmon.
[p] 2005 Shaktoolik and Unalakleet River drainage surveys were conducted during peak spawning periods but Chinook salmon counts are thought to be underestimated due to large numbers of pink salmon.
[q] Nelson River Chinook salmon logbook data used to estimate sport harvest above weir 2010-2011. Angler effort not reported in SWHS. 2012 data only escapement counts.
[r] Chignik River Chinook salmon logbook data used to estimate sport harvest above weir 2010-2011. Angler effort not reported in SWHS. 2012 data only escapement counts.
[s] 2012 Karluk River Chinook salmon escapement is the weir count; no upriver harvest due to fishery closure.
[t] Ayakulik River Chinook salmon logbook data used to estimate sport harvest above weir 2011. Angler effort not reported in SWHS. 2012 data only escapement counts.

Table 3. Assessment of whether escapements met (Met), exceeded (Over), or did not meet (Under) the escapement goal in place at the time of enumeration for Chinook salmon stocks in Alaska.

| Region | System | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|
| SEAK | Blossom River | Met | Met | Met | Under | Met | Under | Met | Under | Met[a] |
| | Keta River | Met | Met | Over | Met | Met | Under | Met | Under | Met[a] |
| | Unuk River | Met | Met | Met | Met | Met | Met[b] | Over | Met | Under |
| | Chickamin River | Met | Over | Over | Met | Over | Met | Over | Met | Under |
| | Andrew Creek | Over | Over | Over | Over | Met | Under | Met | Met | Under |
| | Stikine River | Over | Over | Met | Met | Met | Under | Met | Met | Met |
| | King Salmon River | Met | Met | Met | Met | Met | Under | Met | Met | Met |
| | Taku River | Over | Met | Met | Under | Under | Met[a] | Met | Met | Met |
| | Chilkat River | Met | Met | Met | Under | Met | Over | Met | Met | Under |
| | Klukshu (Alsek) River | Over | Under | Under | Under | Under | Met | Met | Met | Under |
| | Situk River | Met | Met | Met | Met | Under | Met | Under | Under | Under |
| | Subsistence Fishery? | | | | | | | | Yes | No, except Klukshu (Alsek) R. and Federal subsistence fishery on Stikine R., Chilkat R. normal closure extended by 2 weeks, Situk R. closed. |
| | Commercial Fishery? | | | | | | | | Yes | No directed fisheries, except Taku R. - restricted then closed; Chilkat R. - normal closure extended by two weeks; Situk R. - closed. Regional purse seine - Chinook non-retention until August 6. Regional troll - Chinook non-retention July 1 - August 6 and September 9 - 30. |
| | Sport Fishery? | | | | | | | | Yes | Situk River and Chilkat Inlet restricted |
| Central | ***Bristol Bay*** | | | | | | | | | |
| | Nushagak River | Over | Over | Over | Met[c] | Over | Met | Met | Met | Over |
| | Togiak River | NS | NS | NS | NS[d] | NS | NS | NS | NS | NS |
| | Naknek River | Over | NS | NS | Met[d] | Met | Under | NS | NS | NS |
| | Alagnak River | | | | Met | Under | Under | NS | NS | NS |
| | Egegik River | | | | Met | Under | Under | NS | NS | NS |
| | Subsistence Fishery? | | | | | | | | Yes | Yes - no restrictions. |
| | Commercial Fishery? | | | | | | | | Limited in Nushagak District | Limited in Nushagak District - This is confusing. Does this mean the fishery was restricted because of Chinook escp level? It was not. However no directed Chinook fishery occurred in 2012 |
| | Sport Fishery? | | | | | | | | Restricted on Nushagak | Yes - reduced annual limit from from June 28 - July 3; reduced bag limit from June 28 - July 7. |
| | ***Upper Cook Inlet*** | | | | | | | | | |
| | Alexander Creek | Met | Met | Under | Under | Under | Under | Under | Under | Under |
| | Campbell Creek | Over | eliminated | | | Met[e] | Met | Met | Under | NA |
| | Chuitna River | Over | Met | Met | Under | Under | Under | Under | Under | Under |
| | Chulitna River | Met | Met | Met | Over | Met | Met | Under | Met | Under |
| | Clear (Chunilna) Creek | Over | Met | Met | Met | Met | Met | Under | Under | Met |
| | Crooked Creek | Over | Over | Met | Met | Met | Under | Met | Met | Under |
| | Deshka River | Over | Over | Over | Met | Under | Under | Met | Met | Met |
| | Goose Creek | Met | Met | Met | Under | Under | Under | Under | Under | Under |
| | Kenai River - Early Run | Met | Over[a] | Over | Over | Over | Over | NA | NA | NA |
| | Kenai River - Late Run | Over | Met | Met | Met | Met | Under | NA | NA | NA |
| | Lake Creek | Over | Met | Met | Met | Under | Under | Under | Met | Under |

| Region | System | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lewis River | Over | Met | Met | Under | Under | Under | Under | Under | Under |
| | Little Susitna River | Met | Over | Over | Met | Met | Met | Under | Under | Met |
| | Little Willow Creek | Over | Met | Met | Met | NC | Met | Met | Met | Met |
| | Montana Creek | Met | Met | Met | Met | Met | Met | Under | Under | Under |
| | Peters Creek | Over | Met | Met | Met | NC | Met | NC | Met | Under |
| | Prairie Creek | Met | Met | Met | Met | Under | Met | Under | Under | Under |
| | Sheep Creek | Under | Met | Under | Under | NC | Under | NC | Under | Under |
| | Talachulitna River | Over | Met | Over | Met | Met | Met | Under | Under | Under |
| | Theodore River | Under | Under | Met | Under | Under | Under | Under | Under | Under |
| | Willow Creek | Over | Met | Met | Under | Under | Under | Under | Under | Under |
| | Subsistence Fishery? | | | | | | | | Yes | Yes |
| | Commercial Fishery? | | | | | | | | Restricted in Northern District | Restricted in Northern District. Set gillnetting restricted and then closed in Upper Subdistrict (Central District). |
| | Sport Fishery? | | | | | | | | Various restrictions including complete closure | Various restrictions including closure of Kenai River. Anchorage area- Ship Cr closure, none to Campbell |
| | ***Lower Cook Inlet*** | | | | | | | | | |
| | Anchor River | Over | eliminated | | | Met[f] | Under | Under | Under[g] | Met |
| | Deep Creek | Over | Over | Met | Met | Under | Met | Met | Met | Met |
| | Ninilchik River | Met | Met | Met | Met | Met[h] | Under | Met | Met | Met |
| | Subsistence Fishery? | | | | | | | | Yes | Yes |
| | Commercial Fishery? | | | | | | | | Yes | Yes |
| | Sport Fishery? | | | | | | | | Restricted; closed Anchor river | Restricted and then closed Anchor and Ninilchik rivers. |
| | ***Prince William Sound*** | | | | | | | | | |
| | Copper River | Met | Under | Met | Met | Met | Met | Under | Met | Met |
| | Subsistence Fishery? | | | | | | | | Personal use fishery closed to retention of king salmon June 27. | Personal use fishery closed to retention of king salmon June 18. |
| | Commercial Fishery? | | | | | | | | Yes with restrictions additional periods with inside closures | Yes with restrictions additional periods with inside closures |
| | Sport Fishery? | | | | | | | | Yes | Reduced annual limit from 4 to 1 fish in the Upper Copper R drainage, no retention of king salmon in Gulkana River and single hooks, no bait effective June 30. No retention in the Klutina River and all waters downstream of the Klutina River and no bait effective July 28. |
| AYK | ***Kuskokwim Area*** | | | | | | | | | |
| | North (Main) Fork | | | | | | | | | |
| | Goodnews River | Met | NS[g] | Over | NS | Met | NS | NS | Met | NS |
| | Middle Fork | | | | | | | | | |
| | Goodnews River | Met | Over[g] | Over | Over[a] | Met | Met | Met | Met | Under |
| | Kanektok River | Met | Over[g] | Over | NS | Met | NS | Under | NS | NA |
| | Kogrukluk River | Met | Over[g] | Over | Met | Met | Met | Met | Met | NA |
| | Kwethluk River | Over | Over | NA | Over[f] | Under | Under | Under | Under | NA |
| | Tuluksak River | | | | Under | Under | Under | Under | Under | Under |
| | George River | | | | Met | Under | Met | Under | Under | Under |
| | Kisaralik River | Met | Over[g] | Over | Met | Met | NS | Under | NS | Met |

| Region | System | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Aniak River | Met | NS[g] | Over | Over | Over | NS | NS | NS | NS |
| | Salmon River (Aniak R) | Met | Over[g] | NS | Over | Met | NS | NS | Under | Under |
| | Holitna River | Met | Over[g] | Over | NS | Under | NS | Under | NS | NS |
| | Cheeneetnuk River (Stony R) | | Met | Met | NS | Under | Under | NS | Under | Under |
| | Gagaryah River (Stony R) | | Met | Met | Over | Under | Met | Under | Under | Under |
| | Salmon River (Pitka Fork) | Under | Over[g] | Met | Met | Met | Met | Under | Met | Met |
| | Subsistence Fishery? | | | | | | | | Yes, 3 tributaries closed, restrictions in mainstem District 1 | Yes, 5 tributaries closed, restrictions in mainstem Kuskokwim River through most of the season. |
| | Commercial Fishery? | | | | | | | | None on Kuskokwim River, limited in Bay | None on Kuskokwim River, incidental retained as personal use in chum fishery. Limited in Kuskokwim Bay. |
| | Sport Fishery? | | | | | | | | 3 tributaries closed | 6 tributaries closed June 1; bag limit reduced from 3 to 1in remaining tributaries and closed mainstem June 13; closed all waters of the Kuskokwim drainage June 22. |
| | ***Yukon River*** | | | | | | | | | |
| | E Fork Andreafsky River | Met | Over[g] | Under | Over | Under | Under | Met[f] | Over | Met |
| | W Fork Andreafsky River | Under | Met[g] | Met | Met | NS | Over | Met | Met | NS |
| | Anvik River | Met | Over[g] | Over | Met | Under | Under | Under | Under | Under |
| | Nulato River (all forks) | Met | Under[g] | Met | Over | Under | Over | Under | Met | Met |
| | Gisasa River | Met | Met[g] | Met | Met | Met | Met | eliminated | | |
| | Chena River | Over | NS | Met | Met | Met | Met | Under | NS | Under |
| | Salcha River | Over | Met | Over | Met | Met | Over | Met | Over | Over |
| | Canada Mainstem | Met | Met | Met | Met[i] | Under[i] | Met | Under[i] | Met | Under |
| | Subsistence Fishery? | | | | | | | | Yes, restricted fishing schedule | Yes, restricted fishing schedule |
| | Commercial Fishery? | | | | | | | | No directed, small incidental take with chum but not sold | No directed, small incidental take with chum but not sold |
| | Sport Fishery? | | | | | | | | Bag limit reduced to 1 all tributaries, no retention mainstem and Tanana R., no bait allowed Tanana R. tributaries | Bag limit reduced from 3 to 1 in tributaries and closed mainstem May 15. No retention in Tanana River drainage and no bait in tributaries July 21; Closed Chena River drainage and confluence with Tanana July 30. |
| | ***Norton Sound*** | | | | | | | | | |
| | Fish River/Boston Creek | Met | Under[d] | NS | NS | NS | NS | NS | NS | NS |
| | Kwiniuk River | Over | Met[j] | Under | Under | Under | Met | Under | Under | Under |
| | North River (Unalakleet R) | Under | Under[a] | Under | Met | Under | Met | Met | Under | Under |
| | Shaktoolik River | Under | Under[j] | Under | Met | NS | NS | NS | Under | NS |
| | Unalakleet/Old Woman River | Under | Under[j] | NS | Met | NS | Over | NS | Under | NS |
| | Subsistence Fishery? | | | | | | | | Yes, with restrictions | Yes, with restrictions |
| | Commercial Fishery? | | | | | | | | No directed, incidental take not sold | No directed, incidental take not sold |
| | Sport Fishery? | | | | | | | | Started the season open then was closed and use of bait prohibited in Unalakleet and Shaktoolik rivers. | Started the season open then closed all waters of the Unalakleet and Shaktoolik drainages to sport fishing for king salmon and prohibited bait when sport fishing July 11. |
| Westward | ***AK Peninsula*** | | | | | | | | | |
| | Nelson River | Over[a] | Over | Met | Met | Over | Under | Met | Under | Under |

| Region | System | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Subsistence Fishery? | | | | | | | | Yes | Yes |
| | Commercial Fishery? | | | | | | | | Yes | Yes |
| | Sport Fishery? | | | | | | | | Yes | Closed inseason |
| | ***Chignik*** | | | | | | | | | |
| | Chignik River | Over | Over | Over | Met | Met | Met | Over | Met | Met |
| | Subsistence Fishery? | | | | | | | | Yes | Yes |
| | Commercial Fishery? | | | | | | | | Yes | Yes |
| | Sport Fishery? | | | | | | | | Yes | Restricted inseason to non-retention |
| | ***Kodiak*** | | | | | | | | | |
| | Karluk River | Met | Met | Met | Under | Under | Under | Under | Met[a] | Met |
| | Ayakulik River | Over | Met | Under | Met | Under | Under | Met | Met[a] | Met |
| | Subsistence Fishery? | | | | | | | | Yes | Yes |
| | Commercial Fishery? | | | | | | | | Restricted, nonretention in Karluk and Ayakulik areas | Restricted, nonretention in Karluk and Ayakulik areas |
| | Sport Fishery? | | | | | | | | Restricted, nonretention in Karluk, reduced bag and annual limits in Ayakulik | Ayakulik: Restricted preseason - reduced bag limit; Karluk: Restricted preseason - nonretention |

*Note*: NA = data not available; NC = no count; NS = no survey.
[a] Escapement goal reevaluated, goal changed.
[b] Prior to 2009, goal was based on index count of escapements.
[c] Escapement goal reevaluated, point goal changed to a range.
[d] Escapement goal reevaluated, point goal changed to a lower-bound goal.
[d] Previous escapement goal reinstated.
[f] Escapement assessment method changed; therefore, escapement numbers in Table 1 are not comparable to previous goal.
[g] Escapement goal reevaluated, lower-bound goal changed to a range.
[h] Escapement goal reevaluated, current goal based on escapement count over longer period during spawning season, escapement numbers in Table 2 are based on longer counting time.
[i] Escapement goal revised by The United States and Canada Yukon River Joint Technical Committee (JTC).
[j] Escapement goal reevaluated, goal type changed but goal value remained the same.

# 3 Adult equivalence analysis update

An adult equivalency (AEQ) model was developed for use in the Chinook Salmon PSC management measures final environmental impact statement (FEIS) (NPFMC/NMFS 2009). This was done to understand the impacts of bycatch on Chinook salmon populations, and required the development of a method to estimate how the different bycatch numbers would propagate to adult equivalent spawning salmon. This is distinguished from the annual bycatch numbers that are recorded by observers each year for management purposes.

The AEQ bycatch applies the extensive observer datasets on the length frequencies of Chinook salmon taken as bycatch and converts these to the ages of the bycaught salmon, appropriately accounting for the time of year that catch occurred. Coupled with information on the proportion of salmon that return to different river systems at various ages, the bycatch-at-age data is used to pro-rate, for any given year, how bycatch affects future potential spawning runs of salmon.

Estimating the adult equivalent bycatch is necessary because not all salmon caught as bycatch in the pollock fishery would otherwise have survived to return to their spawning streams. Because the salmon caught in the pollock fishery range in ages from 3-7 year olds, the impacts of bycatch in any one year may be lagged by several years. Thus a high bycatch year (such as in 2007) may have impacts lower than the number of PSC recorded as mortality in that year but will continue to impact returns to rivers for several years into the future. Similarly a low bycatch year may indicate low mortality in that year but the true impacts are influenced by the bycatch that has occurred in previous years. Therefore AEQ is a more accurate representation of the true impact to spawning salmon than the mortality in numbers of fish recorded in any one year.

The Council requested an updated AEQ analysis (from the 2009 version) including expanding the analysis to stock of origin using the most recent genetic information from the Chinook salmon bycatch in the pollock fishery (2011). The previous analysis (presented at final action on Amendment 91 in 2009; NPFMC/NMFS 2009) provided an estimate of the AEQ by stock of origin from 2003-2007 using genetic data from sampling in 2005-2007 (Templin et al., 2007) and was designed to complement information provided to the Council and the public as to the likely impacts of different bycatch management cap levels at that time.

Since the Council's action in 2009 some additional work has been done to augment and update the AEQ analysis prior to the Council's most recent request. Notably the analysts were requested to provide a white paper in conjunction with the Arctic Yukon Kuskokwim Sustainable Salmon Initiative (AYKSSI) science panel review and subsequent outreach meeting in May and December of 2012, respectively. This was to provide additional information to assist with their hypotheses on Chinook salmon decline[1] by summarizing information on Chinook salmon AEQ in the pollock fishery. Information that was provided to the AYKSSI science panel as well as additional analyses summarized below are being compiled into a manuscript for submission to a peer-reviewed publication as soon as possible (Ianelli and Stram, In prep).

## 3.1 Methods

Methods are the same as detailed in the 2009 analysis (NPFMC/NMFS, 2009) with modifications to account for the lagged-effect of genetic stock ID information compared to the year that the Chinook salmon were expected to return (as was presented in the chum salmon EA of 2012 (Ianelli and Stram, In

[1] Hypothesis #5: Ocean Bycatch/Ecosystem Overfishing – Fishery caused mortality or changes in Bering Sea ecosystem structure and function have contributed to the decline of AYK-region Chinook salmon stocks. Per request that paper addressed only the ocean bycatch portion of the hypothesis.

prep). Data are partitioned into three strata: the entire fishing area for the A-season (which is usually constrained by ice), and the two other strata are defined as the NW and SE regions of the eastern Bering Sea for the B season.

## 3.2 Observer data and age compositions

NMFS scientific observers collect extensive data on target species and prohibited species such as Chinook salmon taken incidentally in the pollock fishery. The number of Chinook salmon lengths measured in this fishery since 1991 by sector and season/area are shown in Table 4 (Figure 1). The observer program, in conjunction with landings data provide estimates of total Chinook salmon catch which is broken down by strata (Table 5). The result of the age composition (with proportion by age that occurs in the A season) shows considerable variability between years but age 4 is typically the predominant Chinook salmon age group in the bycatch (Table 6). Table 7 and Table 8 show the season-specific estimate of uncertainty at age in the bycatch with a marked increase in uncertainty due to the reduced sampling for lengths (and ages) since 2008.

Table 4. The number of Chinook salmon measured for lengths in the pollock fishery by season (A and B), area (NW=east of 170°W; SE=west of 170°W), and sector (S=shorebased catcher vessels, M=mothership operations, CP=catcher-processors). *Source: NMFS Alaska Fisheries Science Center observer data.*

| Season | A | A | A | B | B | B | B | B | B | |
|---|---|---|---|---|---|---|---|---|---|---|
| Area | All | All | All | NW | NW | NW | SE | SE | SE | |
| Sector | S | M | CP | S | M | CP | S | M | CP | Total |
| 1991 | 2,227 | 302 | 2,569 | | 25 | 87 | 221 | 10 | 47 | 5,488 |
| 1992 | 2,305 | 733 | 889 | 2 | 4 | 14 | 1,314 | 21 | 673 | 5,955 |
| 1993 | 1,929 | 349 | 370 | 1 | 11 | 172 | 298 | 255 | 677 | 4,062 |
| 1994 | 4,756 | 408 | 986 | 3 | 93 | 276 | 781 | 203 | 275 | 7,781 |
| 1995 | 1,209 | 264 | 851 | | 8 | 31 | 457 | 247 | 305 | 3,372 |
| 1996 | 9,447 | 976 | 2,798 | | 17 | 161 | 5,658 | 1,721 | 493 | 21,271 |
| 1997 | 3,498 | 423 | 910 | 12 | 303 | 839 | 12,126 | 370 | 129 | 18,610 |
| 1998 | 3,124 | 451 | 1,329 | | 38 | 191 | 8,277 | 2,446 | 1,277 | 17,133 |
| 1999 | 1,934 | 120 | 1,073 | | 1 | 627 | 1,467 | 97 | 503 | 5,822 |
| 2000 | 608 | 17 | 1,388 | 4 | 40 | 179 | 564 | 3 | 120 | 2,923 |
| 2001 | 4,360 | 268 | 3,583 | | 25 | 1,816 | 1,597 | 291 | 1,667 | 13,607 |
| 2002 | 5,587 | 850 | 3,011 | | 23 | 114 | 5,353 | 520 | 494 | 15,952 |
| 2003 | 9,328 | 1,000 | 5,379 | 258 | 290 | 1,290 | 4,420 | 348 | 467 | 22,780 |
| 2004 | 7,247 | 594 | 3,514 | 1,352 | 557 | 1,153 | 8,884 | 137 | 606 | 24,044 |
| 2005 | 9,237 | 694 | 3,998 | 4,081 | 244 | 1,610 | 10,336 | 45 | 79 | 30,324 |
| 2006 | 17,875 | 1,574 | 5,716 | 685 | 66 | 480 | 12,757 | 3 | 82 | 39,238 |
| 2007 | 16,008 | 1,802 | 9,012 | 881 | 590 | 1,986 | 21,725 | 2 | 801 | 52,807 |
| 2008 | 21 | 272 | 1,306 | 1 | 94 | 164 | 28 | 0 | 22 | 1,908 |
| 2009 | 221 | 124 | 653 | 0 | 33 | 106 | 43 | 2 | 0 | 1,182 |
| 2010 | 13 | 52 | 916 | 3 | 6 | 27 | 8 | 2 | 0 | 1,027 |
| 2011 | 464 | 46 | 228 | 15 | 5 | 131 | 1,386 | 232 | 66 | 2,573 |
| 2012 | 480 | 36 | 287 | 9 | 1 | 3 | 338 | 2 | 1 | 1,157 |

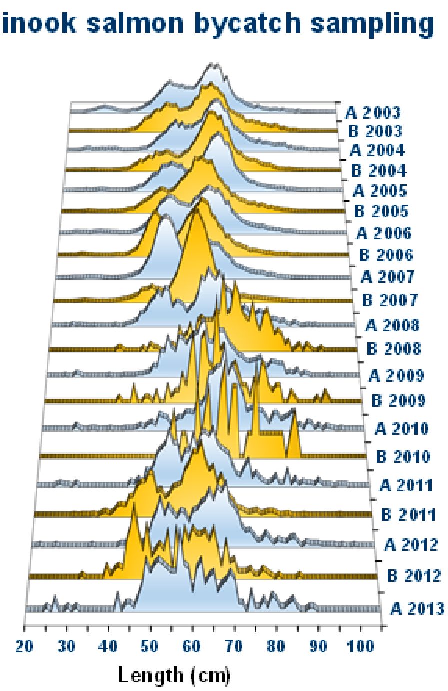



Figure 1. NMFS Observer program Chinook salmon length frequency by season and year, 2003-2012.

Table 5. Chinook salmon PSC taken bycatch in the pollock fishery by season (A and B), area (NW=east of 170°W; SE=west of 170°W), and sector (S=shorebased catcher vessels, M=mothership operations, CP=catcher-processors). Note that CDQ prior to 2003 were included in the other sectors. *Source: NMFS Alaska Regional Office, Aug 23 2013.*

| Season<br>Area<br>Sector | A<br>All<br>S | A<br>All<br>M | A<br>All<br>CP | A<br>All<br>CDQ | B<br>NW<br>S | B<br>NW<br>M | B<br>NW<br>CP | B<br>NW<br>CDQ | B<br>SE<br>S | B<br>SE<br>M | B<br>SE<br>CP | B<br>SE<br>CDQ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991 | 10,192 | 9,001 | 17,645 | | 0 | 48 | 318 | | 1,667 | 103 | 79 | | 39,054 |
| 1992 | 6,725 | 4,057 | 12,631 | | 0 | 26 | 187 | | 1,604 | 1,739 | 6,702 | | 33,672 |
| 1993 | 3,017 | 3,529 | 8,869 | | 29 | 157 | 7,158 | | 2,585 | 6,500 | 4,775 | | 36,619 |
| 1994 | 8,346 | 1,790 | 17,149 | | 0 | 121 | 771 | | 1,206 | 452 | 2055 | | 31,890 |
| 1995 | 2,040 | 971 | 5971 | | 0 | 35 | 77 | | 781 | 632 | 2896 | | 13,403 |
| 1996 | 15,228 | 5,481 | 15,276 | | 0 | 113 | 908 | | 9,944 | 6,208 | 2,315 | | 55,472 |
| 1997 | 4,954 | 1,561 | 3,832 | | 43 | 2,143 | 4,172 | | 22,508 | 3,559 | 1,549 | | 44,320 |
| 1998 | 4,334 | 4,284 | 6,500 | | 0 | 309 | 511 | | 27,218 | 6,052 | 2,037 | | 51,244 |
| 1999 | 3,103 | 554 | 2694 | | 13 | 12 | 1,284 | | 2,649 | 362 | 1306 | | 11,978 |
| 2000 | 878 | 19 | 2525 | | 4 | 230 | 286 | | 714 | 23 | 282 | | 4,961 |
| 2001 | 8,555 | 1,664 | 8,264 | | 0 | 162 | 5,346 | | 3,779 | 1,157 | 4,517 | | 33,444 |
| 2002 | 10,336 | 1,976 | 9,481 | | 0 | 38 | 211 | | 9,560 | 1,717 | 1,175 | | 34,495 |
| 2003 | 15,367 | 2,567 | 12,982 | 1,693 | 712 | 858 | 2,461 | 504 | 6,286 | 971 | 817 | 368 | 45,586 |
| 2004 | 11,576 | 1,830 | 8,559 | 1,140 | 2,310 | 1,375 | 1,824 | 1,217 | 19,921 | 494 | 845 | 609 | 51,699 |
| 2005 | 13,797 | 1,864 | 10,328 | 1,299 | 8,870 | 546 | 3,792 | 555 | 25,956 | 144 | 105 | 62 | 67,319 |
| 2006 | 35,638 | 4,864 | 16,204 | 1,585 | 961 | 148 | 1,251 | 130 | 21,687 | 11 | 165 | 26 | 82,671 |
| 2007 | 36,463 | 4,816 | 25,841 | 3,113 | 1,637 | 1,825 | 4,558 | 2,023 | 39,701 | 20 | 1,748 | 506 | 122,252 |
| 2008 | 10,692 | 1,127 | 4,091 | 605 | 251 | 175 | 339 | 31 | 3,994 | 0 | 38 | 5 | 21,347 |
| 2009 | 6,241 | 547 | 2,738 | 358 | 115 | 70 | 310 | 89 | 2,092 | 16 | 0 | 0 | 12,576 |
| 2010 | 3,735 | 493 | 3,066 | 335 | 73 | 20 | 50 | 0 | 1,859 | 64 | 1 | 0 | 9,695 |
| 2011 | 4,441 | 459 | 1,806 | 430 | 142 | 69 | 1,244 | 76 | 13,809 | 2,357 | 408 | 258 | 25,499 |
| 2012 | 4,624 | 312 | 2,484 | 344 | 75 | 7 | 52 | 2 | 3,358 | 42 | 40 | 3 | 11,343 |
| 2013 | 3,640 | 557 | 3,563 | 472 | 13 | 7 | 34 | 6 | 697 | 18 | 32 | 2 | 9,041 |

Table 6. Calendar year age-specific Chinook salmon bycatch estimates based on the mean of 100 bootstrap samples of available length and age data. Age-length keys for 1997-1999 were based on Myers et al. (2003) data split by year while for all other years, a combined-year age-length key was used. Values in parenthesis indicate the proportion that occurred in the "A" season.

| Year | Age 3 | | Age 4 | | Age 5 | | Age 6 | | Age 7 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991 | 5,624 | (96%) | 15,901 | (93%) | 13,486 | (95%) | 3,445 | (95%) | 347 | (90%) | 38,802 | (94%) |
| 1992 | 5,136 | (20%) | 9,528 | (49%) | 14,538 | (93%) | 3,972 | (96%) | 421 | (97%) | 33,596 | (70%) |
| 1993 | 2,815 | (44%) | 16,565 | (22%) | 12,992 | (57%) | 3,673 | (76%) | 401 | (72%) | 36,446 | (42%) |
| 1994 | 849 | (51%) | 5,300 | (66%) | 20,533 | (91%) | 4,744 | (89%) | 392 | (83%) | 31,817 | (86%) |
| 1995 | 498 | (53%) | 3,895 | (26%) | 4,827 | (80%) | 3,796 | (93%) | 367 | (89%) | 13,382 | (67%) |
| 1996 | 5,091 | (17%) | 18,590 | (39%) | 26,202 | (88%) | 5,062 | (88%) | 421 | (83%) | 55,366 | (65%) |
| 1997 | 5,855 | (8%) | 23,972 | (8%) | 7,233 | (50%) | 5,710 | (68%) | 397 | (68%) | 43,167 | (24%) |
| 1998 | 19,168 | (8%) | 16,169 | (14%) | 11,751 | (74%) | 2,514 | (83%) | 615 | (83%) | 50,216 | (30%) |
| 1999 | 870 | (59%) | 5,343 | (31%) | 4,424 | (71%) | 1,098 | (82%) | 21 | (85%) | 11,757 | (53%) |
| 2000 | 662 | (55%) | 1,923 | (61%) | 1,800 | (78%) | 518 | (87%) | 34 | (78%) | 4,939 | (69%) |
| 2001 | 6,512 | (44%) | 12,365 | (28%) | 11,948 | (82%) | 1,994 | (90%) | 190 | (90%) | 33,009 | (55%) |
| 2002 | 3,843 | (41%) | 13,893 | (36%) | 10,655 | (87%) | 5,469 | (97%) | 489 | (98%) | 34,349 | (63%) |
| 2003 | 5,575 | (51%) | 16,297 | (56%) | 19,423 | (86%) | 3,661 | (91%) | 286 | (90%) | 45,242 | (71%) |
| 2004 | 6,582 | (16%) | 22,662 | (24%) | 17,654 | (71%) | 4,247 | (85%) | 390 | (87%) | 51,536 | (45%) |
| 2005 | 10,406 | (13%) | 30,520 | (23%) | 21,661 | (71%) | 4,295 | (77%) | 301 | (74%) | 67,184 | (40%) |
| 2006 | 11,801 | (30%) | 31,296 | (56%) | 32,210 | (94%) | 6,589 | (96%) | 487 | (95%) | 82,382 | (70%) |
| 2007 | 16,129 | (36%) | 66,131 | (45%) | 33,693 | (86%) | 5,651 | (91%) | 361 | (89%) | 121,966 | (57%) |
| 2008 | 1,144 | (46%) | 7,025 | (58%) | 10,775 | (91%) | 2,177 | (93%) | 108 | (92%) | 21,229 | (78%) |
| 2009 | 589 | (50%) | 4,789 | (63%) | 5,900 | (92%) | 1,074 | (97%) | 87 | (97%) | 12,439 | (79%) |
| 2010 | 461 | (29%) | 2,698 | (45%) | 4,816 | (96%) | 1,591 | (99%) | 71 | (98%) | 9,637 | (79%) |
| 2011 | 6,253 | (5%) | 13,203 | (16%) | 4,944 | (75%) | 951 | (91%) | 66 | (96%) | 25,418 | (28%) |
| 2012 | 1,722 | (10%) | 3,959 | (55%) | 4,650 | (96%) | 874 | (99%) | 84 | (99%) | 11,288 | (69%) |

Table 7. Estimates of coefficients of variation of Chinook salmon bycatch estimates for the **A-season** and calendar age based on the mean of 100 bootstrap samples of available length and age data. Note shaded cells are based on the new length-frequency sampling protocol.

| A season | Age 3 | Age 4 | Age 5 | Age 6 | Age 7 |
|---|---|---|---|---|---|
| 1991 | 14% | 6% | 6% | 10% | 31% |
| 1992 | 20% | 9% | 4% | 9% | 27% |
| 1993 | 22% | 9% | 5% | 10% | 37% |
| 1994 | 27% | 12% | 3% | 10% | 30% |
| 1995 | 25% | 12% | 5% | 6% | 22% |
| 1996 | 19% | 6% | 2% | 9% | 21% |
| 1997 | 35% | 12% | 6% | 7% | 28% |
| 1998 | 16% | 9% | 3% | 10% | 23% |
| 1999 | 19% | 10% | 5% | 11% | 91% |
| 2000 | 25% | 9% | 6% | 9% | 27% |
| 2001 | 10% | 6% | 3% | 7% | 22% |
| 2002 | 15% | 6% | 3% | 4% | 16% |
| 2003 | 14% | 6% | 3% | 8% | 21% |
| 2004 | 15% | 6% | 2% | 5% | 20% |
| 2005 | 18% | 6% | 3% | 7% | 23% |
| 2006 | 17% | 5% | 3% | 7% | 22% |
| 2007 | 22% | 5% | 4% | 8% | 25% |
| 2008 | 75% | 33% | 13% | 39% | 105% |
| 2009 | 40% | 12% | 5% | 16% | 45% |
| 2010 | 106% | 46% | 13% | 28% | 49% |
| 2011 | 29% | 10% | 6% | 12% | 42% |
| 2012 | 41% | 10% | 5% | 15% | 42% |

Table 8. Estimates of coefficients of variation of Chinook salmon bycatch estimates for the **B-season** and calendar age based on the mean of 100 bootstrap samples of available length and age data. Note shaded cells are based on the new length-frequency sampling protocol.

| B season | Age 3 | Age 4 | Age 5 | Age 6 | Age 7 |
|---|---|---|---|---|---|
| 1991 | 23% | 8% | 12% | 27% | 67% |
| 1992 | 9% | 9% | 25% | 69% | 87% |
| 1993 | 19% | 4% | 9% | 20% | 65% |
| 1994 | 17% | 6% | 6% | 14% | 27% |
| 1995 | 21% | 5% | 12% | 23% | 48% |
| 1996 | 6% | 3% | 7% | 11% | 29% |
| 1997 | 12% | 3% | 10% | 12% | 39% |
| 1998 | 5% | 6% | 9% | 23% | 36% |
| 1999 | 16% | 3% | 8% | 22% | 149% |
| 2000 | 9% | 5% | 8% | 25% | 49% |
| 2001 | 7% | 3% | 8% | 20% | 52% |
| 2002 | 6% | 2% | 8% | 17% | 43% |
| 2003 | 8% | 3% | 5% | 15% | 32% |
| 2004 | 6% | 2% | 5% | 12% | 30% |
| 2005 | 5% | 2% | 5% | 10% | 23% |
| 2006 | 4% | 3% | 8% | 15% | 33% |
| 2007 | 6% | 2% | 7% | 13% | 28% |
| 2008 | 58% | 14% | 39% | 102% | 145% |
| 2009 | 61% | 10% | 36% | 82% | 163% |
| 2010 | 77% | 18% | 54% | 96% | 190% |
| 2011 | 7% | 4% | 13% | 42% | 234% |
| 2012 | 12% | 9% | 32% | 145% | 250% |

### 3.3 Chinook salmon in-river data

The State of Alaska provided some estimates of Chinook salmon for western Alaska systems (Table 9; Figure 2). For preliminary examinations on impact rates (AEQ / run estimates) these estimates were used for the period 1994-2012 (during the time that AEQ estimates can be computed and aggregated to similar stock groupings). The ADFG scientists also provided estimates of the age composition for these systems which were used in the AEQ model to estimate the age-specific proportion of Chinook salmon taken at sea that would return to spawn (Table 10).

Table 9. Estimated run size in numbers of Chinook salmon by system for 1976-2012 as provided by ADFG. The "CWAK" column represents the sum of five columns to the left of it. Analyses on impacts were done as aggregated for CWAK and for the Upper Yukon from 1994-2012.

| Year | Nushagak | KuskoBay | Kuskokwim River | Norton Sound | Lower and Mid Yukon | "CWAK" | Upper Yukon |
|---|---|---|---|---|---|---|---|
| 1976 | 348,677 | | 233,967 | | | | |
| 1977 | 324,983 | | 295,559 | | | | |
| 1978 | 531,783 | | 264,325 | | | | |
| 1979 | 544,859 | | 253,970 | | | | |
| 1980 | 454,644 | | 300,573 | | | | |
| 1981 | 741,073 | | 389,791 | | | | |
| 1982 | 741,092 | | 187,354 | | | | 148,000 |
| 1983 | 650,754 | | 166,333 | | | | 158,200 |
| 1984 | 321,238 | | 188,238 | | | | 123,000 |
| 1985 | 401,845 | | 176,292 | | 224,324 | | 145,700 |
| 1986 | 164,656 | | 129,168 | | 186,298 | | 155,900 |
| 1987 | 231,453 | | 193,465 | | 177,287 | | 156,700 |
| 1988 | 141,908 | | 207,818 | | 146,991 | | 141,000 |
| 1989 | 187,644 | | 241,857 | | 102,297 | | 146,100 |
| 1990 | 156,663 | | 264,802 | | 196,126 | | 161,600 |
| 1991 | 246,718 | | 218,705 | | 156,538 | | 140,600 |
| 1992 | 232,103 | | 284,846 | | 183,889 | | 157,800 |
| 1993 | 283,385 | | 269,305 | | 267,718 | | 141,100 |
| 1994 | 334,604 | | 365,246 | | 253,226 | 953,077 | 185,600 |
| 1995 | 271,126 | | 360,513 | | 224,219 | 855,858 | 194,800 |
| 1996 | 193,029 | | 302,603 | 23,080 | 86,934 | 605,646 | 198,500 |
| 1997 | 247,097 | | 303,189 | 59,196 | 324,333 | 933,816 | 186,900 |
| 1998 | 370,883 | | 213,873 | 35,916 | 139,171 | 759,843 | 93,090 |
| 1999 | 148,963 | | 189,939 | 18,972 | 193,172 | 551,046 | 114,600 |
| 2000 | 137,979 | | 136,618 | 13,087 | 112,255 | 399,939 | 52,660 |
| 2001 | 213,128 | | 223,707 | 13,586 | 166,822 | 617,243 | 97,910 |
| 2002 | 228,919 | 29,954 | 246,296 | 15,685 | 159,138 | 679,992 | 95,250 |
| 2003 | 224,724 | 36,908 | 248,789 | 16,244 | 170,637 | 697,303 | 160,800 |
| 2004 | 351,930 | 76,429 | 388,136 | 14,581 | 249,800 | 1,080,875 | 135,700 |
| 2005 | 307,245 | 60,875 | 366,601 | 12,528 | 158,044 | 905,294 | 123,900 |
| 2006 | 218,031 | 45,646 | 307,662 | 13,628 | 178,348 | 763,315 | 119,200 |
| 2007 | 125,077 | 55,511 | 273,060 | 15,311 | 144,449 | 613,408 | 87,420 |
| 2008 | 128,445 | 33,104 | 237,074 | 11,505 | 109,548 | 519,675 | 63,640 |
| 2009 | 117,530 | 32,095 | 204,747 | 19,707 | 111,612 | 485,692 | 86,540 |
| 2010 | 93,676 | 32,312 | 118,507 | 8,360 | 96,232 | 349,086 | 59,789 |
| 2011 | 144,795 | 31,463 | 133,059 | 6,718 | 126,428 | 442,464 | 71,751 |
| 2012 | 196,545 | 12,043 | 99,143 | 6,645 | 73,555 | 387,930 | 50,094 |

Table 10. Average age composition estimated by system for 2003-2012 as provided by ADFG. The "combined" row represents the weighted average over the systems.

| In-river age | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|
| Norton sound | 1% | 10% | 37% | 49% | 3% | 0% |
| Yukon | 0% | 12% | 40% | 44% | 3% | 0% |
| Kuskokwim River | 0% | 25% | 39% | 34% | 2% | 0% |
| Kuskokwim Bay | 1% | 35% | 35% | 28% | 1% | 0% |
| Nushagak | 1% | 27% | 43% | 29% | 1% | 0% |
| Combined | 0% | 27% | 38% | 32% | 2% | 0% |
| Natural mortality | 0.3 | 0.2 | 0.1 | 0.1 | 0 | 0 |
| Oceanic maturity rate (from combined average brood age composition) | 0.0422 | 0.2684 | 0.4892 | 0.9196 | 1.000 | 1 |

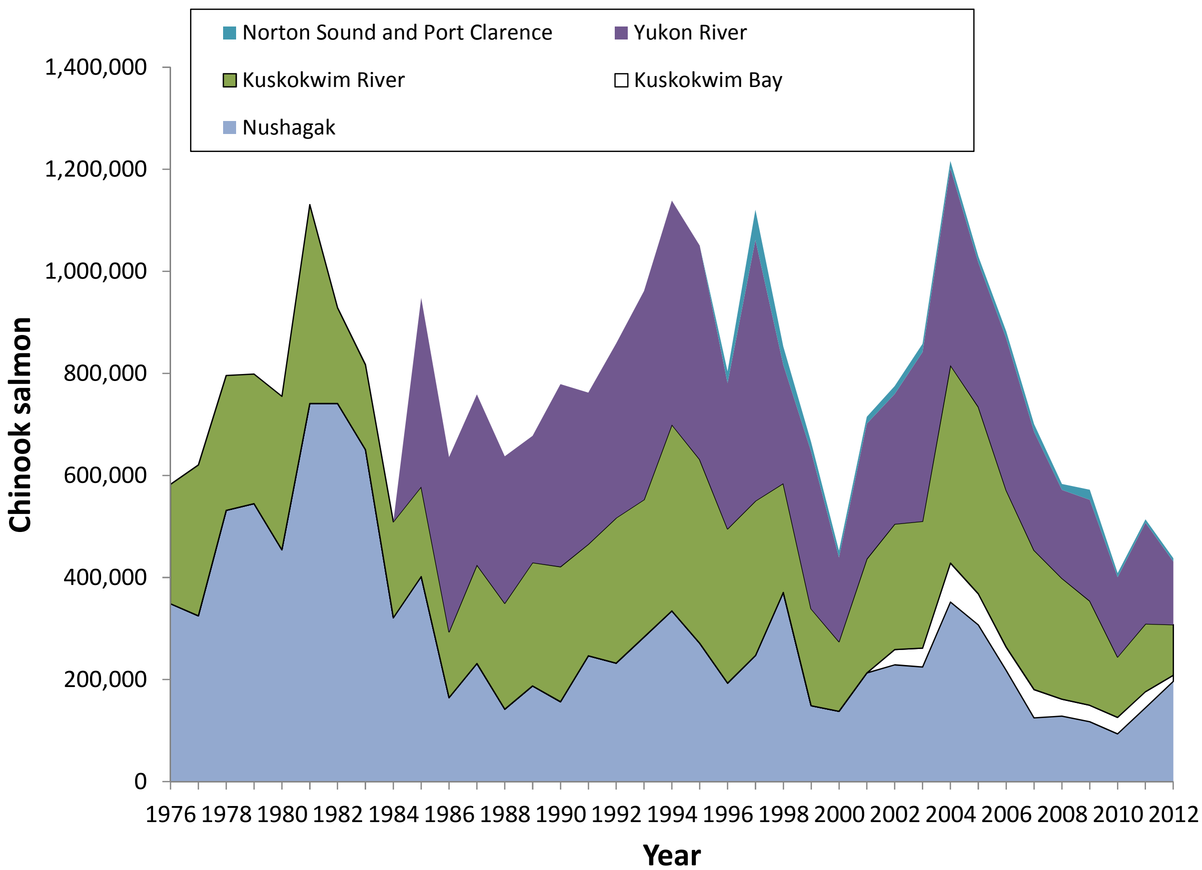



Figure 2. Estimates of western Alaska region total return by sub-area. Years included for this analysis include 1994-2012.

## 3.4 Genetics

Updated AEQ analysis based on the ongoing studies at the NMFS Auke Bay Lab were applied here. Whereas refinements continue and stock discrimination methods have improved (i.e., as in Guthrie et al. (2013), for the purposes of comparing past work with the improved samples and methods, the new data were processed according to the same strata used in NPFMC/NMFS (2009) for comparisons and these are shown in Table 11. The earlier study was required to weight the available stock ID information according to where and when the bycatch occurred since sampling was out of proportion to the bycatch. This resulted in a higher variance in the estimates as applied to the AEQ analysis but recent sampling protocols have been precisely proportional (Table 12).

Table 11. Stock composition based on genetic samples stratified by year, season, and region (SE=east of 170°W, NW=west of 170°W). Source: Templin et al. 2011; Guthrie et al. 2013; and Guyon et al. 2012 (as modified by first author to match these strata and stock groupings).

| Year / Season / Area | | Sample size | BC-WA-OR | Coast W AK | Cook Inlet | Middle Yukon | N AK Penin | Other | Russia | SEAK | Upper Yukon |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | B SE | 282 | 45.3% | 34.2% | 5.3% | 0.2% | 8.8% | 0.6% | 3.3% | 0.0% | 2.4% |
| 2005 | B NW | 489 | 6.5% | 70.9% | 2.2% | 4.7% | 6.7% | 2.0% | 3.5% | 2.8% | 0.7% |
| 2006 | A All | 801 | 22.9% | 38.2% | 0.2% | 1.1% | 31.2% | 1.1% | 1.1% | 2.3% | 1.9% |
| 2006 | B SE | 304 | 38.4% | 37.2% | 7.5% | 0.2% | 7.0% | 0.6% | 4.3% | 0.1% | 4.7% |
| 2006 | B NW | 286 | 6.4% | 67.3% | 3.0% | 8.0% | 2.1% | 3.3% | 0.5% | 8.0% | 1.4% |
| 2007 | A All | 360 | 9.4% | 75.2% | 0.1% | 0.5% | 12.0% | 0.2% | 0.1% | 0.1% | 2.4% |
| 2007 | B SE | 464 | 6.1% | 77.9% | 3.6% | 3.3% | 3.5% | 0.3% | 0.9% | 1.2% | 3.1% |
| 2007 | B NW | 402 | 1.4% | 71.7% | 2.6% | 5.9% | 5.3% | 0.4% | 3.3% | 0.0% | 9.3% |
| 2008 | A All | 788 | 0.9% | 59.5% | 0.0% | 0.4% | 33.4% | 0.0% | 0.8% | 0.4% | 4.4% |
| 2008 | B SE | 280 | 11.1% | 71.0% | 3.6% | 2.0% | 5.7% | 1.6% | 1.8% | 1.8% | 1.5% |
| 2008 | B NW | 245 | 2.0% | 71.1% | 2.8% | 5.3% | 3.9% | 0.2% | 2.2% | 0.6% | 11.8% |
| 2009 | A All | 202 | 0.5% | 47.3% | 2.9% | 4.9% | 22.2% | 0.3% | 1.1% | 0.0% | 21.0% |
| 2009 | B SE | 78 | 28.9% | 54.6% | 3.1% | 3.0% | 3.9% | 0.0% | 0.1% | 2.1% | 4.4% |
| 2009 | B NW | 88 | 0.1% | 70.8% | 0.9% | 11.2% | 5.2% | 0.3% | 1.6% | 0.9% | 8.9% |
| 2010 | A All | 702 | 3.4% | 41.4% | 0.6% | 12.1% | 16.2% | 0.0% | 2.2% | 0.3% | 23.9% |
| 2010 | B SE | 107 | 46.2% | 34.8% | 4.8% | 1.0% | 4.0% | 2.7% | 1.0% | 5.6% | 0.0% |
| 2010 | B NW | 17 | 11.6% | 45.6% | 4.8% | 16.2% | 0.0% | 0.0% | 11.9% | 0.7% | 9.2% |
| 2011 | A All | 695 | 11.2% | 54.0% | 0.6% | 1.8% | 21.8% | 0.0% | 0.2% | 3.1% | 7.4% |
| 2011 | B SE | 1,627 | 15.1% | 72.7% | 4.1% | 0.9% | 3.3% | 1.1% | 0.7% | 1.5% | 0.5% |
| 2011 | B NW | 151 | 2.9% | 75.5% | 2.8% | 3.6% | 2.4% | 1.7% | 4.9% | 1.6% | 4.6% |

Table 12. NMFS regional office estimates of Chinook salmon bycatch in the pollock fishery compared to genetics sampling levels by season and region, 2005-2012 (SE=east of 170°W, NW=west of 170°W) in absolute terms (top 8 data rows) and percentages (bottom 8 data rows).

| | Genetic samples | | | PSC | | |
|---|---|---|---|---|---|---|
| | A season | B SE | B NW | A season | B SE | B NW |
| 2005 | NA | 282 | 489 | 27,209 | 26,425 | 13,793 |
| 2006 | 801 | 304 | 286 | 58,035 | 21,922 | 2,484 |
| 2007 | 360 | 464 | 402 | 70,054 | 42,353 | 10,089 |
| 2008 | 788 | 280 | 245 | 16,510 | 4,017 | 793 |
| 2009 | 202 | 78 | 88 | 9,866 | 2,100 | 469 |
| 2010 | 702 | 107 | 17 | 7,623 | 1,923 | 143 |
| 2011 | 695 | 1,627 | 151 | 7,131 | 16,832 | 1,531 |
| 2012 | NA | NA | NA | 7,761 | 3,570 | 136 |
| | **Genetic samples** | | | **PSC** | | |
| | A season | B SE | B NW | A season | B SE | B NW |
| 2005 | | 37% | 63% | 40% | 39% | 20% |
| 2006 | 58% | 22% | 21% | 70% | 27% | 3% |
| 2007 | 29% | 38% | 33% | 57% | 35% | 8% |
| 2008 | 60% | 21% | 19% | 77% | 19% | 4% |
| 2009 | 55% | 21% | 24% | 79% | 17% | 4% |
| 2010 | 85% | 13% | 2% | 79% | 20% | 1% |
| 2011 | 28% | 66% | 6% | 28% | 66% | 6% |
| 2012 | | | | 68% | 31% | 1% |

## 3.5 Results

Application of the AEQ model provides estimates of the number of Chinook salmon that would have returned to the different systems had the bycatch not occurred. In recent years the aggregate numbers of Chinook salmon impacted from bycatch has dropped markedly and has been at record low levels since 2010 (for the period 1994-2012; Table 13 and Figure 3). This figure also shows that the updated results (in aggregate) are identical to the previous analysis presented in the NPFMC/NMFS (2009). Broken down by the genetic stock IDs, the largest component of the bycatch impact is from the coastal western Alaska regions with some interesting patterns by season (Table 13). For example, larger proportions of the Upper Yukon Chinook salmon are taken in the fishery during the winter months than in the summer fishery.

Applying the updated genetics data shows some subtle differences from the 2009 study for the CWAK region (Figure 4). For the Upper Yukon the updated information increased the historical estimates of AEQ Chinook salmon but their uncertainty remains high (Figure 5). The reason for this increase is principally due to the new genetics information from 2008-2011 which was unavailable for the earlier analysis. Since the stock proportions attributed to the Upper Yukon from the genetics data are much higher (Table 11), the mean proportion has increased which affects the estimates from earlier years. As noted above, the improved sampling for genetics has reduced the variance of the estimates in recent years (e.g., Figure 5 for 2010 and 2011 the relative uncertainty is lower). In summary, the new improved sampling design for genetics information resulted in an increase in the estimate and presumably is a better depiction of the impact of the pollock fishery on the Upper Yukon River Chinook salmon for the period 1994-2004.

The next step for these estimates was to apply them to evaluate the potential impact relative to estimated run strengths. This was done by using the AEQ estimates in Table 13 divided the analogous run size estimates as supplied by ADFG (Table 9). For the CWAK region the impact rate peaks at about 7.5% in 2007 whereas for the Upper Yukon stock the peak occurred in 2010 year at about 3.7% (Figure 6; Table 14). For 2011 and 2012 the average impact for the Upper Yukon was estimated at 1.5% and for the CWAK region it was 1.8%. Comparable run size estimates were unavailable for the 2009 analysis (NPFMC/NMFS) hence these are the first time impact rates have been formally estimated.

As requested by the Council, a “what-if” analysis was done where the PSC was raised (proportional to the observed PSC 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 PSC limit was attained by inflating the observed PSC. This resulted in a change in impact on the CWAK group which went from the 2011 estimate of 1.6% to about 3.0% for 60,000 fish cap (Table 15). A similar pattern occurred by doing the same operation on the 2012 data (Figure 7). Applying the cap of 47,591 is intermediate to the estimated observed impact and the higher cap. Note that there is a lagged effect of applying caps to 2011 (they weren’t applied to prior years) so that the impact of the 2011 (and 2012) cap (and resulting higher PSC levels compared to the actual PSC in those years) will be spread over future years.

However, for the Upper Yukon, the difference between the estimated impact for 2011 and 2012 and the hypothetical impact had the bycatch equaled either of the caps was smaller. For 2011 the estimated impact was 1.6% and had the 47,591 fish cap been taken the impact would have increased to 1.9% (2.1% for the 60,000 fish cap; Figure 8). The peak impact rates for Upper Yukon are below that observed for the CWAK stocks. As with the CWAK results the impact of applying these caps would spread into future years given the higher implied impact of reaching those cap levels. Results for 2012 (lower panel of Figure 8) show higher uncertainty than 2011 (as shown by a broader distribution of the curve) due to the fact that uncertainty is estimated based on between-year mean values and not actual data for 2012 (as these data are unavailable). Once 2012 genetic data are used to estimate stock proportions for that year the uncertainty would be more similar to the 2011 estimates (upper panel of Figure 8) as represented by a more narrow distribution of the curve. Genetics data from 2012 will be available in 2014.

The results suggest that—assuming that environmental factors that affect the degree of overlap of Chinook salmon and the pollock fishery are the same—the fishery has reduced the impact of Chinook salmon bycatch on western Alaska stocks. The extent that this arises from lower overall TACs for pollock (which were at 813 kt in 2010 and subsequently 1.2 million t in 2011 and 2012) and/or environmental conditions is unclear. This what-if analysis also shows that current cap levels are well below the higher impact rates estimated in 2007 for CWAK. For the Upper Yukon, the estimated impact rate in 2011 and 2012 is less than half of the highest estimate (which occurred in 2010).

Again, it is important to note that expecting that the full limit would have been attained given the proportional bycatch as observed is highly unrealistic (i.e., some sectors would have reached their limit while others could remain below). Nonetheless, this illustrates some degree of the effectiveness of the management measures put in place in 2011.

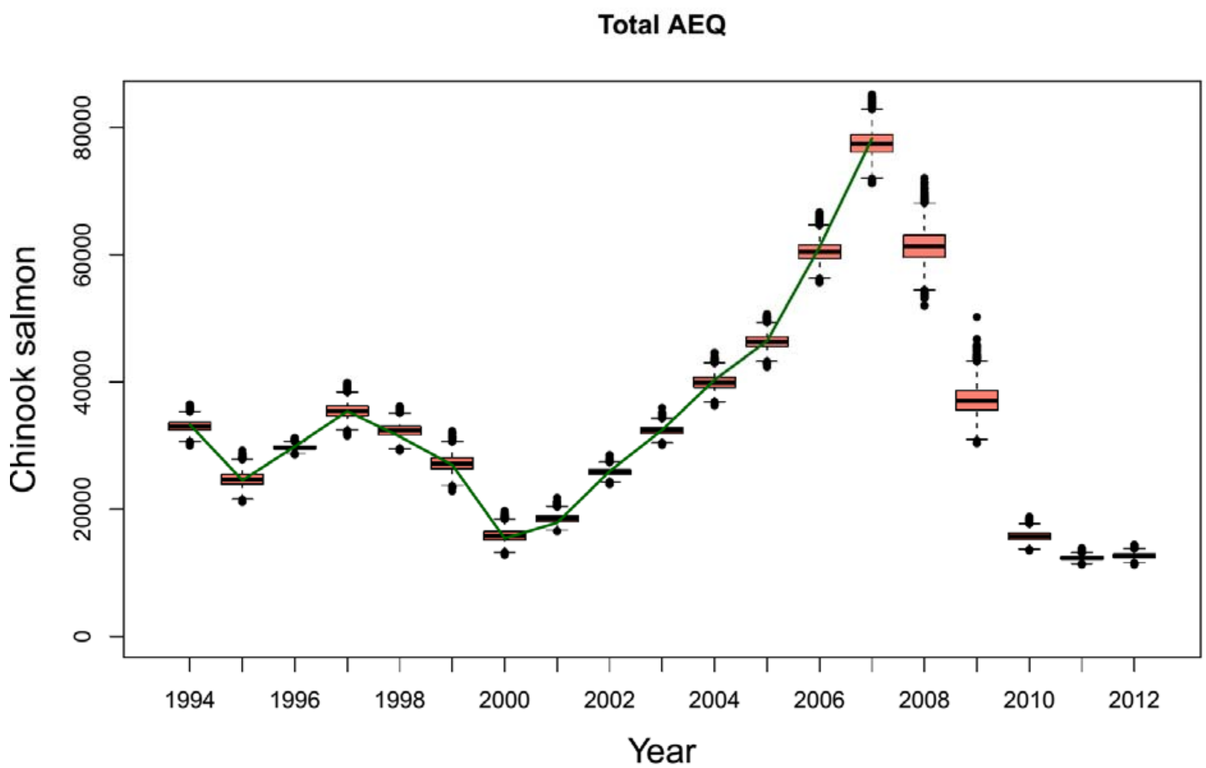



Figure 3. Total estimated AEQ mortality of Chinook salmon from the EBS pollock fishery, 1994-2012. Units are numbers of salmon and height of boxes represent the uncertainty due to uncertain oceanic survival and other factors that vary within the model. The line represents the estimate from the FEIS result (1994-2007) for comparison.

Table 13. Results of the Chinook salmon AEQ analysis combined with the available genetic data for the years 1994-2012 in numbers (top panel) and also shown is the proportion for each stock group that occurred during the A season (bottom panel).

| | BC-WA-OR | Coast W AK | Cook Inlet | Middle Yukon | N AK Penin | Other | Russia | SEAK | Upper Yukon | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1994 | 3,936 | 18,926 | 539 | 739 | 5,845 | 108 | 355 | 288 | 2,310 | 33,045 |
| 1995 | 3,043 | 14,039 | 403 | 516 | 4,447 | 77 | 252 | 213 | 1,732 | 24,722 |
| 1996 | 3,532 | 16,779 | 443 | 607 | 5,585 | 83 | 286 | 248 | 2,151 | 29,715 |
| 1997 | 5,141 | 20,359 | 776 | 734 | 5,390 | 151 | 414 | 338 | 2,150 | 35,452 |
| 1998 | 5,617 | 18,688 | 915 | 620 | 3,985 | 174 | 416 | 340 | 1,623 | 32,380 |
| 1999 | 5,038 | 15,777 | 847 | 513 | 2,973 | 162 | 369 | 298 | 1,235 | 27,210 |
| 2000 | 3,059 | 9,134 | 511 | 277 | 1,684 | 96 | 211 | 175 | 690 | 15,836 |
| 2001 | 2,347 | 10,951 | 386 | 483 | 2,714 | 85 | 247 | 180 | 1,149 | 18,542 |
| 2002 | 3,009 | 14,851 | 411 | 591 | 4,606 | 84 | 279 | 225 | 1,825 | 25,883 |
| 2003 | 3,756 | 18,638 | 520 | 752 | 5,716 | 107 | 355 | 283 | 2,277 | 32,405 |
| 2004 | 5,025 | 23,082 | 736 | 915 | 6,605 | 150 | 460 | 364 | 2,652 | 39,989 |
| 2005 | 7,527 | 25,591 | 1,000 | 1,044 | 7,081 | 232 | 748 | 423 | 2,707 | 46,353 |
| 2006 | 13,616 | 27,952 | 1,142 | 990 | 12,176 | 503 | 1,055 | 904 | 2,190 | 60,527 |
| 2007 | 12,957 | 45,744 | 1,356 | 1,201 | 11,694 | 439 | 1,018 | 796 | 2,393 | 77,598 |
| 2008 | 6,864 | 40,236 | 1,075 | 965 | 8,791 | 232 | 663 | 464 | 2,114 | 61,403 |
| 2009 | 2,211 | 25,433 | 737 | 873 | 5,108 | 99 | 336 | 224 | 2,166 | 37,188 |
| 2010 | 1,312 | 7,978 | 336 | 916 | 2,546 | 67 | 227 | 144 | 2,220 | 15,746 |
| 2011 | 1,442 | 6,974 | 277 | 497 | 1,588 | 64 | 132 | 209 | 1,137 | 12,321 |
| 2012 | 1,615 | 7,763 | 283 | 262 | 1,711 | 73 | 114 | 204 | 688 | 12,714 |

| | BC-WA-OR | Coast W AK | Cook Inlet | Middle Yukon | N AK Penin | Other | Russia | SEAK | Upper Yukon | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1994 | 40% | 66% | 17% | 68% | 91% | 16% | 47% | 52% | 87% | 68% |
| 1995 | 40% | 68% | 17% | 75% | 91% | 17% | 50% | 54% | 89% | 69% |
| 1996 | 44% | 72% | 20% | 81% | 93% | 21% | 57% | 59% | 92% | 73% |
| 1997 | 27% | 53% | 10% | 60% | 85% | 10% | 35% | 38% | 81% | 54% |
| 1998 | 16% | 38% | 6% | 46% | 75% | 6% | 23% | 25% | 70% | 39% |
| 1999 | 12% | 30% | 4% | 38% | 69% | 4% | 17% | 19% | 63% | 32% |
| 2000 | 11% | 29% | 4% | 39% | 67% | 4% | 17% | 18% | 62% | 30% |
| 2001 | 29% | 49% | 10% | 45% | 84% | 9% | 29% | 36% | 76% | 52% |
| 2002 | 42% | 66% | 17% | 68% | 91% | 17% | 47% | 53% | 87% | 68% |
| 2003 | 41% | 65% | 17% | 66% | 91% | 16% | 46% | 52% | 87% | 67% |
| 2004 | 35% | 59% | 13% | 61% | 89% | 13% | 40% | 45% | 84% | 61% |
| 2005 | 23% | 53% | 10% | 52% | 81% | 8% | 24% | 38% | 80% | 52% |
| 2006 | 49% | 59% | 8% | 56% | 88% | 56% | 34% | 72% | 72% | 62% |
| 2007 | 54% | 62% | 7% | 38% | 86% | 53% | 29% | 64% | 57% | 63% |
| 2008 | 54% | 61% | 6% | 28% | 87% | 40% | 29% | 48% | 53% | 61% |
| 2009 | 50% | 54% | 20% | 36% | 87% | 19% | 36% | 25% | 70% | 58% |
| 2010 | 17% | 63% | 40% | 85% | 90% | 11% | 68% | 20% | 93% | 68% |
| 2011 | 33% | 49% | 21% | 84% | 88% | 5% | 55% | 52% | 94% | 57% |
| 2012 | 34% | 46% | 11% | 71% | 87% | 5% | 39% | 48% | 91% | 52% |

Table 14. 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.

| Year | CWAK | Upper Yukon | Year | CWAK | Upper Yukon |
|---|---|---|---|---|---|
| 1994 | 2.0% | 1.2% | 2004 | 2.1% | 1.9% |
| 1995 | 1.6% | 0.8% | 2005 | 2.8% | 2.1% |
| 1996 | 2.8% | 1.0% | 2006 | 3.7% | 1.8% |
| 1997 | 2.2% | 1.1% | 2007 | 7.5% | 2.7% |
| 1998 | 2.5% | 1.7% | 2008 | 7.7% | 3.3% |
| 1999 | 2.9% | 1.0% | 2009 | 5.2% | 2.5% |
| 2000 | 2.3% | 1.2% | 2010 | 2.3% | 3.7% |
| 2001 | 1.8% | 1.1% | 2011 | 1.6% | 1.6% |
| 2002 | 2.2% | 1.8% | 2012 | 2.0% | 1.4% |
| 2003 | 2.7% | 1.3% | | | |

Table 15. 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% | 3.0% | 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% |

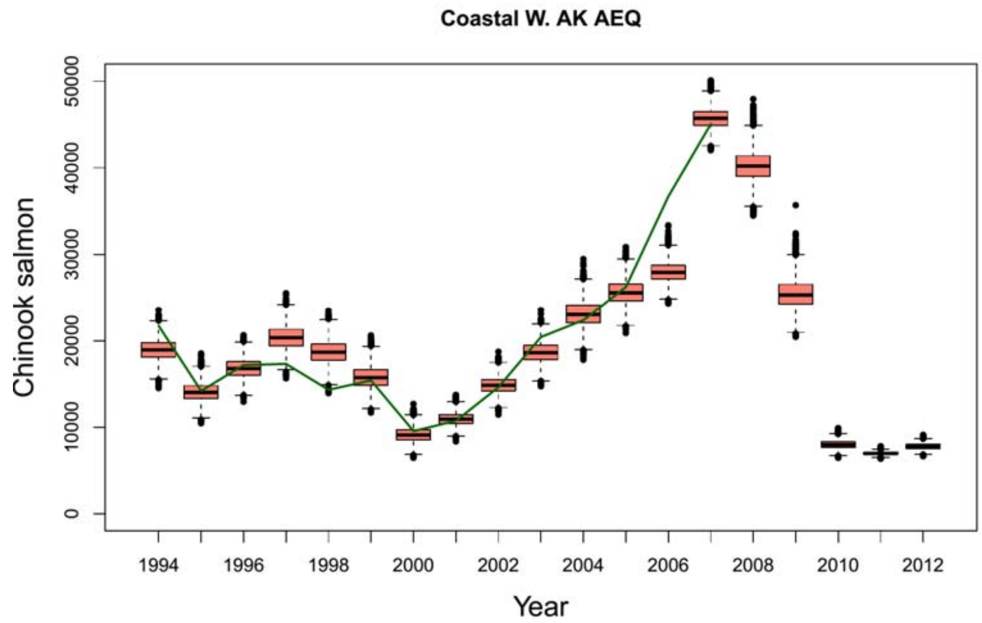



Figure 4. Estimated AEQ mortality of Chinook salmon from the EBS pollock fishery attributed to the **coastal western Alaska** stocks, 1994-2012. Units are numbers of salmon and height of boxes represent the uncertainty due to uncertain oceanic survival and other factors that vary within the model. The line represents the estimate from the FEIS result (1994-2007) for comparison.

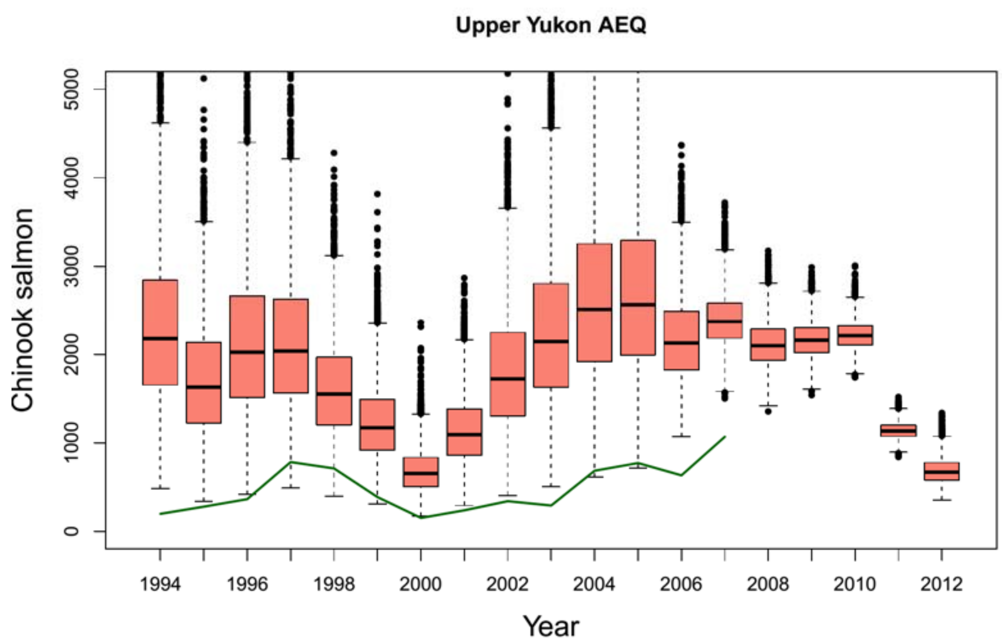



Figure 5. Estimated AEQ mortality of Chinook salmon from the EBS pollock fishery attributed to the **Upper Yukon** stock, 1994-2012. Units are numbers of salmon and height of boxes represent the uncertainty due to uncertain oceanic survival and other factors that vary within the model. The line represents the estimate from the FEIS result (1994-2007) for comparison.

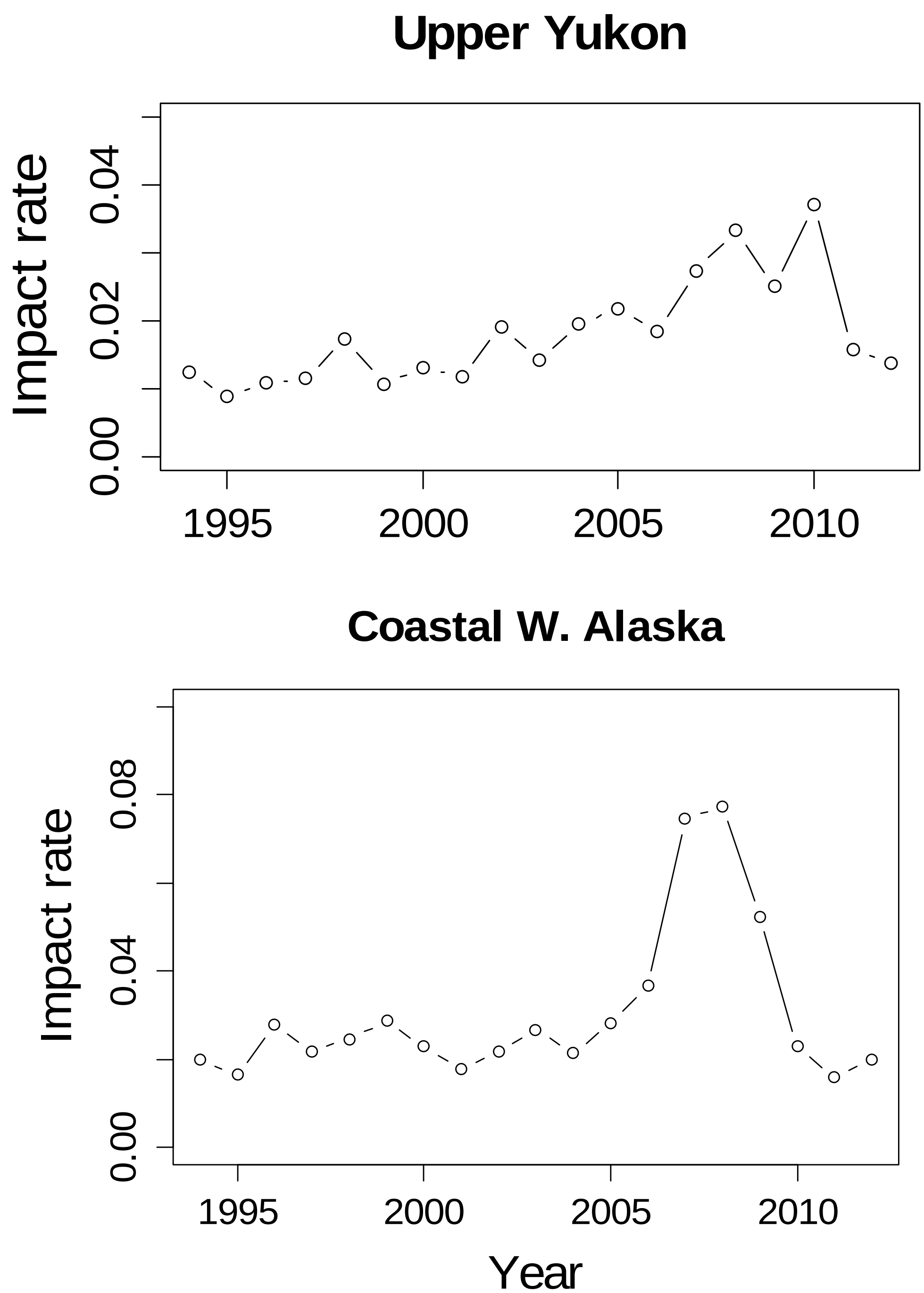



Figure 6. Estimated impact of the EBS pollock fishery on the Upper Yukon stock (top) and coastal west Alaska (which includes the "middle Yukon"; bottom), 1994-2012. Vertical axis is the ratio of AEQ over the point estimates of run sizes.

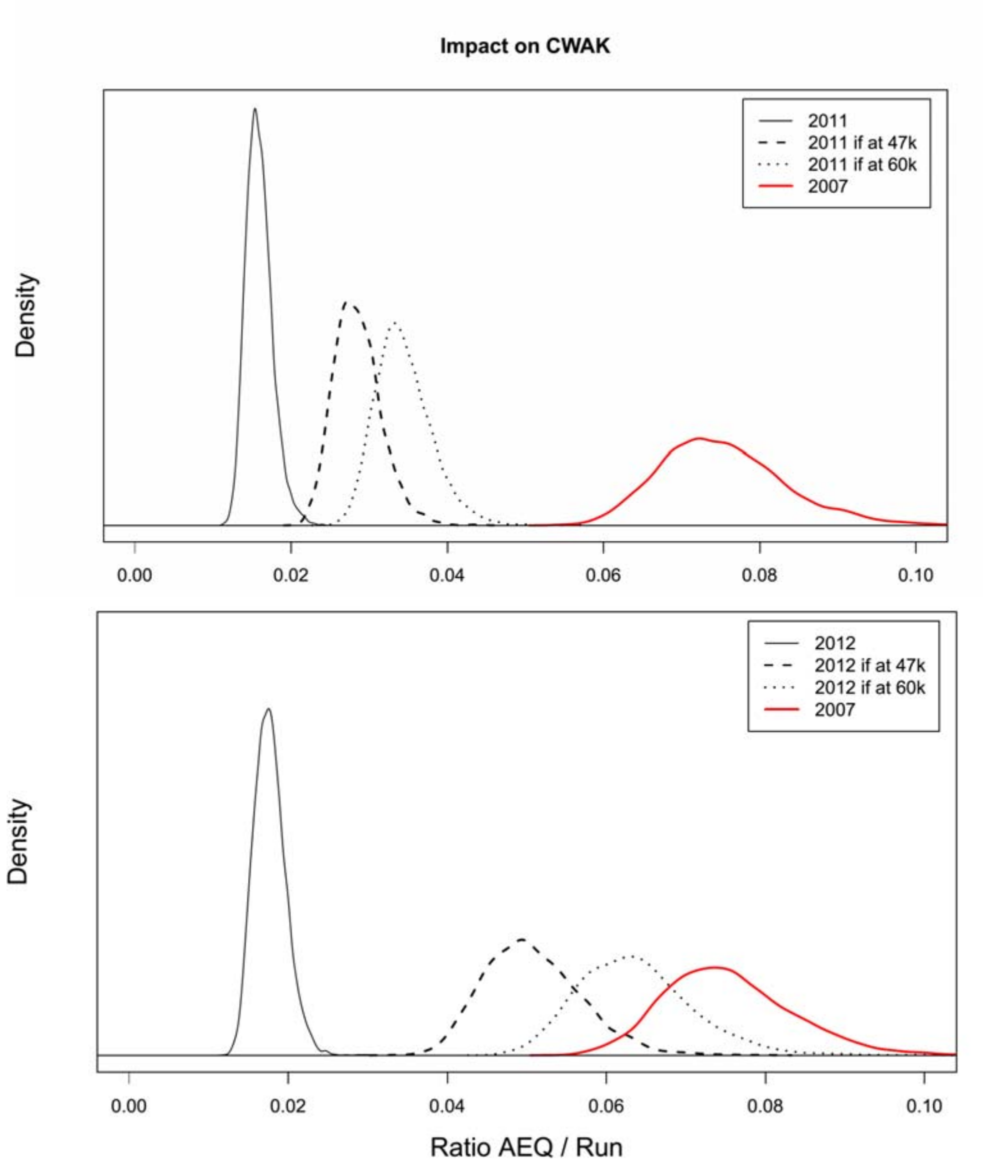



Figure 7. Estimated impact (thin solid line) of the EBS pollock fishery on the coastal west Alaska (which includes the "middle Yukon") for 2011 (top) and 2012 (bottom). The height of the shapes is intended to represent the relative probability (density) of impact rates shown on the horizontal scale. Also plotted are densities of impacts estimated for 2007 (red line) and for 2011 and 2012 had the current constraints been attained.

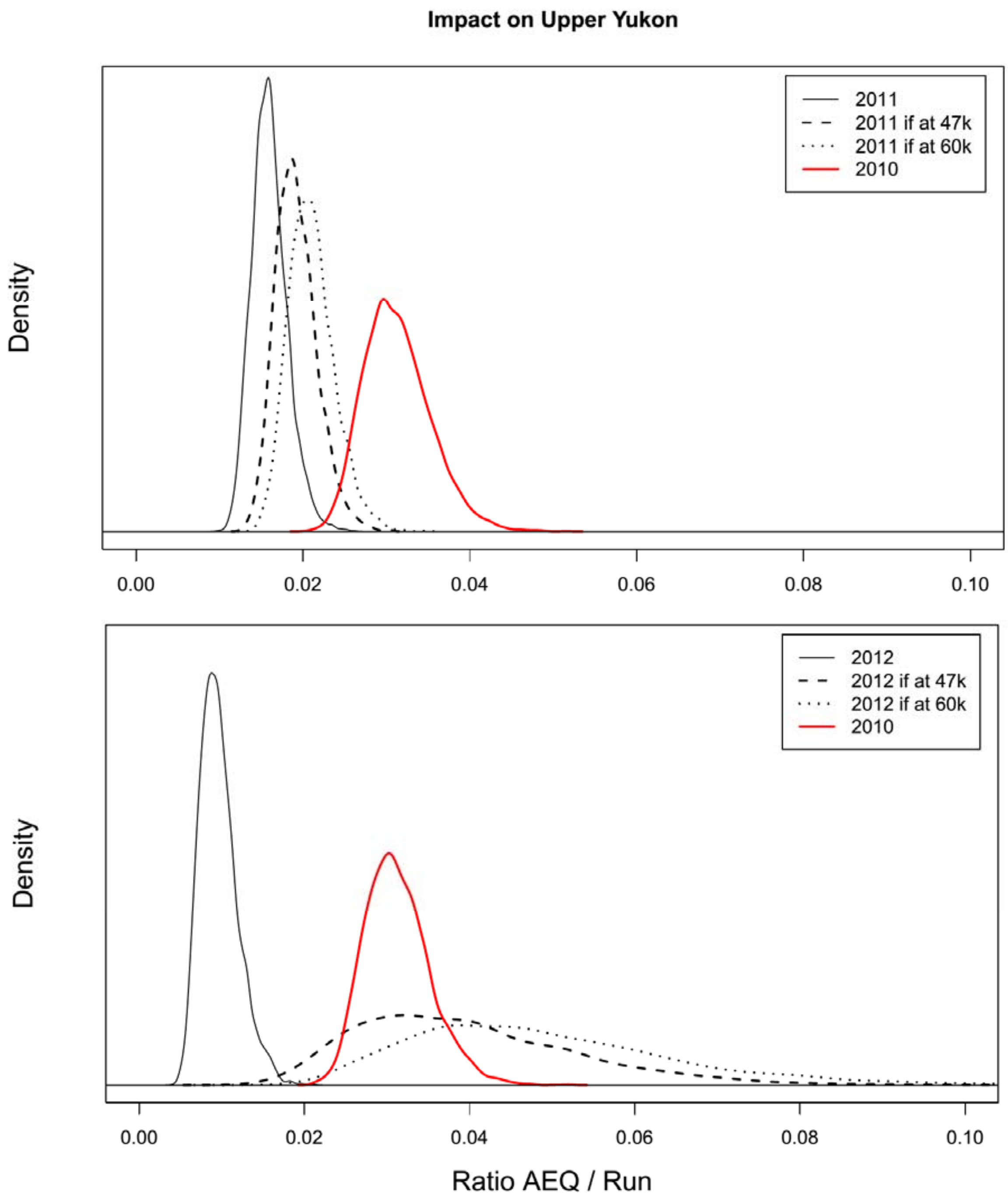



Figure 8. Estimated impact (thin solid line) of the EBS pollock fishery on the Upper Yukon for 2011 (top) and 2012 (bottom). The height of the shapes is intended to represent the relative probability (density) of impact rates shown on the horizontal scale. Also plotted are densities of impacts estimated for 2007 (red line) and for 2011 and 2012 had the current constraints been attained.

# 4 Fishing and bycatch performance

Fishing and bycatch performance are characterized by several different measures: PSC amounts and rates by sector and season, rates and cumulative amounts by week by sector in September and October and finally rates by individual vessels by sector. All data is shown from 2003 through A-season 2013. B-season data for 2013 is not available for comparative purposes as the season is continuing through the end of October. Additional information is provided regarding voluntary use of salmon excluders by sector.

## 4.1 Overview of PSC by sector

In general PSC rates (Chinook salmon per t of pollock) have declined in all sectors since the 2004-2007 period (Figure 9).

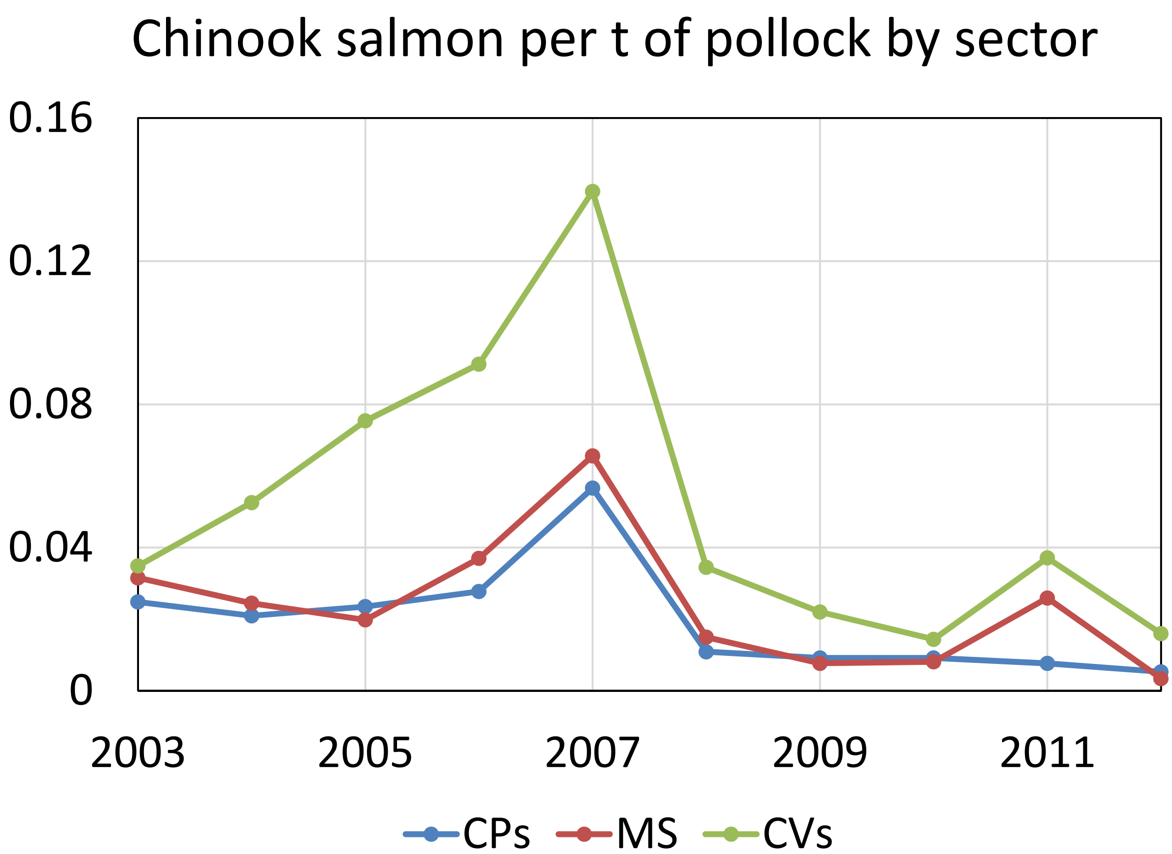



Figure 9. Trends in the annual bycatch rates by sector, 2003-2012.

Table 16 shows the Chinook salmon PSC in finer resolution by number of fish, by month, by sector from 2003 through A season 2013. Table 17 contains Chinook salmon PSC rates (Chinook /t pollock) by month, sector and year. By sector, highest numbers for CPs are in February and March and September and October. Interestingly numbers in October 2011 were the second highest by month over the time period considered after 2007 while the rate for that month while highest for that year was lower in October of 2011 than in the same month in some previous years. For Motherships October of 2011 was also anomalously high over the 2003-2012 time frame for number by month. By rate October of 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 Shoreside CV sector highest numbers are generally in January/February/March and September/October. By rate however October is high in many of the years considered unlike some of the anomalies observed in 2007 and 2011 in the CP and M sectors. Typically rates in the shoreside sector are higher than in the Mothership or CP sectors over the time period considered.

Table 16. Chinook salmon PSC (by sector and month, 2003-2013). Source NMFS Regional Office through August 23 2013.

| | Catcher processors | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| 1 | 1,193 | 1,766 | 1,912 | 2,909 | 5,872 | 392 | 1,188 | 365 | 185 | 290 | 388 |
| 2 | 9,824 | 3,533 | 6,855 | 7,350 | 15,674 | 3,150 | 859 | 1,659 | 1,116 | 1,055 | 1,833 |
| 3 | 3,340 | 4,154 | 2,617 | 6,955 | 6,363 | 1,009 | 995 | 1,312 | 795 | 1,483 | 1,783 |
| 4 | 4 | 0 | 0 | 46 | 0 | 0 | 0 | 65 | 140 | 0 | 31 |
| 6 | 43 | 385 | 203 | 37 | 36 | 16 | 30 | 1 | 32 | 42 | 31 |
| 7 | 119 | 435 | 179 | 154 | 52 | 12 | 14 | 6 | 75 | 10 | 12 |
| 8 | 907 | 881 | 1,370 | 149 | 516 | 126 | 121 | 18 | 115 | 19 | 31 |
| 9 | 1,980 | 1,974 | 2,171 | 729 | 2,342 | 106 | 155 | 18 | 572 | 26 | 0 |
| 10 | 990 | 613 | 393 | 462 | 3,854 | 149 | 13 | 8 | 1,158 | 0 | 0 |
| | Mother ships | | | | | | | | | | |
| Month | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| 1 | 375 | 203 | 477 | 933 | 1,985 | 310 | 99 | 0 | 56 | 110 | 89 |
| 2 | 1,449 | 1,233 | 1,221 | 3,450 | 3,092 | 726 | 321 | 220 | 216 | 119 | 212 |
| 3 | 1,056 | 640 | 409 | 1,011 | 784 | 236 | 181 | 273 | 183 | 83 | 245 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 11 |
| 6 | 3 | 15 | 90 | 0 | 5 | 0 | 27 | 55 | 7 | 18 | 8 |
| 7 | 14 | 83 | 63 | 11 | 16 | 6 | 31 | 11 | 17 | 16 | 11 |
| 8 | 157 | 130 | 160 | 29 | 152 | 8 | 58 | 12 | 30 | 8 | 6 |
| 9 | 434 | 702 | 432 | 112 | 895 | 71 | 36 | 6 | 72 | 7 | 0 |
| 10 | 1,332 | 977 | 143 | 24 | 2,317 | 86 | 0 | 0 | 2,297 | 0 | 0 |
| | Shore-based Catcher Vessels | | | | | | | | | | |
| Month | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| 1 | 1,253 | 1,952 | 1,856 | 4,650 | 14,004 | 2,949 | 3,695 | 875 | 187 | 505 | 566 |
| 2 | 8,118 | 4,538 | 9,023 | 26,004 | 18,228 | 6,313 | 1,427 | 2,010 | 2,173 | 2,532 | 533 |
| 3 | 5,959 | 5,086 | 2,918 | 4,982 | 4,231 | 1,430 | 1,082 | 663 | 1,458 | 1,470 | 2,342 |
| 4 | 36 | 0 | 0 | 2 | 0 | 0 | 37 | 186 | 623 | 117 | 199 |
| 6 | 29 | 79 | 551 | 1,414 | 545 | 199 | 737 | 434 | 85 | 136 | 237 |
| 7 | 57 | 208 | 1,137 | 994 | 224 | 295 | 249 | 118 | 248 | 55 | 155 |
| 8 | 171 | 1,848 | 3,028 | 771 | 697 | 141 | 218 | 110 | 360 | 183 | 318 |
| 9 | 1,830 | 5,585 | 4,894 | 7,019 | 9,092 | 1,076 | 841 | 453 | 3,674 | 990 | 0 |
| 10 | 4,911 | 14,275 | 25,216 | 12,105 | 23,268 | 2,381 | 162 | 817 | 9,584 | 1,801 | 0 |

Table 17. Chinook bycatch rates (number per ton of pollock) by sector and month, 2003-2013). Source NMFS Regional Office through August 23 2013.

| CP | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.055 | 0.030 | 0.035 | 0.057 | 0.137 | 0.018 | 0.070 | 0.042 | 0.013 | 0.019 | 0.030 |
| 2 | 0.103 | 0.030 | 0.054 | 0.057 | 0.141 | 0.036 | 0.014 | 0.028 | 0.012 | 0.011 | 0.023 |
| 3 | 0.038 | 0.049 | 0.034 | 0.083 | 0.072 | 0.016 | 0.017 | 0.021 | 0.008 | 0.014 | 0.014 |
| 4 | 0.002 | 0.000 | 0.000 | 0.082 | 0.000 | 0.000 | 0.000 | 0.005 | 0.006 | 0.000 | 0.003 |
| 6 | 0.001 | 0.008 | 0.006 | 0.002 | 0.001 | 0.001 | 0.001 | 0.000 | 0.001 | 0.001 | 0.000 |
| 7 | 0.001 | 0.003 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 |
| 8 | 0.007 | 0.008 | 0.012 | 0.001 | 0.005 | 0.001 | 0.001 | 0.000 | 0.002 | 0.000 | 0.000 |
| 9 | 0.054 | 0.025 | 0.027 | 0.007 | 0.035 | 0.002 | 0.004 | 0.001 | 0.011 | 0.001 | 0.000 |
| 10 | 0.154 | 0.049 | 0.026 | 0.014 | 0.120 | 0.010 | 0.004 | 0.004 | 0.023 | 0.000 | 0.000 |
| M | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| 1 | 0.072 | 0.015 | 0.035 | 0.085 | 0.210 | 0.110 | 0.050 | 0.000 | 0.022 | 0.047 | 0.027 |
| 2 | 0.055 | 0.037 | 0.040 | 0.097 | 0.099 | 0.025 | 0.020 | 0.017 | 0.012 | 0.006 | 0.015 |
| 3 | 0.052 | 0.046 | 0.031 | 0.088 | 0.049 | 0.029 | 0.012 | 0.018 | 0.009 | 0.004 | 0.010 |
| 4 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.006 |
| 6 | 0.001 | 0.007 | 0.010 | 0.000 | 0.003 | 0.000 | 0.002 | 0.009 | 0.001 | 0.001 | 0.001 |
| 7 | 0.001 | 0.004 | 0.002 | 0.000 | 0.001 | 0.001 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 |
| 8 | 0.005 | 0.006 | 0.007 | 0.001 | 0.006 | 0.001 | 0.003 | 0.001 | 0.002 | 0.000 | 0.000 |
| 9 | 0.022 | 0.023 | 0.022 | 0.005 | 0.037 | 0.005 | 0.012 | 0.001 | 0.008 | 0.001 | 0.000 |
| 10 | 0.145 | 0.077 | 0.018 | 0.002 | 0.183 | 0.009 | 0.000 | 0.000 | 0.176 | 0.000 | 0.000 |
| S | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| 1 | 0.052 | 0.040 | 0.039 | 0.115 | 0.409 | 0.117 | 0.322 | 0.148 | 0.012 | 0.019 | 0.025 |
| 2 | 0.065 | 0.036 | 0.072 | 0.192 | 0.160 | 0.072 | 0.030 | 0.051 | 0.024 | 0.030 | 0.007 |
| 3 | 0.055 | 0.059 | 0.034 | 0.059 | 0.044 | 0.023 | 0.014 | 0.010 | 0.019 | 0.017 | 0.025 |
| 4 | 0.054 | 0.000 | 0.000 | 0.006 | 0.000 | 0.000 | 0.007 | 0.007 | 0.018 | 0.009 | 0.007 |
| 6 | 0.001 | 0.003 | 0.011 | 0.032 | 0.009 | 0.003 | 0.013 | 0.009 | 0.001 | 0.002 | 0.003 |
| 7 | 0.001 | 0.002 | 0.009 | 0.010 | 0.003 | 0.004 | 0.004 | 0.001 | 0.002 | 0.001 | 0.001 |
| 8 | 0.001 | 0.019 | 0.033 | 0.009 | 0.009 | 0.002 | 0.003 | 0.002 | 0.006 | 0.002 | 0.004 |
| 9 | 0.018 | 0.064 | 0.069 | 0.072 | 0.143 | 0.034 | 0.052 | 0.029 | 0.099 | 0.020 | 0.000 |
| 10 | 0.135 | 0.349 | 0.435 | 0.200 | 0.456 | 0.220 | 0.045 | 0.191 | 0.238 | 0.084 | 0.000 |

### 4.1.1 Overview of PSC by week in September and October

Given the indication of higher rates annually in the latter part of the B-season, a more detailed consideration of PSC rates by sector are shown for September and October. Figure 10 shows the average weekly pollock catch compared to Chinook salmon PSC rate (salmon per t of pollock) by sector from September 1 to October 31st, 2003-2012. While all three sectors show some increase in Chinook salmon PSC rate for a decline in pollock catch over the weeks starting September 1st, the shoreside sector shows the most dramatic increase of the three sector, particularly around the middle of October to the end of the month. Annual cumulative Chinook salmon PSC and pollock from September 1 to October 31st, 2003-2012 for the shore-based catcher vessels is shown in Figure 11.

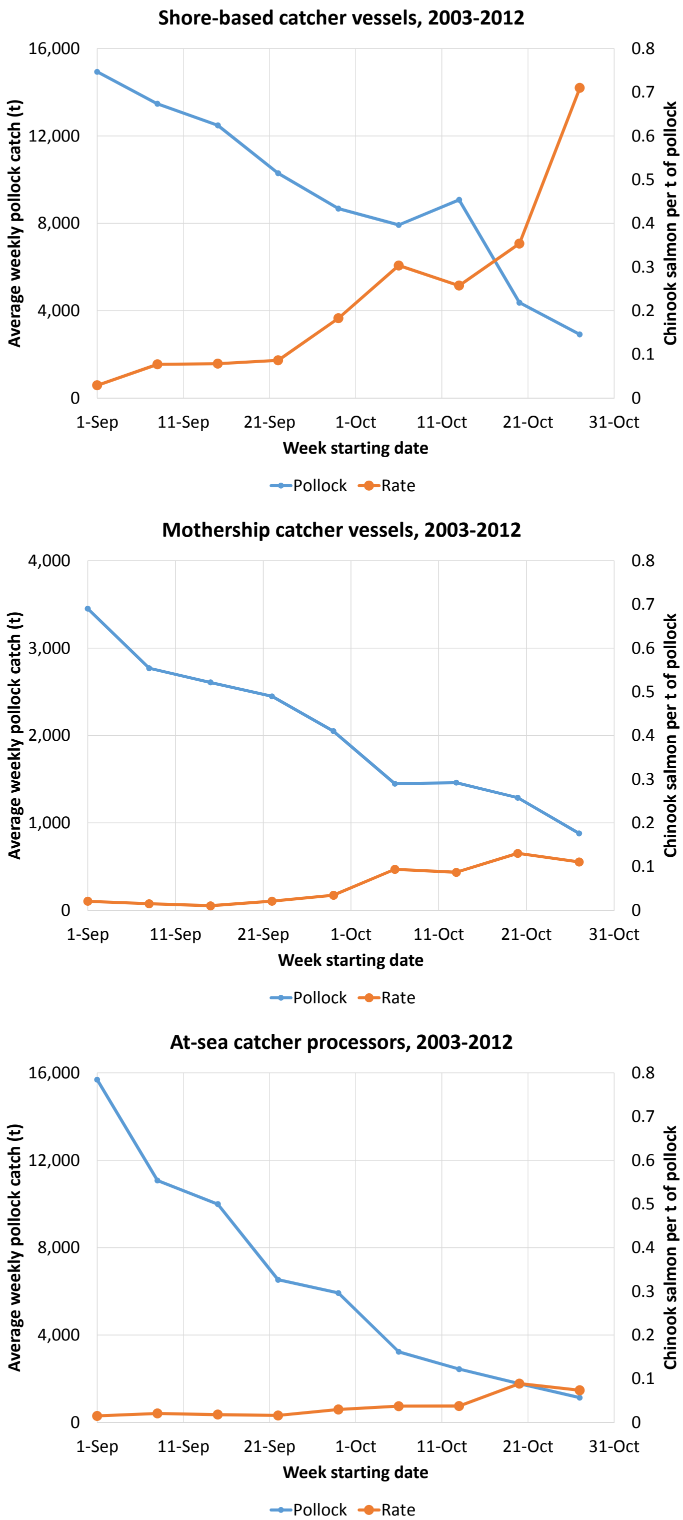
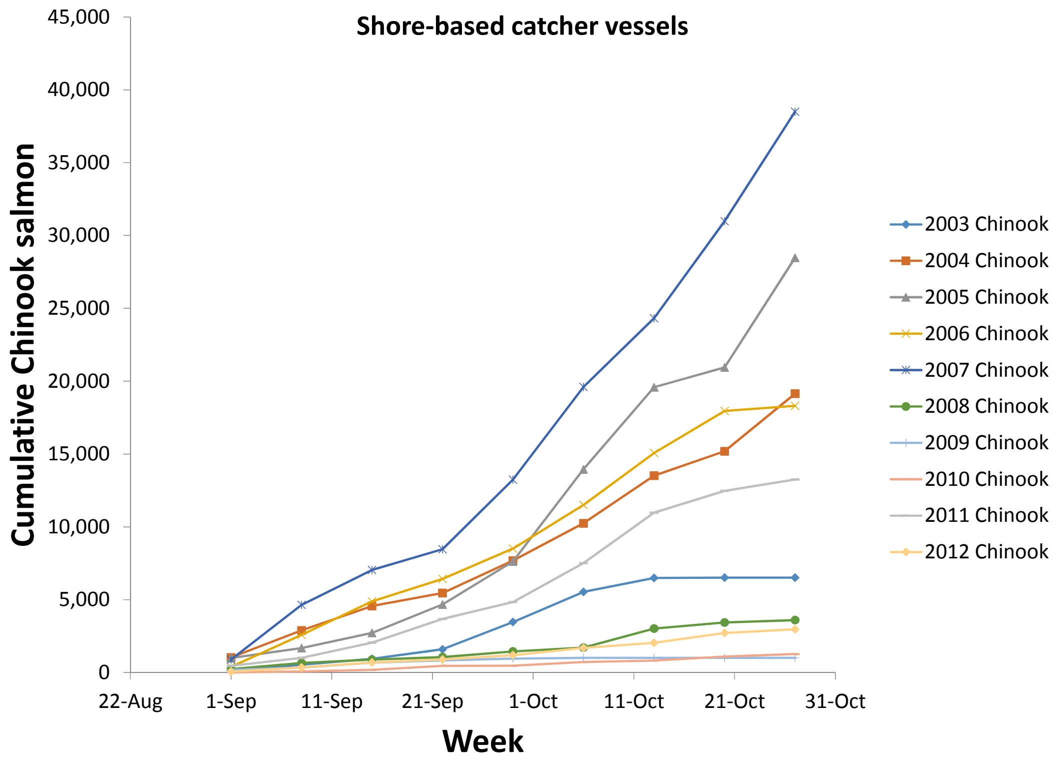



Figure 10. Average weekly pollock catch compared to Chinook salmon PSC rate (salmon per t of pollock) by sector from September 1 to October 31st, 2003-2012.



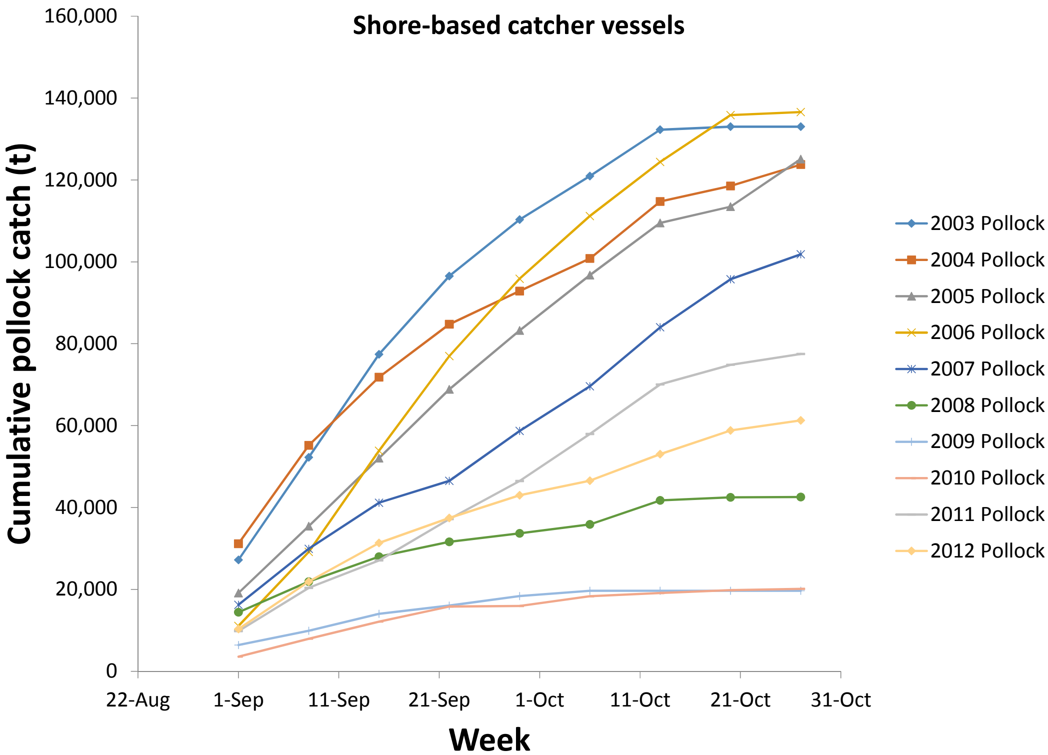




Figure 11. Annual cumulative Chinook salmon PSC (top) and pollock (bottom) from September 1 to October 31st, 2003-2012 for the shore-based catcher vessels.

### 4.2 Vessel bycatch rates

One aspect of the Council's motion was to specifically evaluate changes over time in individual vessel bycatch rates in order to best evaluate to what extent the management program is affecting individual vessel behavior. The ability to display confidential vessel-specific bycatch is limited, thus some grouping of vessels was required. For this reason, we selected vessels that were among the five highest and five lowest bycatch rates and tracked their changes over time.

For shoreside CVs from 2003-2012 the poorer performers (high bycatch) exhibited some variability but less than the better performers (Figure 12). Less consistency was observed in the trends for CP vessels and Mothership vessels between highest and lowest bycatch vessels however (Figure 13 and Figure 14). These figures indicate that comparing rank within the fleet and how they are changing over time, even averaged over vessels, may be a poor metric of the measures being undertaken to reduce Chinook salmon bycatch.

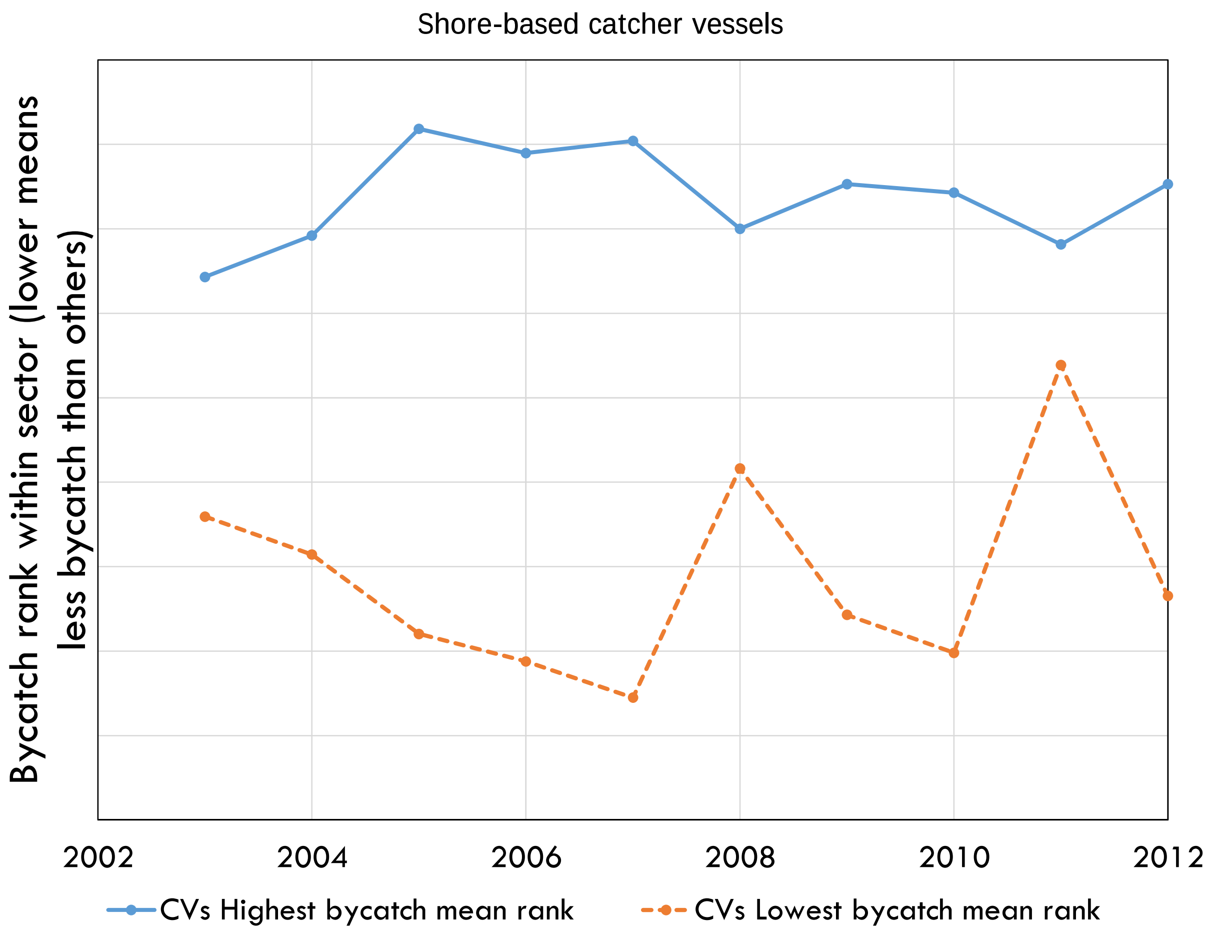



Figure 12. Trend in the performance for the catcher vessels delivering to shore-based plants for 5 of the highest bycatch vessels (top line) compared to 5 vessels with the lowest bycatch rates, 2003-2012.

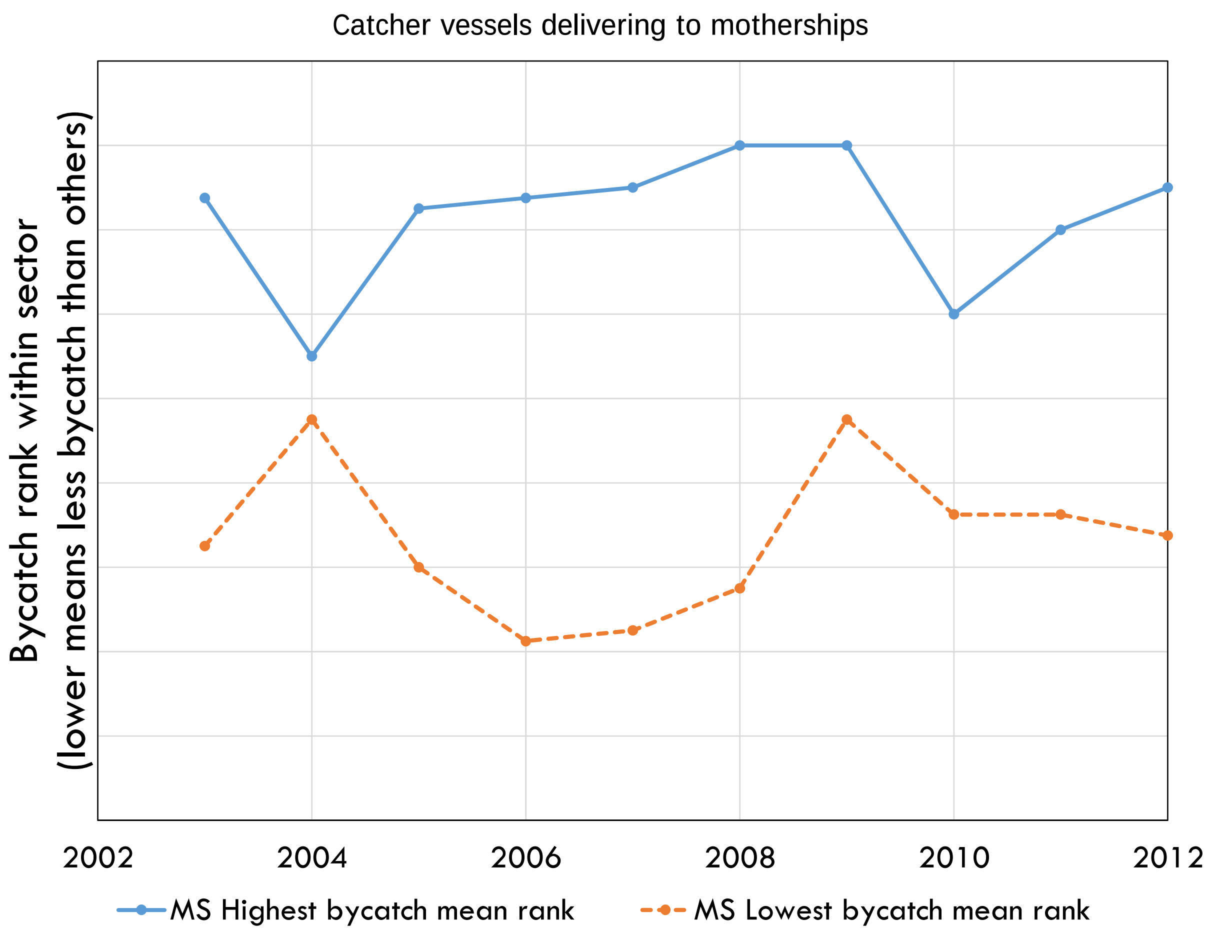



Figure 13. Trend in the performance for the catcher vessels delivering to motherships for 5 of the highest bycatch vessels (top line) compared to 5 vessels with the lowest bycatch rates, 2003-2012.

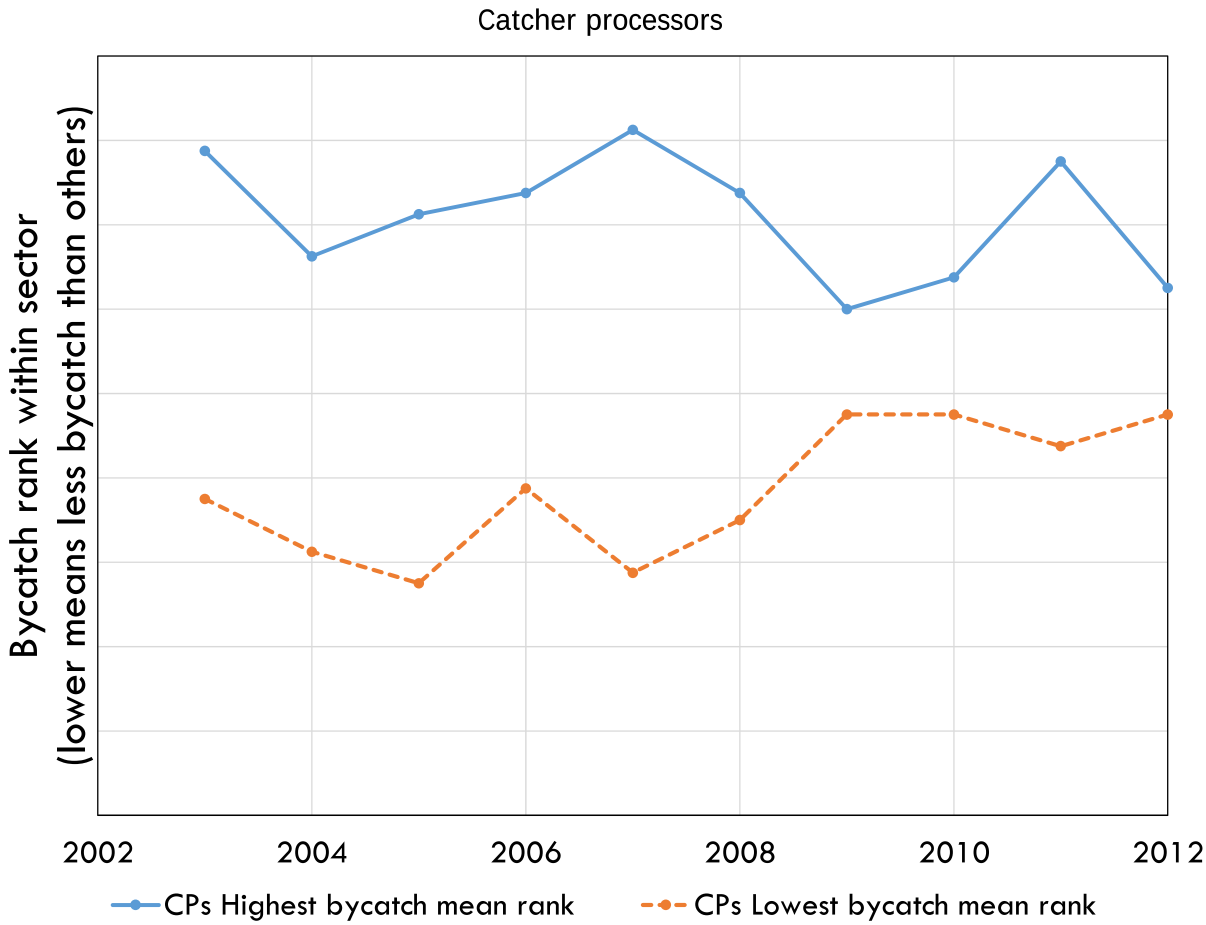



Figure 14. Trend in the performance for the catcher vessels delivering to shore-based plants for 5 of the highest bycatch vessels (top line) compared to 5 vessels with the lowest bycatch rates, 2003-2012.

Table 18 shows how specific vessels perform from one year to the next. Ideally this would show a vessels numerical rank within each year such that it's ranking could be clearly displayed from one year to the next and provide some sort of measure of behavioral changes since the program's inception in 2011. Confidentiality concerns prohibit displays of individual vessels ranking and are instead grouped by shaded categories. Furthermore in order to avoid biasing the results by vessels that did not fish in some years, these data have been screened to remove vessels that caught less than 40,000 tons of pollock cumulatively over the time period (2003-2012).

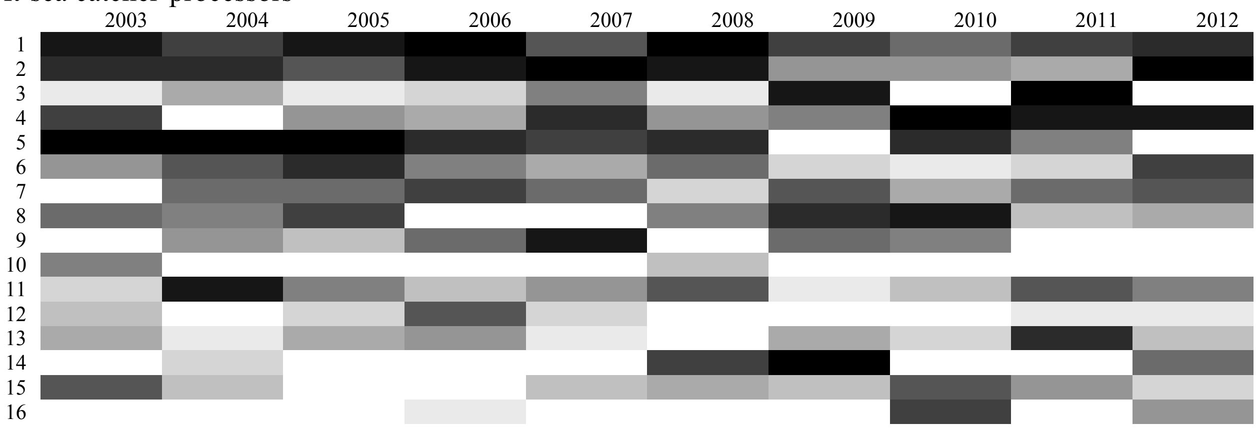
Nonetheless this measure of vessel ranking still demonstrates some consistency in the worst bycatch vessels across all years. There is clearly inter-annual variability such that the worst vessels in general are not the worst vessels in every year. However, it appears that the worst vessels are tending to be together and consistently for the short two-year period of the program (since 2011).

Table 18. Relative ranking of individual vessels bycatch within each year and sector from 2003-2012. The column with the numbers represent a distinct vessel (row) and the shadings show the quintile ranks

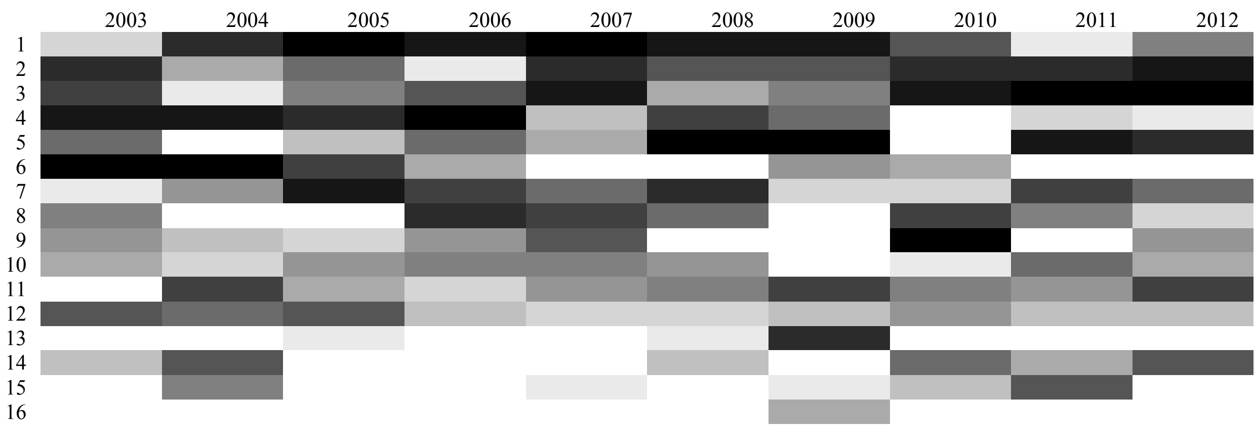
**Legend**

0-20% | 20%-40% | 40%-60% | 60%-80% | 80%-100%

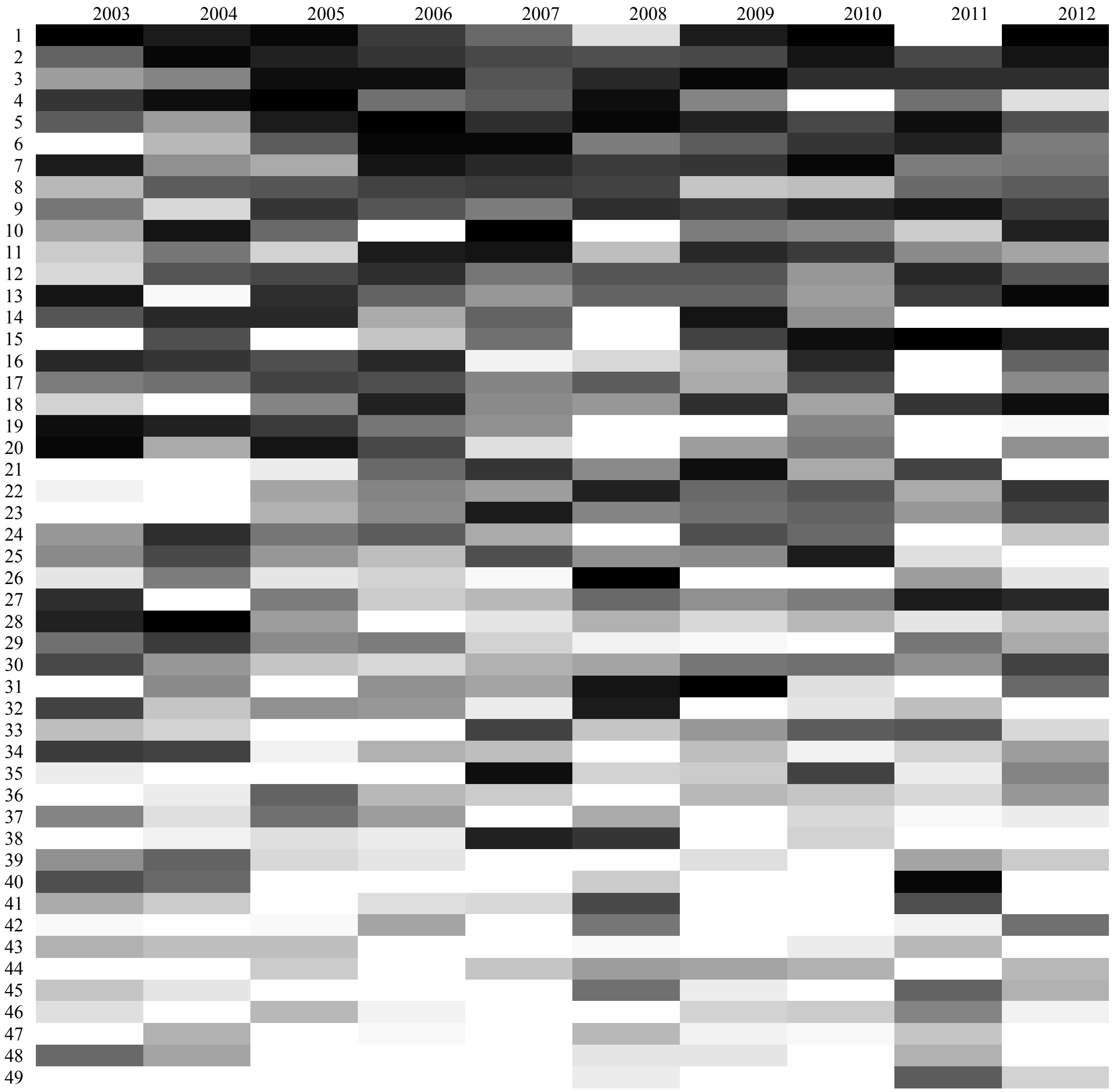
At-sea catcher-processors




Motherships



Shoreside catcher vessels




## 4.3 Use of salmon excluders by sector

Salmon excluder devices have been in development for many years and rely on an opening in the in the pelagic trawl net through which Chinook may escape the net before it is hauled back. Excluders are being used more frequently by the fleet now in an effort to avoid bycatch. The Council specifically requested that information be compiled on the voluntary use of salmon excluders by sectors of the pollock fleet. Information related to the usage of excluder devices is not included in data reporting requirements for Amendment 91 however, thus compilation of information related to general usage is provided voluntarily by the fleet in good faith in an attempt to meet the Council's request. Each sector provided different details for their fleets either from previous reports to the Council or specific inquiries since April 2013 of the fleet.. It should be understood that absent reporting requirements (voluntary or mandatory) to note when a tow is made using an excluder these data are reported qualitatively by participants after the fact (and looking backward several years) in an attempt to best meet the intent of qualitatively describing trends in usage of excluder devices since 2010. Should the Council wish to have this information reported regularly a more explicit request to the fleet to record when excluder are used (and on a tow-by-tow) basis would be preferable to making this request of captains and operators after the fact.

### 4.3.1 Mothership fleet excluder usage

In order to comply with the Council's request, the Mothership Fleet Cooperative (MFC) representatives sent a letter to the Council describing their voluntary use of salmon excluders since 2010[2]. According to these reports catcher vessels use excluders at all times when fishing in the Mothership pollock fishery. The MFC reports 'fleet-wide' use of salmon excluders beginning in 2010 (one year prior to implementation of Amendment 91). Following Amendment 91 the MFC states that it became 'imperative to MFC members to use salmon excluders to manage the disproportionately low Chinook salmon allocation to the Mothership sector". However catcher vessels in the Mothership sector do not keep logbook records of salmon excluder use, nor does the MFC require the members retain or create such records, thus there are no 'official' estimates recorded of percentage usage of excluders .

Nonetheless, MFC representatives contacted all owners or operators of catcher vessels in the fleet to provide a voluntary estimate of how long they have been using excluders, and whether they are in use at all times during the A and B seasons. Based on this inquiry, 100% of owners and operators confirmed that they have been using excluders for many years, some as far back as 2008. They confirmed their continuous usage in both A and B season in 2012 and 2013. However given the lack of specific records respondents were uncomfortable estimating a relative percentage of usage on a tow-by-tow basis. They did note that the only instances were excluders were not in use were isolated incidences to verify the effectiveness of their pollock catch and verification of proper installation. Rare cases were noted when a spare net was used absent an excluder while the primary net was being repaired. It was noted by MFC that many owners and operators now have excluders on their spare nets as well.

### 4.3.2 Catcher Processor fleet excluder usage

In April 2013 the Catcher Processor sector provided and overview of excluder use within their sector in conjunction with the CP IPA report to the Council. The frequency with which excluders were used during the 2012 fishery was reported. Figure 15 shows the frequency report included in that document (need ref for CP IPA report) broken out by A and B season, with B-season broken out by early) June through August) and late (September and October) time frames. It appears that use of excluders is slightly more prevalent in the A-season for this sector than the B-season and within the B-season higher usage in the early compared to the latter part of the season.

The CP IPA report notes that while improved escapements of Chinook on the order of 20-40% have been measured in experimental trials, it is nevertheless possible for pollock to escape the trawl, especially during periods when the trawl is short-wired. This was cited in that report as a reason why some vessel captains remain reluctant to exclusively deploy excluder devices particularly when there is 'evidence that that Chinook abundance on the grounds is very low". They further note that in 2013 CP IPA vessels will begin a program to confirm low pollock escapement during haul-back using video observations which may help to promote increased use of excluder devices in the CP fleet. Information is not provided on a tow-by-tow basis.

[2] Letter to C. Oliver from J. Bersch, Mothership Fleet Cooperative. This letter will be included in briefing books for the October Council meeting.

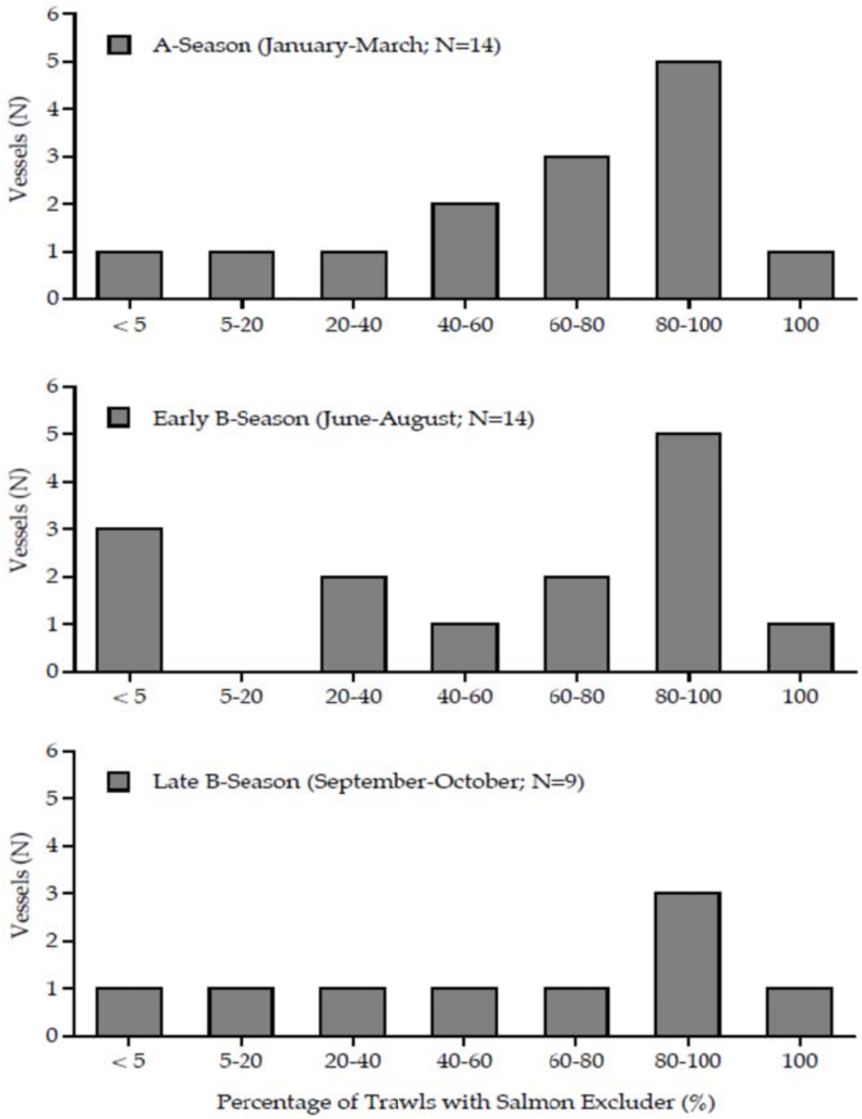



Figure 15. Frequency of IPA Chinook excluder use 2012.

### 4.3.3 Inshore catcher vessel excluder usage

In order to best respond to the request of the Council, the Inshore catcher vessel sector initiated a survey of all captains to request information on their relative excluder usage from 2010 through 2013 (A-season only). Results from the survey are shown in Table 19. The survey was designed to provide an estimate of the number of actual tows made with an excluder by season. Due to the difficulty in estimation after the fact and the discomfort with providing a hard number absent any records to back that up, operators were asked to provide details on a relative scale of 4 response categories. These categories were the following: "all tows", "almost all tows", "more than half", "about half of tows" and "occasionally". This survey is by necessity qualitative and as with the results from other sectors should be understood to be carefully caveated in the context of a voluntary estimation without records upon which to verify. However it does, nonetheless, provide a general trend of both increased number of vessels using excluders for some of their tows in both seasons as well as increasing excluder usage by tow, particularly in the A-season.

Table 19. AFA Inshore Sector Catcher Vessel Salmon Excluder Use Summary - 2010 A Season through 2013 A Season

| Number of Vessels That Fished | Number of Vessels That Used an Excluder | Vessels' Estimated Number of Tows Made with Excluder | Number of Vessels That Fished | Number of Vessels That Used an Excluder | Vessels' Estimated Number of Tows Made with Excluder |
|---|---|---|---|---|---|
| **2010 A Season** | | | **2010 B Season** | | |
| 74 | 44 | 28 All<br>15 Almost All<br>1 About Half | 69 | 41 | 26 All<br>13 Almost All<br>2 Occasionally |
| **2011 A Season** | | | **2011 B Season** | | |
| 69 | 55 | 37 All<br>16 Almost All<br>2 Occasionally | 71 | 56 | 28 All<br>23 Almost All<br>1 More than half<br>1 About Half<br>3 Occasionally |
| **2012 A Season** | | | **2012 B Season** | | |
| 72 | 61 | 40 All<br>16 Almost All<br>2 About Half<br>3 Occasionally | 72 | 60 | 28 All<br>27 Almost All<br>1 More than half<br>3 About Half<br>1 Occasionally |
| **2013 A Season** | | | **2013 B Season** | | |
| 72 | 59 | 40 All<br>16 Almost All<br>2 More Than Half<br>1 About Half | NA | NA | NA |

## 4.4 Additional measures of bycatch performance

Additional information is summarized here to better list of what other sources of information are either currently available or could be requested as well as analyses that will be available in the future. Some combination of these reports may assist the Council in the future in understanding the efficacy of the Chinook PSC management system.

### 4.4.1 Update on the Chinook Economic data report (EDR)

Several pieces of information are being collected annually to help analyze Amendment 91:[3]

- Chinook PSC Compensated Transfer Report (CTR)
- Vessel Fuel usage survey
- Vessel master survey
- By-haul salmon-avoidance/vessel movement checkbox in vessel logbooks

The CTR, fuel, and vessel master surveys are collected as annual reports of data pertaining to the calendar year, to be submitted to NMFS by June 1 of the following year.[4] Vessel movement for each haul is captured for in the daily fishing logbook (DFL) for catcher vessels and in the electronic logbook for CP's and motherships.

[3] The Amendment 91 EDR forms and additional information are available at http://alaskafisheries.noaa.gov/sustainablefisheries/bycatch/salmon/chinook/edr/default.htm.
[4] The data are to be submitted electronically through an online reporting portal at http://www.psmfc.org/chinookedr/.

#### 4.4.1.1 *Planned timeline for EDR analysis*

All data collection for the 2012 fishing year has been completed and data is being prepared for validation and analysis. An administrative report on the data collection, describing the timeline of the data collection process, compliance, data validation results, and a summary of the reported data is in preparation and is expected to be complete by end of this year.

The fuel usage and vessel master survey will provide a considerable amount of data and are being organized and integrated with other fishing data to support analysis of fishing behavior and costs of Amendment 91 on the pollock fishery. AFSC intends to complete this analysis by early 2014. In future years, the EDR will be summarized and the results will be utilized in future salmon bycatch analyses. An important result of the EDR data collection was that compensated transfers were reported for 2012, and a minimal number of vessel moves have been reported via the logbook checkbox. AFSC staff have held several informal meetings and discussions with AFA members regarding the EDR and indicate that the survey design of the CTR and logbook checkbox may require substantial revisions to effectively capture the information the Council intended. Data quality and survey design issues will be addressed in the administrative report being prepared.

### 4.4.2 Chum salmon PSC management measures environmental analysis (EA)

In December 2012 the Council reviewed the Chum salmon PSC management measures EA and elected to postpone any further action on that analysis at that time. The Council moved at that time to request that industry provide proposals for including chum salmon in the existing sector-specific IPAs for discussion at the October 2013 Council meeting. In conjunction with the Chum EA however, staff made some suggestions regarding reporting requirements that could be included in a revised RHS program for chum and/or add to the ability to evaluate the efficacy of the Chinook measures. These suggestions are excerpted below as they may be relevant to discussions of evaluating the Chinook salmon PSC management program efficacy as well as assist in the discussion of appropriate measures for chum salmon PSC at this time.

#### 4.4.2.1 *Reporting requirements and analytical suggestions (excerpt of Section 2.6.5.3 of Chum Salmon PSC management measures EA, December 2012 draft)*

The main rationale for these specific reporting requirements is to provide transparency to the activities that actively affect fishing patterns and industry management of the RHS program. Following this, a list of additional information and analyses which could be requested of staff (Agency or Council or otherwise) is provided to indicate what additional information could be provided annually or periodically in order to best evaluate the efficacy of the program. The industry-requested reporting requirements can be derived from data SeaState currently uses for their in-season program. Reporting this information annually (or in-season as noted in the table) is meant to provide the Council and the public with information on the management and efficacy of the program and will complement additional analyses by staff. No additional data collection is envisioned.

Table 20. Suggested reporting requirements in conjunction with selection of a RHS-based management program. 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. |

Details on these numbered items are as follows:

1. Chinook closures under IPAs: This information is not required under the reporting requirements for Amendment 91. However, understanding the areas and frequency of closures for Chinook would allow for a better understanding of the constraints already imposed on the fleet outside of the measures proposed for chum salmon PSC management. This information is available through the IPA representatives but would require an agreement from each IPA to make this publicly available in conjunction with these reporting requirements. This information could be reported on an annual basis in the annual report to provide broader transparency of management, or in-season (as well) in order to better inform the fleet itself in-season as to high bycatch areas of which they may not yet be aware. Not all closures under IPAs are shared between sectors currently.
2. Date and area Chinook threshold invoked: Detailed information on when the chum closures are suspended and based on what Chinook data (area, time period of calculation, etc.). This would be provided in the annual report. For greater transparency to the public it could be provided in-season.
3. Sea State summary of closure decision-making: collect data from SeaState that would provide additional information on why an area was closed and allow greater transparency about what information is being used which would also allow improved future analysis of when closures are most effective.
4. Continue publication of any chum RHS reports sent to the pollock fleet: when Amendment 91 was implemented, RHS agreements became private and NMFS, the Council, and the public no longer view when RHS were put in place. This requirement will ensure that chum RHS reports continued to be available at the time that closures are implemented.
5. Advisory closure listings: Often the RHS provides additional information to participants on areas which do not qualify as a closure based on criteria but are still potential hot spots that some participants may wish to avoid voluntarily. Currently there are no provisions for test fishing in RHS closures however the revised program under Alternatives 3 and 4 does provide a test-fishing provision associated with modified tier structure in June and July. Some measure of fishing in

those closure areas as well as any information available from vessels fishing in advisory areas would be beneficial in examining the efficacy of these voluntary methods of bycatch avoidance.

6. This item was suggested by NMFS RO staff as a means to better consolidate reporting requirements for salmon PSC by the fleet. Developing the details for this option is incomplete but could happen at the Council request for inclusion in a public review draft.

Table 21. Additional information that could be compiled and analyzed by Agency or Council staff analysts in conjunction with Table 20information provided by industry for evaluating the efficacy of the selected RHS-based management program

| | Requirement | Rationale for requirement | Details and frequency |
|---|---|---|---|
| 1 | Cumulative catch statistics by ADFG area for pollock, chum and Chinook | Allows for comparison with historical data, greater transparency for effectiveness of closures | Data used weekly by SeaState to manage closures in-season |
| 2 | Relative ranking of bycatch rates for chum and Chinook by vessel | Measure of performance of incentives to reduce bycatch | Show distribution of rankings over vessels (no vessel identification) |
| 3 | CPUE, fuel cost, travel time | Measure of search time for fishing opportunities | Fuel costs from EDR in 2012, distance traveled from VMS |
| 4 | Index of salmon impact by species | Relative change in bycatch rates of affected vessels | *See below |
| 5 | Summary of % of pollock, chum, and Chinook in closure areas prior to Closure | The larger % of chum is in an area, the more likely the closure will be effective. This reveals whether the RHS closures are capturing much of the effort and salmon PSC | Ideally as part of each report, but if this is infeasible this information could be summarized post-season |

Descriptions of these numbered items are as follows:

1. Cumulative catch statistics by ADFG area for pollock, chum and Chinook: The rationale for this requirement is to provide the data that is currently used weekly by SeaState to manage in-season closures in order to allow for transparent evaluation of the actions taken to delineate a closure and for comparison with similar data available historically. These data are easily available from the Observer Program thus requiring this of industry as opposed to tasking staff to compile annually is one negative to this requirement.
2. Relative ranking of bycatch rates for chum and Chinook by vessel: The rationale for this requirement is to give some vessel-level performance comparison under the new management regime to evaluate to what extent the incentives of fishing under the program are effective. The distribution of ranking of vessels within and across years would provide the Council with information in order to assess the performance of the program. Some of the difficulties that would need to be addressed in including this requirement would be issues related to not identifying vessels by name, for including a caveat that there are complications with evaluating vessel trends due to multiple changes in operator and ownership.
3. Data on CPUE, fuel cost, travel time: Providing data on these items will allow for an assessment of the fishing search time undergone in operation under the new management program. Fuel cost data will become available from the Chinook EDR starting in 2012 while estimates of distance traveled could be made available using VMS data and the Catch-in-Areas-database.
4. Index of salmon by species: Some method of accounting for salmon PSC reduction by virtue of the imposed RHS closures should be annually reported. There are multiple methods by which this calculation could be done, understanding that the variability between years may affect the reliability of this calculation. Examples of calculating this index are shown below:
   a. <u>Index of total salmon impact</u>

i. Examines the degree to which there is a measurable average (and/or median) impact on bycatch rates in the period following closures compared to the period before the actual closures.
ii. This follows the work done in the status quo analysis to estimate the observed savings from the closures.
iii. Because there are periods of rising and declining bycatch during given years, this will be most informative over longer time-frames (annual or multi-year) rather than determining whether or not a particular closure is effective.
iv. Other measures of annual impact will be researched and utilized as available.

b. Index of salmon reduction by species for affected vessels:
Use a simple formula which would provide a relative index of salmon savings. E.g., use the rate at the time of closure, the proportion of pollock that occurred in the closed area in that week (or specified time period), and use the "diverted pollock" to come up with an index that can be computed going forward and historically. E.g., let *C*

$$\hat{C}_{in} = p_{prior} C_{out}$$
$$\hat{S}_{in} = r_{in} \hat{C}_{in}$$
$$\hat{S}_{out} = r_{out} \hat{C}_{in}$$
$$S_{saved} = \hat{S}_{in} - \hat{S}_{out}$$

where $\hat{C}_{in}$ is estimated pollock catch that would have occurred inside closed area given the proportion ( $p_{prior}$ ) of the pollock that occurred inside the closure prior to the closure and $\hat{S}_{in}$ is the estimated salmon that would have been caught inside the closure given the observed rate $r_{in}$ and estimated pollock) etc.

It's important to note that there are limitations to the method because it is not necessarily a causal relationship. If where and when bycatch occurs is random and areas of high bycatch are identified every period, vessels in the high-bycatch area before the closure will be average in the second (because bycatch is random), and this method would estimate a large salmon savings that would not actually be due the closures. However, bycatch is not completely random, and thus this may potentially provide a useful index from year to year, although the specific numbers should be viewed with caution.

5. Summary of % of pollock, chum, and Chinook in closure areas prior to Closure: similar to the information presented in the status quo analysis, a summary of pollock and PSC occurring in the area prior to the closure would be presented. If feasible, this information could be presented with all reports or alternatively at the end of the season. The following information could be included, reported by sector:
    a. % of pollock hauls and catch inside each closure
    b. % and number of chum and Chinook PSC occurring inside each closure.
    c. Number and % of vessels that fished in each closure.

# 5 Summary and Considerations for Council in October

The Council requested this report in April 2013 after receiving their second annual report from the IPAs on performance of the Chinook salmon PSC management program enacted in 2011. The Council's primary motivation in requesting this report (as well as the separate reports from the IPAs on their incentive mechanisms) was to consider bycatch management performance measures in the context of the ongoing interest and actions in front of the Council to minimize salmon bycatch and to have the opportunity to evaluate this issue with updated information on directed salmon fisheries and with the most recent genetic information, AEQ analysis and examination of individual vessel performance. Information included in this report provides both an update of what was previously available to the Council at final action in 2009 for Amendment 91 as well as information and analyses that were not available in the 2009 analysis. The latter includes calculated AEQ impact rates by stock grouping at current levels and cap levels, vessel-specific bycatch comparison, and voluntary excluder usage.

Results indicate that overall AEQ has declined considerably from the peak value in 2007. Furthermore, the estimated impact rates to western Alaska have declined in recent years from peaks in 2008 (for CWAK) and 2010 (for Upper Yukon). The regulatory caps that are in place, assuming they could have been reached by the fishery in 2011 and 2012, would have resulted in lower impacts to both CWAK and Upper Yukon than what was estimated for those peak values. The extent that the impact rate has decreased due to measures such as these or due to fishing conditions (e.g., changes in the TAC, overlap of Chinook salmon distribution relative to the pollock fishery, and the concentrations (CPUE) of pollock) is unclear.

The updated genetics sampling has succeeded in improving the precision of the stock composition estimates but remains limited for resolving fine-scale stock separation issues. Should finer scale stock identification become available, estimates of the number of Chinook salmon returning at the same resolution would be employed to better evaluate fishery impacts. Currently aggregate impacts only can be estimated for western Alaska at the resolution of coastal western Alaska and Upper Yukon. Using these recent genetic data results in estimated AEQ to coastal western Alaska that is similar to previous estimates (considered by the Council in 2009). However, the estimated AEQ attributed to the Upper Yukon is higher than previously estimated.

Overall, the pollock fleet bycatch rate (in Chinook salmon per t of pollock) has declined annually while some sectors continue to have disproportionately higher rates in some months. Examinations of individual vessel performance, to the extent this was possible given confidentiality issues, suggests that some vessels are improving their within-fleet rank by lowering their bycatch rates. However, there are still indications that there is some consistency in the worst bycatch vessels across all years. These results were variable. The use of salmon excluders has also increased in recent years both in the number of boats that are outfitted with them and in the regularity with which they are used. More explicit reporting requirements would facilitate estimation of excluder usage.

Considerations for Council: This report is intended as a way for the Council to monitor progress towards their objectives and to begin evaluating the effectiveness of the new measures. Whereas it is premature to make broad conclusions after only two years of data on the program, the results clearly indicate that things are moving in a positive direction. The Council will receive this report at the October meeting in conjunction with the Advisory Panel report and public testimony. They will consider at that time what the appropriate next steps may be and have the discretion to request additional information (e.g., via a discussion paper) or to initiate an action (via an amendment analysis) at any time.

# 6 References

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