INITIAL REVIEW DRAFT

**Environmental Assessment/ Regulatory Impact Review/
Initial Regulatory Flexibility Analysis
for Proposed Amendment
to the Fishery Management Plan for
Groundfish of the Gulf of Alaska**

Chinook Salmon Prohibited Species Catch in the Gulf of Alaska Non-Pollock Trawl Fisheries

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Abstract: This document analyzes proposed management measures that would apply to all trawl fishing by catcher vessels (CV) in the groundfish fisheries of the Central and Western Gulf of Alaska (GOA), except the directed pollock fishery. Trawl fishing in the GOA is limited by prohibited species catch (PSC) of Chinook salmon (*Oncorhynchus tshawytscha*). PSC limits cap the amount of Chinook salmon that can be taken in the trawl fishery (or a sector of the fishery); directed fishing with trawl gear is closed if that limit is met. The action alternatives under consideration would modify the existing Chinook salmon PSC limits for non-pollock trawl CVs, and CVs fishing under the authority of a Central GOA Rockfish Program cooperative quota permit. Depending on the options selected, the modification could be in the form of either a PSC limit increase or additional flexibility in the form of year-to-year rollovers of unused PSC. Implementation of the management measures evaluated in this analysis would require an amendment to the Fishery Management Plan for Groundfish of the Gulf of Alaska (GOA Groundfish FMP), as well as amendments to implementing regulations.

List of Acronyms and Abbreviations

AAC	Alaska Administrative Code
ABC	acceptable biological catch
ADF&G	Alaska Department of Fish and Game
AEQ	adult equivalent
AFA	American Fisheries Act
AFSC	Alaska Fisheries Science Center
AGDB	Alaska Groundfish Data Bank
AKFIN	Alaska Fisheries Information Network
ANILCA	Alaska National Interest Lands Conservation Act
BASIS	Bering Sea-Aleutian Salmon International Survey
BEG	biological escapement goal
BOF	Board of Fish
BSAI	Bering Sea and Aleutian Islands
CAS	Catch Accounting System
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
COAR	Commercial Operators Annual Report
Council	North Pacific Fishery Management Council
CP	catcher/processor
CV	catcher vessel
CWT	coded-wire tag
DPS	distinct population segment
E	East
E.O.	Executive Order
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESU	endangered species unit
FMA	Fisheries Monitoring and Analysis
FMP	fishery management plan
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FRFA	Final Regulatory Flexibility Analysis
ft	foot or feet
GHL	guideline harvest level
GOA	Gulf of Alaska
ID	Identification
IRFA	Initial Regulatory Flexibility Analysis
IPA	Incentive Plan Agreement
IQF	individually quick frozen
JAM	jeopardy or adverse modification
lb(s)	pound(s)
LEI	long-term effect index
LLP	license limitation program
LOA	length overall
m	meter or meters
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MMPA	Marine Mammal Protection Act
MSST	minimum stock size threshold
t	tonne, or metric ton
NAICS	North American Industry Classification System
NAO	NOAA Administrative Order
NEPA	National Environmental Policy Act
NMFS	National Marine Fishery Service
NOAA	National Oceanic and Atmospheric Administration
NPAFC	North Pacific Anadromous Fish Commission
NPFMC	North Pacific Fishery Management Council
NPPSD	North Pacific Pelagic Seabird Database
Observer Program	North Pacific Groundfish and Halibut Observer Program
OEG	optimal escapement goal
OMB	Office of Management and Budget
PBR	potential biological removal
PSC	prohibited species catch
PPA	Preliminary preferred alternative
PRA	Paperwork Reduction Act
PSEIS	Programmatic Supplemental Environmental Impact Statement
PWS	Prince William Sound
RFA	Regulatory Flexibility Act
RFFA	reasonably foreseeable future action
RIR	Regulatory Impact Review
RPA	reasonable and prudent alternative
RSW	refrigerated seawater
SAFE	Stock Assessment and Fishery Evaluation
SAR	stock assessment report
SBA	Small Business Act
Secretary	Secretary of Commerce
SEG	sustainable escapement goal
SET	sustainable escapement threshold
SNP	single nucleotide polymorphism
SPLASH	Structure of Populations, Levels of Abundance, and Status of Humpbacks
SRKW	Southern Resident killer whales
SSFP	Sustainable Salmon Fisheries Policy
SW	southwest
TAC	total allowable catch
U.S.	United States
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
VMS	vessel monitoring system
W	West

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Executive Summary

This document analyzes proposed management measures that would apply to all trawl fishing by catcher vessels (CV) in the groundfish fisheries of the Central and Western Gulf of Alaska (GOA), except the directed pollock fishery. Trawl fishing in the GOA is limited by prohibited species catch (PSC) of Chinook salmon (*Oncorhynchus tshawytscha*). PSC limits cap the amount of Chinook salmon that can be taken in the trawl fishery (or a sector of the fishery); directed fishing with trawl gear is closed if that limit is met. The action alternatives under consideration would modify the existing Chinook salmon PSC limits for non-pollock trawl CVs, and CVs fishing under the authority of a Central GOA Rockfish Program cooperative quota permit. Depending on the options selected, the modification could be in the form of either a PSC limit increase or additional flexibility in the form of year-to-year rollovers of unused PSC. Implementation of the management measures evaluated in this analysis would require an amendment to the Fishery Management Plan for Groundfish of the Gulf of Alaska (GOA Groundfish FMP), as well as amendments to implementing regulations.

Purpose and Need

The Magnuson-Stevens Act (MSA) National Standards require, among other factors, that the Council to balance the objectives of achieving optimum yield, minimizing bycatch, and minimizing adverse impacts on fishery-dependent communities. Chinook salmon PSC taken in GOA trawl fisheries is a resource concern, and the Council has taken action to set hard cap PSC limits that are below the incidental take amount that would trigger reconsultation under the Endangered Species Act (ESA). Attainment of a PSC hard cap closes the trawl fishery. Since the 2015 implementation of Chinook salmon PSC limits for the GOA non-pollock groundfish trawl CV sector, the fishery has continued to display variable levels and unpredictable timing of salmon encounter. Potential closures and PSC encounter rates that vary from year-to-year or even week-to-week create uncertainty for fishery participants, which in turn can make business planning more difficult or directly lead to forgone harvest opportunities. Those outcomes adversely affect trawl harvesters, crew, processors, and GOA coastal communities.

Relative to what was available when the Council established the PSC limits, new information about the resource and the fishery's rate of salmon encounter has been gathered from salmon genetic identification studies and the expansion of observer sampling onto smaller trawl vessels. Meanwhile, the non-Rockfish Program GOA trawl fisheries continue to operate under a limited access management structure where harvesters must compete for a share of the available catch without formalized cooperative tools to best minimize and utilize PSC.

The proposed action would consider increasing Chinook salmon PSC limits and establishing an annual rollover of unused Chinook salmon PSC for the GOA non-pollock non-Rockfish Program trawl CV sector and/or the Central GOA Rockfish Program CV sector. Alternatives to increase PSC limits or provide more flexibility under the existing PSC limits are offered in light of new information and multiple years of experience fishing under constraining hard caps for these fisheries with variable and unpredictable PSC rates. The action would not modify PSC rollovers from the Rockfish Program CV sector to the limited access CV sector, and NMFS's ability to make in-season Chinook salmon PSC limit reapportionments between certain trawl sectors. The action seeks to find the most appropriate PSC limits or flexibility within the existing PSC limits for these fisheries by providing a margin that accommodates expected high variability, while remaining within previously established outer bounds for annual GOA-wide PSC levels that are not expected to jeopardize the Chinook salmon resource.

Notable Additions Since the Previous Draft

The Council, SSC, and AP reviewed a previous version of this document at their February 2018 meeting. The following list highlights areas of the document where substantial changes were made in response to Council requests, AP comments, and the SSC's minutes. Additional minor changes have been made throughout the document.

- The Council added an Option 4 to both Alternatives 2 and 3. Whereas Options 1 through 3 represent increases to a sector's annual base PSC limit, Option 4 offers a potential rollover of unused Chinook salmon PSC from one year to the next. The mechanics of Option 4 are described in Section 2. The potential impacts of selecting Option 4 under either action alternative are woven into the discussion provided in the EA and the RIR. The general nature of the impact is similar to those represented by an increase to the base PSC limit but would not necessarily be experienced in every year.
- Section 3.3.3 is expanded to include observer data on Chinook PSC size at capture, the best available information on the correlation between size and age, correlations between GOA Chinook salmon abundance and trawl fishery PSC levels, and example applications of models from other Alaska fisheries that link fishing removals to Chinook salmon spawning potential (AEQ models).
- Section 3.3.4 includes information from the most recent reports on stock of origin identification (genetic and mark/capture studies). The studies' authors note that sampling levels have reached the point at which region-of-origin identifications from the sample set can be presumed to reflect the distribution of the total population of Chinook salmon that are taken as PSC in GOA trawl fisheries.
- Section 3.3.5 is revised to provide greater detail on Stock of Concern designations for Alaska management areas, as well as management measures that have been enacted to protect lower-escapement runs. Additional information on British Columbia and U.S. west coast stocks is provided in an addendum posted under Agenda Item C-6 to the NPFMC's April 2018 Agenda.[1]
- Section 3.3.7 has been updated to include more recent years of information from the North Pacific Anadromous Fish Commission.
- Section 3.4 has been updated to include more recent information on Southern Resident Killer Whales in Puget Sound, and the interaction between their stock status and the management of Chinook salmon in that region.
- Section 4.5.1 has been revised to include additional detail on PSC estimation procedures and a discussion of the sources in estimation variance over short time-scales (within-season) and longer time-scales (year-to-year).
- Section 4.5.2.4 includes additional information to describe the relative dependency of GOA trawl vessels on different commercial fisheries. Table 71 complements the annual fleetwide tables by showing the fleet as quintiles based on revenues earned in the GOA non-pollock trawl fishery. The section also includes new information on trawl vessels' revenues derived from the commercial catch of salmon species (non-trawl fisheries).
- Section 4.6 is updated with more granular data on commercial catch and value of Chinook salmon by region and by gear type. The section also includes new information about the distribution of commercial salmon permits and their value. Summaries of non-commercial Chinook salmon fisheries have been updated based on the most recent available reports from ADF&G.

[1] http://legistar2.granicus.com/npfmc/meetings/2018/4/977_A_North_Pacific_Council_18-04-02_Meeting_Agenda.pdf

Alternatives

Alternative 1: No action

Alternative 2: Modify the Chinook salmon PSC limit for the GOA non-pollock non-Rockfish Program CV sector by:

- Option 1: 1,000 fish
- Option 2: 2,000 fish
- Option 3: 3,000 fish
- Option 4: Replace the performance standard/incentive buffer with an annual rollover of any unused Chinook salmon PSC in this sector. NMFS will determine the amount of unused Chinook salmon PSC based on the amount used in the sector relative to the base limit of 2,700 fish. The maximum amount of Chinook salmon PSC that may be rolled over cannot exceed:
  - Suboption 1: 675 fish (25% of the limit of 2,700 fish)
  - Suboption 2: 1,350 fish (50% of the limit of 2,700 fish)
  - Suboption 3: 2,025 fish (75% of the limit of 2,700 fish)

  Under Option 4, in any year the total amount of Chinook salmon PSC available cannot exceed the base limit plus the amount in the suboption selected.

Alternative 3: Modify the Chinook salmon PSC limit for the Central GOA Rockfish Program CV sector by:

- Option 1: 300 fish
- Option 2: 600 fish
- Option 3: 900 fish
- Option 4: Allow an annual rollover of any unused Chinook salmon PSC in this sector. NMFS will determine the amount of unused Chinook salmon PSC based on the amount used in the sector relative to the base limit of 1,200 fish. The maximum amount of Chinook salmon PSC that may be rolled over cannot exceed:
  - Suboption 1: 300 fish (25% of the limit of 1,200 fish)
  - Suboption 2: 600 fish (50% of the limit of 1,200 fish)
  - Suboption 3: 900 fish (75% of the limit of 1,200 fish)

  Under Option 4, in any year the total amount of Chinook salmon PSC available cannot exceed the base limit plus the amount in the suboption selected.

The Council may select either Alternative 2 or 3 or may select both in combination. The Council did not specify whether increasing the base PSC limit for the non-pollock non-Rockfish Program CV sector would affect the performance standard and resulting incentive buffer (Alternative 2, Options 1 through 3), or whether additional PSC that is available to the Rockfish Program CV sector would be available for the October 1 "rollover" of unused PSC to the non-Rockfish Program CV sector (Alternative 3, Options 1 through 4). The Council may also wish to clarify whether the cap on inseason reallocations of Chinook PSC between GOA trawl sectors (GOA Amendment 103) will increase in proportion to any higher effective annual limit that results from Options 1 through 4 of Alternative 2 and/or Alternative 3.

Table ES-1 shows the maximum amount of Chinook salmon PSC that could be taken under Alternative 2 during a single year across all GOA trawl fisheries, including the pollock fishery and the non-pollock CV sector. If the Council also selects Alternative 3, the overall PSC limit could increase by up to 900 Chinook. The highest possible Chinook salmon PSC limit for a single year would 37,640. That amount could be reached under the combination of Alternative 2 Option 3 with either Alternative 3 Option 3 or Alternative 3 Option 4 (36,740 + 900).

Table ES-1 Maximum annual GOA trawl Chinook salmon PSC under Alternative 2

	No action	Option 1	Option 2	Option 3	Option 4
Base PSC Limits	32,500	33,500	34,500	35,500	32,500
Base + Non-RP CV Incentive Buffer (Table 2) + CP Incentive Buffer (480)	33,340	34,473	35,607	36,740	--
Base + CP Incentive Buffer (480) + Maximum inter-annual rollover (2,025)	--	--	--	--	35,005

RP = Central GOA Rockfish Program; CP = GOA catcher/processor sector

Environmental Assessment

Groundfish

Under the status quo, groundfish stocks are neither overfished nor approaching an overfished condition. Increased PSC limits are not likely to increase fishing pressure. Even if there is a redistribution of effort to avoid Chinook salmon, the fishery will likely remain within the established footprint of the non-pollock trawl fishing grounds. The choice of a lower hard cap option may result in the fishery closing before the TACs are reached, while a higher hard cap would allow for groundfish fishing at current levels, and impacts would likely be similar to the status quo fishery. If the groundfish TACs are not fully harvested, fishing will have less impact on the stocks, and there will be no adverse impact on the groundfish stocks from the fishery. Any changes in fishing patterns that may result from the alternatives, however, would be monitored and updated in future stock assessments.

Chinook salmon

The non-pollock trawl fisheries have an adverse impact on Chinook salmon through direct mortality due to PSC. Under the status quo, the annual hard cap PSC limit for the Western and Central GOA non-pollock trawl fishery is 7,500 Chinook salmon. Chinook salmon are a prohibited species, and it is incumbent upon fishermen to avoid catching Chinook salmon. From 2003 through 2017, the average PSC for the non-pollock trawl fisheries was 5,572 Chinook salmon. In 2017, the non-pollock trawl fishery recorded 3,408 Chinook salmon PSC. The years with the highest Chinook salmon PSC during this time period were 2003, 2010, and 2017 with catches of 10,967, 9,853, and 10,389 Chinook salmon, respectively (NMFS Alaska Region Catch Accounting System, January 2018).

Since 2007, there have been poor or below average Chinook salmon runs in Alaska. Implementation of strict fishery management actions has been necessary to meet escapement objectives, and some fisheries have been curtailed to protect Chinook salmon. These restrictions have resulted in forgone subsistence, personal use, sport, and commercial fishing opportunity resulting in negative effects to coastal and interior Alaska communities. There are currently 66 stock-specific Chinook salmon escapement goals. In 2017, 49% of the Chinook salmon escapement goals were met or exceeded statewide. This is a decrease from 54% in 2016 and second year of decline since an increasing trend between 2012 and 2015.

Relating Chinook salmon PSC levels to broader GOA Chinook abundance is complicated. Data suggest that non-pollock trawl fisheries might catch more Chinook the year before the Pacific Salmon Commission estimates a high abundance index. It is understood that increasing PSC limits could increase the potential to impact salmon stocks in the aggregate. However, there is no evidence to indicate whether the groundfish fishery's take of Chinook salmon is, or is not, causing escapement failures in Alaska rivers.

While it is not possible to assess the effect on individual Chinook salmon stocks that are taken as PSC in the GOA non-pollock trawl fisheries, this document develops general conclusions for the considered action. If Chinook salmon PSC is higher in some years as a result of this action, Chinook salmon stocks as well as the harvesters and consumers of Chinook salmon would be negatively affected relative to the No Action alternative (Alternative 1). While the relative abundance of specific Chinook salmon stocks in the GOA trawl fishery areas is not known, the analysis utilizes available stock of origin identification data that can be generalized to describe the population of Chinook that are taken as PSC. In recent years, when genetic and tagging data have been sufficient to draw conclusions, the Chinook taken in the trawl fishery have shown roughly the following regional breakdown: 40% British Columbia, 40% U.S. west coast, 15% Southeast Alaska, and 5% northwest GOA. Fewer than 1% of GOA trawl Chinook PSC originated in western Alaska rivers or trans-Pacific regions. However, available data do not allow the analysts to identify Chinook PSC to the level of river of origin, so impacts on individual stocks are undetermined. The analysis provides examples of how adult equivalents (AEQ) models have been employed in other Alaska commercial fisheries to determine the effect of catch and bycatch on Chinook salmon spawning potential. The effect of a PSC removal on spawning potential is less than 1:1 because not all salmon taken as bycatch would necessarily have returned to spawn in their natal streams. Fully developed AEQ models require robust data on Chinook age-at-capture, river-level stock of origin identification, and in-river age-at-maturity; this information is not available for the GOA trawl fishery. Nevertheless, this analysis draws on example models from Southeast Alaska salmon fisheries and the Bering Sea pollock trawl fishery to illustrate a range of likely AEQ model outcomes. The results suggest that between 65% and 85% of Chinook salmon taken as PSC would have otherwise survived to reproduce.

The options under Alternatives 2 and 3 could increase the upper limit on Chinook salmon PSC in the GOA non-pollock trawl fisheries in the Western and Central GOA. The PSC limit could be modified by a direct increase to the base annual limit, or by allowing year-to-year rollovers of unused PSC. The latter option (Option 4 to both Alternatives 2 and 3) might not result in a higher limit in every year. If the attainment of the PSC limit appears to be imminent, the non-pollock trawl fleet may be active in making efforts to avoid high PSC rates, in order to preserve the opportunity to fully harvest the groundfish TACs. The extent and nature of any effort redistribution is difficult to predict and would depend not only on the distribution of Chinook salmon PSC rates on the fishing grounds but also participants' flexibility to alter their temporal and spatial fishing behavior. It is possible that shifting the spatial or temporal distribution of the non-pollock trawl fisheries may impact some particular Chinook salmon stocks more than others, but such impacts are not currently possible to assess.

Under Alternatives 2 and 3, Chinook salmon PSC may increase slightly from the status quo. Any impact to the Chinook salmon stocks as a whole is likely to represent either no change from the status quo or to cause minor impact, as PSC levels either remain the same or are slightly increased. None of the options considered under Alternatives 2 or 3 are anticipated to have a significant adverse impact on Chinook salmon stocks.

Other Resource Components

Under the status quo, marine mammal and seabird disturbance and incidental take are at low levels and are mitigated by seasonal and spatial restrictions on the GOA non-pollock trawl fisheries. Under the alternatives, disturbance or incidental take is not expected to increase to a level that would result in population level effects on marine mammals or seabirds. In years where the PSC limit constrains fishing, the chosen limit may reduce the potential effects of the fishery on prey availability. If the fleet spends longer time fishing in areas with lower catch rates to avoid salmon, there may be some increase to benthic habitat impacts and potential removals of marine mammal and seabird prey. However, this increase is unlikely to result in population level effects.

Previous analyses have found no substantial adverse effects to habitat in the GOA caused by fishing activities (NMFS 2005; NPFMC and NMFS 2017). A more constraining hard cap may reduce any effects on habitat that are occurring under the status quo; however, any effects continue to be limited by the amount of the groundfish TACs and by the existing habitat conservation and protection measures. Overall, the combination of the direct, indirect, and cumulative effects on habitat complexity for both living and non-living substrates, benthic biodiversity, and habitat suitability is not likely to be significant under either alternative.

Regulatory Impact Review

Alternative 1

Selecting the No Action alternative would maintain status quo Chinook salmon PSC limits for GOA non-pollock trawl CV fisheries. The RIR considers the impact of the existing Chinook PSC limits on social and economic benefits across GOA non-pollock trawl CV harvesters, processors, and communities, as well as the Chinook salmon resource and its users. The status quo PSC limits were established in the preferred alternative for GOA Groundfish FMP Amendment 97 (NPFMC 2014). As such, the broad effects of selecting Alternative 1 are similar in nature to the effects described in that analysis.

The most obvious effect of a PSC limit on the GOA non-pollock trawl CV sector is the potential to close a fishery prematurely. An early closure affects vessel revenues and crew compensation in a manner that reverberates throughout stakeholder communities. Hard cap PSC limits are a blunt tool in terms of incentivizing participants to minimize Chinook salmon PSC at all times in the context of a competitive limited access fishery, where actions to avoid salmon – such as standing down, relocating, or employing a net excluder device – are individually costly but benefit the fleet as a whole by decreasing the likelihood of a closure. The Council has set PSC hard caps with dual-objectives in mind: preventing PSC from exceeding established conservation goals and supporting the regulated fishery and its dependent stakeholders at historic levels of participation. In selecting the status quo PSC limit for the fisheries affected by this action, the Council intended to select a limit that supported the non-pollock trawl sector's historical PSC use over an average of years but did not select a level that covered the highest PSC years in order to incentivize bycatch minimization. The purpose and need for this action notes that new information from observer coverage that was not available when the Council took action on Amendment 97 might indicate that estimated Chinook PSC for a segment of the fishery was lower than the actual rate that supported historical harvest levels. Though it is not possible to retrospectively prove or disprove that smaller trawl vessels had been encountering more Chinook salmon than was estimated based on PSC rates extrapolated from larger Western and Central GOA trawl CVs, the marked increase in maximum estimated Chinook PSC for that sector post-restructuring warrants consideration.

Retrospective analysis of annual harvest and PSC distribution throughout the years since the hard cap was implemented and the observer program was restructured suggest that a PSC closure is not expected before the end of March. This means that direct harvest and revenue impacts on the non-pollock fishery would not occur in the Western GOA non-pollock CV sector. The impact of a PSC closure hinges on whether or not the Central GOA Pacific cod B season fishery and the late-year Central GOA flatfish fisheries will remain open. Those fisheries account for roughly 23% of harvest and 24% of ex-vessel revenues in the non-pollock non-Rockfish Program CV fisheries. A closure that occurs in April or May could preclude as much as 60% of average annual harvest and revenue. A closure that occurs during the summer months has a modest marginal impact relative to any other closure that falls after the Pacific cod A season.

The Rockfish Program fishery is fully observed, cooperatively managed, and represents a smaller, more interconnected fleet compared to the GOA limited access non-pollock CVs. Stand-downs or cooperative test-fishing to mitigate unexpectedly high PSC rates are easier to coordinate. The first two months of the Rockfish Program CV season (May/June) account for 72% of the sector's average annual Chinook PSC and 66% of its groundfish harvest by weight. Analysis suggests that it is not impossible for the Rockfish Program CV sector to reach its annual PSC limit of 1,200 Chinook, but it is highly improbable for that to occur early in the season.

In addition to any revenue loss associated with forgone non-pollock groundfish harvest, the processing sector might be impacted vis-à-vis its ability to anticipate the need for and utilization of labor, fixed costs per unit of production, loss of input supply products to value-added processors in other regions, and fulfillment of output supply contracts. One of the greatest impacts of hard cap PSC limits on processors is uncertainty about the amount and/or timing of groundfish deliveries. Processing workers may be impacted by unexpected lost wages during times of year when non-pollock groundfish are the only product moving through Central GOA plants.

Limiting the amount of Chinook salmon PSC taken in non-pollock fisheries provides value to commercial Chinook salmon harvesters and processors, consumers, sport fishermen, charter operators, subsistence users, species that prey upon salmon (including ESA-listed species), and salmon stocks that are protected under the ESA. The economic activity generated by salmon harvesting in commercial and non-commercial sectors creates employment and other socioeconomic benefit multipliers throughout coastal communities. Taking fewer Chinook in the trawl fishery represents a benefit to other users of the resource in aggregate, but the direct effect of a marginal "saved" Chinook salmon cannot be quantified; it is not possible to draw any correlation between levels of PSC and the status of individual salmon stocks. The most recent available data from genetic stock of origin analyses indicates that roughly 80% of the sampled GOA trawl Chinook PSC come from British Columbia and the U.S. west coast; roughly 15% come from Southeast Alaska, and 5% come from Northwest GOA stocks.

Alternative 2

The non-pollock non-Rockfish Program CV sector was apportioned the smallest amount of "head room" in its base PSC limit (2,700) relative to its historical PSC use as analyzed when the Council took action on Amendment 97. PSC estimates for the sector in recent years suggest that the sector's expected annual PSC encounter is even closer to the allotted hard cap of 2,700 Chinook salmon. Since the implementation of Amendment 97 in 2015, the sector has recorded Chinook PSC levels of 2,873, 425, and 2,244. Those widely varying totals, plus the acknowledged risk of a lightning strike PSC event of up to 1,000 estimated Chinook PSC in a week, illustrate the fact that the sector operates in an unstable setting. The analysis considers the possibility that the true probability of a non-Rockfish Program CV closure in any given year is higher than what was assumed when the existing PSC limit was defined; this consideration is based on the coincidence of expanded observer coverage onto smaller Western GOA trawl CVs and increased PSC estimates for that segment of the fleet.

Modifying the sector's base PSC limit would reduce the likelihood of unpredictable closures, providing security to groundfish harvesters, processors, and communities. That security could allow for better business planning, encourage investment in the affected fishery, stabilize the shoreside and at-sea workforce, and reduce uncertainty in an important source of public revenues. The benefits of reducing unpredictability in the frequency and timing of PSC closures are likely to be felt more strongly by stakeholders in the Central GOA fishery, where harvest and revenues continue to accrue later in the calendar when closure is more likely.

The Council should weigh the potential benefits to the trawl sector and its stakeholders against the possibility that higher PSC limits will decrease incentives to avoid Chinook PSC and result in higher bycatch levels relative to the No Action alternative. Chinook salmon provide direct and indirect benefits to a wide range of consumptive and non-consumptive user groups. Actions that increase Chinook removals represent a marginal adverse impact on those stakeholders.

Alternative 3

Historical annual Chinook PSC levels recorded for the Rockfish Program CV sector are expected to be a strong indicator of annual average PSC levels that can be expected in the future. Average Chinook PSC from 2007 through 2017 was 848 fish, ranging from a low of 158 (2016) to a high of 1,802 (2015). The fact that the highest and lowest PSC levels occurred in consecutive years reflects that Chinook PSC is unpredictable and that hard caps should account for expected variability, even in cooperatively managed fisheries with secure groundfish species allocations that remove the incentive to race for fish. The sector recorded Chinook PSC levels higher than the status quo PSC limit in three of the 11 years since the Pilot Program was implemented (2007). Moreover, even in the context of a full observer coverage fishery, lightning strike PSC events have occurred.

The sector operates under a PSC limit that is high relative to its historical average use, and it has the operational advantages conferred by cooperative management. As a result, the most likely impact of increasing the sector's PSC limit is that the probability of a PSC closure will marginally decrease while the expected amount of the October 1 PSC rollover to the non-Rockfish sector will increase. Increasing the expected October 1 rollover to the non-Rockfish CV sector is in accordance with the Council's original intent for apportioning the Rockfish sector with a base PSC limit that exceeded its historical average use; an average of 87% of Rockfish CVs participate in Central GOA Pacific cod and/or flatfish fisheries after October 1 on an annual basis.

Actions that increase the amount of Chinook PSC available for use in a given year entail potential adverse impacts on direct and indirect users of the Chinook salmon resource. The level and distribution of those impacts are not quantifiable with available information.

1 Introduction

This document analyzes proposed management measures that would apply to all trawl fishing by catcher vessels (CV) in the groundfish fisheries of the Central and Western Gulf of Alaska (GOA), except the directed pollock fishery. Trawl fishing in the GOA is limited by prohibited species catch (PSC) of Chinook salmon (*Oncorhynchus tshawytscha*). PSC limits cap the amount of Chinook salmon that can be taken in the trawl fishery (or a sector of the fishery); directed fishing with trawl gear is closed if that limit is met. The action alternatives under consideration would modify the existing Chinook salmon PSC limits for non-pollock trawl CVs, and CVs fishing under the authority of a Central GOA Rockfish Program cooperative quota permit. Implementation of the management measures evaluated in this analysis would require an amendment to the Fishery Management Plan for Groundfish of the Gulf of Alaska (GOA Groundfish FMP), as well as amendments to implementing regulations.

This document is an Environmental Assessment/Regulatory Impact Review. An EA/RIR provides assessments of the environmental impacts of an action and its reasonable alternatives (the EA), and the economic benefits and costs of the action alternatives, as well as their distribution (the RIR). This EA/RIR addresses the statutory requirements of the Magnuson Stevens Fishery Conservation and Management Act, the National Environmental Policy Act, and Presidential Executive Order 12866. An EA/RIR is a standard document produced by the North Pacific Fishery Management Council (Council) and the National Marine Fisheries Service (NMFS) Alaska Region to provide the analytical background for decision-making.

1.1 Purpose and Need

The Council adopted the following purpose and need statement at its February 2018 meeting:

The Magnuson-Stevens Act (MSA) National Standards require, among other factors, that the Council to balance the objectives of achieving optimum yield, minimizing bycatch, and minimizing adverse impacts on fishery-dependent communities. Chinook salmon PSC taken in GOA trawl fisheries is a resource concern, and the Council has taken action to set hard cap PSC limits that are below the incidental take amount that would trigger reconsultation under the Endangered Species Act (ESA). Attainment of a PSC hard cap closes the trawl fishery. Since the 2015 implementation of Chinook salmon PSC limits for the GOA non-pollock groundfish trawl CV sector, the fishery has continued to display variable levels and unpredictable timing of salmon encounter. Potential closures and PSC encounter rates that vary from year-to-year or even week-to-week create uncertainty for fishery participants, which in turn can make business planning more difficult or directly lead to forgone harvest opportunities. Those outcomes adversely affect trawl harvesters, crew, processors, and GOA coastal communities.

Relative to what was available when the Council established the PSC limits, new information about the resource and the fishery’s rate of salmon encounter has been gathered from salmon genetic identification studies and the expansion of observer sampling onto smaller trawl vessels. Meanwhile, the non-Rockfish Program GOA trawl fisheries continue to operate under a limited access management structure where harvesters must compete for a share of the available catch without formalized cooperative tools to best minimize and utilize PSC.

The proposed action would consider increasing Chinook salmon PSC limits and establishing an annual rollover of unused Chinook salmon PSC for the GOA non-pollock non-Rockfish Program trawl CV sector and/or the Central GOA Rockfish Program CV sector. Alternatives to increase PSC limits or provide more flexibility under the existing PSC limits are offered in light of new information and multiple years of experience fishing under constraining hard caps for these fisheries with variable and unpredictable PSC rates. The action would not modify PSC rollovers from the Rockfish Program CV sector to the limited access CV sector, and NMFS's ability to make in-season Chinook salmon PSC limit reapportionments between certain trawl sectors. The action seeks to find the most appropriate PSC limits or flexibility within the existing PSC limits for these fisheries by providing a margin that accommodates expected high variability, while remaining within previously established outer bounds for annual GOA-wide PSC levels that are not expected to jeopardize the Chinook salmon resource.

1.2 History of this Action

This document analyzes proposed modifications to regulations established under GOA Groundfish FMP Amendment 97 (NPFMC 2014), and the Central GOA Rockfish Program.[2] The final rule for Amendment 97 established annual Chinook salmon PSC limits for three GOA trawl sectors: the Central GOA Rockfish Program CV sector, the non-pollock non-Rockfish Program CV sector, and the GOA trawl CP sector. The Final Rule was published on June 5, 2014 (79 FR 32525). Annual Chinook PSC limits were first applied to the non-pollock trawl sectors during the 2015 fishing year. Prior to that, the Council had developed Chinook salmon PSC limits for the GOA pollock fishery, with separate limits for the Central and the Western GOA. Those limits were implemented under GOA Groundfish FMP Amendment 93 and became effective in August of 2012.

Chinook salmon bycatch, or PSC, taken incidentally in GOA pollock trawl fisheries is a concern to stakeholders, and the Council is required to minimize bycatch under National Standard 9 in the MSA. The Council developed GOA trawl Chinook salmon PSC limits with that standard in mind, and as a measure to avoid exceeding the annual Chinook salmon threshold of 40,000 Chinook salmon identified in NMFS's incidental take statement of a Biological Opinion published on November 30, 2000 (see Section 4.5.3.1 for greater detail on the need for, and findings in, the Biological Opinion). When selecting the levels for pollock and non-pollock trawl fishery PSC limits, the Council analyzed a range of options that would appropriately balance the need to minimize bycatch with the National Standards that set objectives to achieve optimum yield from the fishery (NS 1), to minimize adverse impacts on fishery-dependent communities (NS 8), and to account for variability in fisheries (NS 6). For the GOA non-pollock trawl fishery (CVs and CPs), the Council set a total annual PSC limit of 7,500 Chinook salmon. The Council considered a range of PSC limit options that spanned 5,000 fish to 12,500 fish per year. The Council selected the 7,500 Chinook limit and the sector apportionments described below based on available data for historical PSC use and observer information from the period of 2003 through 2011. In describing its preferred alternative, the Council relied on historical Chinook PSC levels from 2007 through 2012 as a guide for how much PSC the non-pollock trawl CV sectors were likely to use in a typical year (NPFMC 2014).

The annual non-pollock hard cap of 7,500 Chinook salmon is apportioned among the three trawl sectors as follows: CPs (3,600 fish), CVs participating in the Central GOA Rockfish Program (1,200 fish), and CVs participating in all other directed GOA non-pollock groundfish trawl fisheries in the Western and Central GOA Regulatory Areas (2,700 fish). If a sector reaches its Chinook salmon PSC limit, NMFS prohibits further directed trawl fishing for non-pollock groundfish by vessels in that sector. Note that the vessels that participate in the Central GOA Rockfish Program also participate in the non-Rockfish Program CV sector. Amendment 97 provides for reapportionments (or "rollovers") of unused Chinook salmon PSC from the Rockfish Program CV Sector to the non-Rockfish Program CV sector on October 1 and November 15.

[2] The final EA/RIR/IRFA for GOA Groundfish FMP Amendment 97 is available at https://alaskafisheries.noaa.gov/sites/default/files/analyses/goa97earirirfa.pdf. CGOA Rockfish Program was established under GOA Groundfish FMP Amendment 88; final rule published in the Federal Register on December 27, 2011 (76 FR 81248).

On May 3, 2015— the first year that the non-pollock Chinook PSC cap was in effect—the GOA non-pollock groundfish trawl sector was closed for the remainder of the year after the non-pollock non-Rockfish Program CV sector reached its PSC limit of 2,700 fish. In June 2015, the Council requested that NMFS implement an Emergency Rule to allocate an additional 1,600 Chinook salmon PSC to the non-pollock/non-Rockfish Program CV sector of the GOA groundfish trawl fishery. NMFS determined that an emergency existed because the early closure of the non-Rockfish Program CV groundfish fishery caused adverse, significant, and unforeseen impacts on harvesters, processors, and the community of Kodiak. The Final Rule for the emergency action was published on August 10, 2015 (80 FR 47864).[3] Providing 1,600 additional Chinook salmon PSC allowed the sector to harvest its recent average amount of groundfish during the remainder of the 2015 fishing year, while keeping the total Chinook salmon PSC well below the annual 40,000 Chinook PSC threshold for all GOA trawl fisheries. The additional allocation of 1,600 Chinook salmon was determined to be consistent with the overall goals of Chinook salmon PSC management in the GOA trawl fisheries and did not substantially increase Chinook salmon PSC relative to the limits established under Amendments 93 and 97, in aggregate.

The language of the Emergency Rule noted that the action was a direct response measure intended to mitigate the estimated costs of the 2015 closure while the Council develops an FMP amendment to permanently address the ability of the GOA trawl fleet to operate within the established conservation limits. The Emergency Rule was referring to the Council's efforts to develop a cooperative-based GOA trawl management program that would allocate quota for groundfish and PSC species (Chinook salmon and halibut). That effort began in 2013 but was tabled in December 2016 without reaching a recommendation for a preferred alternative. The complete history of that action is described in Section 1.1.2 of a preliminary economic analysis that the Council reviewed in December 2016.[4] Other supporting documents that describe the program that was considered but not implemented – including the set of alternatives considered, an EIS public comment scoping report prepared by NMFS, and a preliminary social impact analysis – can be found under Item C-10 from the Council's December 2016 meeting agenda.[5]

Following the 2015 non-pollock trawl closure and concurrent with the development of the Emergency Rule – and while the cooperative-based "management tools" program was still under development – the Council began developing an action that would provide NMFS inseason managers the ability to reallocate Chinook PSC between GOA trawl sectors based on projected need and use (GOA Groundfish FMP Amendment 103). The Council took final action in December 2015, increasing flexibility to respond to unforeseen or unanticipated changes in Chinook salmon PSC levels. The rule became effective in the 2017 fishing year. To date, NMFS has used this authority on one occasion, moving 404 Chinook PSC from the Central GOA pollock trawl sector to the Western GOA pollock trawl sector on November 15, 2017.[6] The intent of Amendment 103 was not to encourage higher levels of Chinook salmon PSC. The action entails no guarantee that a sector would be entitled to a total Chinook salmon PSC limit that exceeds the amount set forth for that sector in existing regulations. No sector would experience a reduction in the amount Chinook salmon PSC apportioned for its use if that reallocation would, in the judgment of NMFS inseason managers, jeopardize the sector's ability to harvest available groundfish. When eligible sectors are not sufficiently under their respective PSC limits to allow a reallocation, Chinook salmon reallocations do not occur. That uncertainty provides an incentive for each GOA trawl sector to stay within the initial PSC limit that is defined for it in regulation (see Section 2.1 of this document). Moreover, NMFS is not bound to reallocate Chinook PSC to a sector that has reached its

[3] RIR for the Emergency Rule is available at: https://alaskafisheries.noaa.gov/sites/default/files/analyses/goatrawl-chinookpsc-rir0715.pdf

[4] http://npfmc.legistar.com/gateway.aspx?M=F&ID=0636d970-11cf-4f6a-8037-cfb9b7ca34a3.pdf

[5] http://legistar2.granicus.com/npfmc/meetings/2016/12/950_A_North_Pacific_Council_16-12-06_Meeting_Agenda.pdf

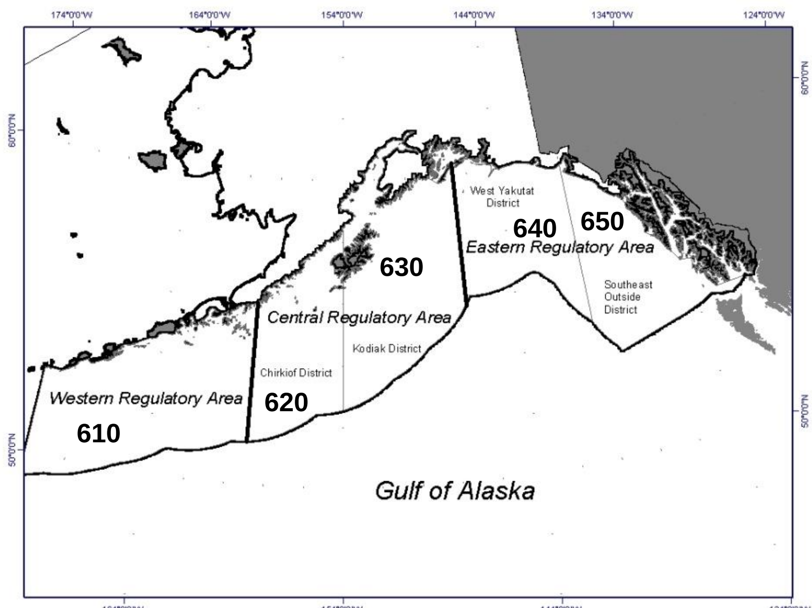
[6] https://www.gpo.gov/fdsys/pkg/FR-2017-11-20/pdf/2017-25115.pdf

limit. Inseason managers will consider patterns of fishing, PSC rates, and fleet behavior before making a reallocation, and might not take an inseason action if a sector is encountering Chinook PSC at a rate that does not conform to the sector's historical best practices. The factors that NMFS will consider and the process for making inseason reallocations is described in Section 4.5.1.2 of this document.

1.3 Description of Management Area

The proposed action would be implemented through an amendment to the GOA Groundfish FMP and through rulemaking. This action specifically regulates the non-pollock trawl fishery in the Western and Central GOA, including the West Yakutat district. Figure 1 illustrates the action area, spanning regulatory areas 610, 620, 630, and 640. In 1998, a gear type prohibition on trawl fisheries went into effect in the Southeast Outside district (regulatory area 650).

Figure 1 Regulatory and reporting areas in the GOA



2 Description of Alternatives

NEPA requires that an EA analyze a reasonable range of alternatives consistent with the purpose and need for the proposed action. The alternatives in this chapter are designed to accomplish the stated purpose and need for the action, which is to provide non-pollock trawl CV sectors with an amount of PSC that is reflective of their historical use, provides a reasonable opportunity to prosecute the fishery in a limited access regulatory environment, accounts for variability and unpredictability in Chinook salmon encounter, minimizes bycatch to the extent practicable, and does not jeopardize the health of ESA-listed Chinook salmon stocks. The Council adopted the following alternatives for analysis in February 2018.[7]

Alternative 1: No action

Alternative 2: Modify the Chinook salmon PSC limit for the GOA non-pollock non-Rockfish Program CV sector by:

- Option 1: 1,000 fish
- Option 2: 2,000 fish
- Option 3: 3,000 fish
- Option 4: Replace the performance standard/incentive buffer with an annual rollover of any unused Chinook salmon PSC in this sector. NMFS will determine the amount of unused Chinook salmon PSC based on the amount used in the sector relative to the base limit of 2,700 fish. The maximum amount of Chinook salmon PSC that may be rolled over cannot exceed:
  - Suboption 1: 675 fish (25% of the limit of 2,700 fish)
  - Suboption 2: 1,350 fish (50% of the limit of 2,700 fish)
  - Suboption 3: 2,025 fish (75% of the limit of 2,700 fish)

  Under Option 4, in any year the total amount of Chinook salmon PSC available cannot exceed the base limit plus the amount in the suboption selected.

Alternative 3: Modify the Chinook salmon PSC limit for the Central GOA Rockfish Program CV sector by:

- Option 1: 300 fish
- Option 2: 600 fish
- Option 3: 900 fish
- Option 4: Allow an annual rollover of any unused Chinook salmon PSC in this sector. NMFS will determine the amount of unused Chinook salmon PSC based on the amount used in the sector relative to the base limit of 1,200 fish. The maximum amount of Chinook salmon PSC that may be rolled over cannot exceed:
  - Suboption 1: 300 fish (25% of the limit of 1,200 fish)
  - Suboption 2: 600 fish (50% of the limit of 1,200 fish)
  - Suboption 3: 900 fish (75% of the limit of 1,200 fish)

  Under Option 4, in any year the total amount of Chinook salmon PSC available cannot exceed the base limit plus the amount in the suboption selected.

The Council may select either Alternative 2 or 3 or may select both in combination. If an action alternative is not selected, that CV sector's Chinook salmon PSC limit will remain at the status quo level

[7] http://npfmc.legistar.com/gateway.aspx?M=F&ID=67107e90-5098-4ad4-b9ff-7c4fe112ae13.pdf

described in Section 2.1. Selecting either action alternative (or both) would require an amendment to the GOA Groundfish FMP and to Federal Regulations at Section 679.21(h).

The Council has not specified whether increasing the base PSC limit for the non-pollock non-Rockfish Program CV sector (Options 1, 2, or 3) would affect the performance standard and resulting buffer amount for the incentive measure described in Section 2.1, or whether additional PSC that is allocated to the Rockfish Program CV sector would be available for the October 1 or November 15 "rollovers" of unused PSC (also described in Section 2.1). This analysis considers the effects of treating additional PSC both as a simple increase to the base limit – i.e., affects the performance standard and the Rockfish Program rollover provision – and as a special apportionment of additional Chinook PSC that may only be used in that sector. The Council should also clarify whether the cap on inseason reallocations of Chinook PSC between GOA trawl sectors (GOA Amendment 103) would increase in proportion to any higher base PSC limit that is selected under Alternatives 2 or 3 (Options 1, 2, or 3). *At final action, the Council should explicitly identify how any PSC limit increase, if recommended, should be applied.*

Under either action alternative, Option 4 would not increase the base PSC limit. Alternative 2 explicitly states that selecting that option would replace the incentive buffer mechanism for the non-pollock non-Rockfish Program CV sector.[8] The analysts presume that any Chinook PSC that is carried from one year to the next would not affect mechanisms that are tied to the base PSC limit – which is unchanged – such as the maximum amount of inseason reallocations that NMFS can make between sectors. *At final action, the Council should identify whether Chinook PSC that is rolled over from one year to the next within the Rockfish Program CV sector is eligible for the October 1 or November 15 inter-sectoral rollovers to the non-Rockfish Program CV sector.*

2.1 Alternative 1, No Action

Selecting the "no action" alternative would result in status quo management for the GOA non-pollock trawl fishery. The status quo Chinook salmon PSC limits for the CV sector of the GOA non-pollock trawl fishery are defined in regulation at Section 679.21(h) and in Section 3.6.2.2 of the GOA Groundfish FMP.[9] The annual PSC limit is 3,900 Chinook salmon. From this total, 1,200 Chinook salmon are for use during fishing activity that takes place under the authority of a Central GOA Rockfish Program cooperative quota permit, between May 1 and November 15. The limit for all other GOA trawl catcher vessel activity is 2,700 Chinook salmon. If more than 150 Chinook salmon PSC are available to the Central GOA Rockfish Program CV sector on October 1, the NMFS Alaska Regional Administrator may reapportion Chinook salmon PSC to the non-Rockfish Program catcher vessel sector, so long as no fewer than 150 Chinook salmon PSC remain with the Rockfish Program CV sector. Any Chinook salmon PSC that remain available to the Central GOA Rockfish Program CV sector on November 15 may be made available to the non-Rockfish Program catcher vessel sector upon that date.

Table 1 Base annual GOA Chinook salmon trawl sector PSC limits (status quo)

Trawl Fishery	Sector	Base PSC Limit
Pollock	Central GOA	18,316
	Western GOA	6,684
Non-Pollock	Rockfish Prog. CV	1,200
	Non-Rockfish Prog. CV	2,700
	All CP	3,600
Total		**32,500**

[8] The incentive buffer mechanism for the CP sector would not be affected.
[9] www.npfmc.org/wp-content/PDFdocuments/fmp/GOA/GOAfmp.pdf

In order to promote further avoidance of Chinook salmon, the Council established an incentive for the non-Rockfish Program CV sector to meet a PSC performance standard that is lower than the hard cap (GOA Groundfish FMP Section 3.6.4.1). If the sector's PSC use in one year is less than or equal to 2,340 Chinook, then its effective PSC limit for the following year is increased from 2,700 to 3,060 Chinook. The additional 360 Chinook PSC cannot be rolled over into future years if it is unused. Requiring the threshold to be met each year in order to earn the "buffer" for the following year ensures that the sector's average PSC use over any two consecutive years does not exceed 2,700 Chinook.[10]

Within a calendar year, NMFS may reallocate Chinook salmon PSC limits to CV sectors on the basis of need for, and availability of, Chinook PSC that is projected to be unused by the sector to which it was initially apportioned for that year (GOA Groundfish FMP Section 3.6.2.2.1). Total reallocations *to* any particular sector during a year may not exceed 50% of that sectors annual base PSC limit (i.e., notwithstanding any "buffer" that the sector carries per the incentive measure described above). The non-pollock non-Rockfish Program CV sector may not receive total reallocations that sum to more than 1,350 Chinook salmon, and the Rockfish Program CV sector may not receive more than 600 reallocated Chinook salmon. These two sectors may receive reallocations from any other GOA trawl sector that has a Chinook PSC limit, including the CP sector (base limit of 3,600 Chinook) and the Central and Western GOA pollock trawl CV fisheries (base limits of 18,316 and 6,684 Chinook, respectively).

Under current regulations, the absolute maximum amount of Chinook PSC that each sector affected by this action could use in one year is:

- Non-pollock non-Rockfish Program CV: **4,410 Chinook salmon** (2,700 base limit + 360 incentive buffer + 1,350 maximum reallocation). This amount could also be supplemented after October 1 by a rollover of unused PSC from the Rockfish Program CV sector.
- Rockfish Program CV: **1,800 Chinook salmon** (1,200 base limit + 600 maximum reallocation).

Under current regulations, the absolute maximum amount of Chinook PSC that can be taken across all sectors of the GOA trawl fishery is 33,340 Chinook salmon. That total includes the base limits defined in Table 1 (32,500 Chinook), plus the incentive buffers for the non-pollock non-Rockfish Program CV sector (360 Chinook) and the GOA trawl CP sector (480 Chinook). As noted above, the mechanism behind the earned incentive buffer ensures that the maximum Chinook salmon PSC that can be taken over any two consecutive years will not exceed 32,500 Chinook per year.

2.2 Alternative 2: Increase the Non-Pollock Non-Rockfish Program CV Sector Chinook Salmon PSC Limit

Alternative 2 could increase the base Chinook salmon PSC limit for the non-pollock non-Rockfish Program CV sector of 2,700 by 1,000, 2,000, or 3,000 fish (Options 1 through 3), or allow a limited portion of the sector's unused base PSC limit to be rolled over for use in the following year (Option 4). Table 2 shows the PSC limits and maximum inseason reallocations that the sector could receive under Alternatives 1 and 2, presuming that the Council intends for the additional Chinook PSC that would be available under Options 1 through 3 to be treated as part of a new, larger base limit. For Options 1 through 3, the performance standards listed in the table are scaled to match existing regulations wherein the sector must leave at least 13.3% of its base PSC limit unused in order to receive an incentive buffer in the following year (the incentive buffer would be removed from regulation if the Council selects Option 4). The size of the incentive buffer is set equal to 13.3% of the base limit; the buffer does not

[10] The GOA trawl CP sector is also eligible to earn an incentive buffer of 480 additional Chinook PSC if it performs to a standard of 3,120 Chinook in the previous year. If the sector meets that standard, its limit for the following year is increased from 3,600 to 4,080 Chinook.

increase if the sector leaves more than 13.3% of its base PSC limit unused. The maximum inseason reallocation that the sector can receive during a calendar year is similarly scaled to 50% of the base limit (Amendment 103). Note that Option 4 would not change the base annual PSC limit, and thus would not change the maximum inseason reallocation.

Table 3 shows the maximum PSC limit under Options 1 through 3 if the Council increases the base PSC limit but maintains the current structure of the incentive buffer and the inseason reapportionment cap. Table 2 and Table 3 provide end-points that contain the maximum amount of Chinook PSC available if the Council were to change the application of one mechanism but leave the structure of the other in place. For example, under Alternative 2 Option 1, if the calculation of the performance standard and the incentive buffer are scaled to the new base limit of 3,700 Chinook salmon but the maximum inseason reallocation remains capped at 1,350 Chinook then the resulting maximum available PSC for the sector would be 5,543 Chinook (3,700 + 493 + 1,350); this falls between the maximum limits for Option 1 in each of the following tables (6,043 and 5,410, respectively).

The Council specified that Option 4 would not modify the base PSC limit from the status quo level of 2,700 Chinook salmon. Option 4 would provide the fleet with earned flexibility in the form of a higher PSC limit in one year if the sector takes less than its *base* PSC limit in the preceding year. Inter-annual rollovers cannot accumulate over years, and the calculation of "unused" PSC is always judged relative to the base limit of 2,700 Chinook salmon. Table 4 illustrates how rollovers would be calculated in a few example scenarios.

- Scenario 1 shows the non-pollock non-Rockfish Program CV sector achieving the maximum possible rollovers in Year A, resulting in PSC limits for Year B of 3,375 to 4,725 depending on the suboption selected. If the sector records 3,000 Chinook salmon PSC in Year B, no rollover would be applied to the limit for Year C. This illustrates that the rollover is based on performance relative to the base limit of 2,700 Chinook PSC. Had the rollover to Year C been based on the effective PSC limit in Year B, then the sector would have received a rollover under any suboption—this is not the case.
- Scenarios 2 and 3 illustrate that the amount of the rollover is capped depending on the suboption selected. If the sector records 1,000 Chinook PSC, the sector can receive its maximum rollover under suboptions 1 and 2, but not under suboption 3. If the sector records 1,500 Chinook PSC, the sector would only receive its maximum rollover under suboption 1. The fact that the Year B → Year C rollovers under Scenarios 2 and 3 are identical illustrates that additional PSC carried into Year B do not affect how the Year C rollover is calculated.
- Scenario 4 illustrates that high PSC in Year A reduces the rollover amount for Year B but does not reduce the potential Year B → Year C rollover if PSC during Year B is low.

Table 2 Non-pollock non-Rockfish Program CV sector Chinook salmon PSC limits and maximum possible PSC available with all existing mechanisms applied

Option	Base Limit	Performance Standard	Incentive Buffer	Maximum Reallocation	Maximum Possible Limit
No action	2,700	2,340	360	1,350	4,410
Option 1	3,700	3,207	493	1,850	6,043
Option 2	4,700	4,073	627	2,350	7,677
Option 3	5,700	4,940	760	2,850	9,310
Option 4	2,700	n/a	n/a	1,350	6,075*

* 6,075 = base limit (2,700) + maximum rollover (2,025; Option 4, Suboption 3) + maximum reallocation (1,350)

Table 3 Non-pollock non-Rockfish Program CV sector Chinook salmon PSC limits and maximum possible PSC available (other existing PSC mechanisms unchanged)

Option	Base Limit	Performance Standard	Incentive Buffer	Maximum Reallocation	Maximum Possible Limit
No action	2,700	2,340	360	1,350	4,410
Option 1	3,700				5,410
Option 2	4,700				6,410
Option 3	5,700				7,410
Option 4	2,700	n/a	n/a	1,350	6,075*

*** 6,075 = base limit (2,700) + maximum rollover (2,025; Option 4, Suboption 3) + maximum reallocation (1,350)**

Table 4 Example scenarios for inter-annual Chinook salmon PSC rollovers under Option 4

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Suboption (Max Rollover)	**If Year A PSC = 500 then Year B Limit = …**	**If Year A PSC = 1,000 then Year B Limit = …**	**If Year A PSC = 1,500 then Year B Limit = …**	**If Year A PSC = 2,500 then Year B Limit = …**
SO 1 – 675 fish	2,700 + 675 = **3,375**	2,700 + 675 = **3,375**	2,700 + 675 = **3,375**	2,700 + 200 = **2,900**
SO 2 – 1,350 fish	2,700 + 1,350 = **4,050**	2,700 + 1,350 = **4,050**	2,700 + 1,200 = **3,900**	2,700 + 200 = **2,900**
SO 3 – 2,025 fish	2,700 + 2,025 = **4,725**	2,700 + 1,700 = **4,400**	2,700 + 1,200 = 3,9**00**	2,700 + 200 = **2,900**
Suboption (Max Rollover)	**If Year B PSC = 3,000 then Year C Limit = …**	**If Year B PSC = 1,500 then Year C Limit = …**	**If Year B PSC = 1,500 then Year C Limit = …**	**If Year B PSC = 500 then Year C Limit = …**
SO 1 – 675 fish	2,700 + 0 = **2,700**	2,700 + 675 = **3,375**	2,700 + 675 = **3,375**	2,700 + 675 = **3,375**
SO 2 – 1,350 fish	2,700 + 0 = **2,700**	2,700 + 1,200 = **3,900**	2,700 + 1,200 = **3,900**	2,700 + 1,350 = **4,050**
SO 3 – 2,025 fish	2,700 + 0 = **2,700**	2,700 + 1,200 = 3,9**00**	2,700 + 1,200 = 3,9**00**	2,700 + 2,025 = **4,725**

As noted in Section 1.2, total annual Chinook PSC across all GOA trawl sectors cannot exceed 40,000 fish. Exceeding that amount would trigger an ESA Section 7 consultation. The action alternatives under consideration could not result in the GOA trawl fishery reaching the 40,000 Chinook ceiling, even if every sector hits its cap in the same year. Currently, GOA trawl Chinook PSC limits total 32,500 fish (those limits were set with the 40,000 Chinook ceiling as a reference point). Considering incentive buffers that can be carried into a new year, the theoretical ceiling for any given year under current regulations is 33,340. That amount includes the 360 Chinook incentive buffer for the non-pollock non-Rockfish Program CV sector, and a 480 Chinook buffer for the trawl CP sector.[11] If the Council increases the base PSC limit *and* the incentive buffer for the non-pollock non-Rockfish Program CV sector (Options 1 through 3) then the theoretical ceiling for Chinook salmon PSC in a given year increases to the amounts shown in Table 5. Whether or not increasing the sector's base PSC limit affects the in-season reapportionment cap does not change the maximum Chinook salmon take because any reapportioned PSC would be coming out of a reduction in the annual cap of another GOA trawl sector. Table 5 also shows the maximum total annual PSC amount under Alternative 2 Option 4; the incentive buffer for the non-pollock non-Rockfish Program CV sector is replaced by a maximum interannual rollover of 2,025 Chinook and the CP incentive buffer is retained.

[11] Note that the incentive buffer does not increase maximum Chinook PSC averaged over any two consecutive years because the additional PSC that is available in the second year is balanced or – more likely – outweighed by avoidance at or below the performance standard in the previous year.

Table 5 Maximum annual GOA trawl Chinook salmon PSC under Alternative 2

	No action	Option 1	Option 2	Option 3	Option 4
Base PSC Limits	32,500	33,500	34,500	35,500	32,500
Base + Non-RP CV Incentive Buffer (Table 2) + CP Incentive Buffer (480)	33,340	34,473	35,607	36,740	--
Base + CP Incentive Buffer (480) + Maximum inter-annual rollover (2,025)	--	--	--	--	35,005

Alternative 3, described in Section 2.3, could be selected in combination with Alternative 2. Alternative 3 could increase the total GOA trawl Chinook salmon base PSC limit by up to 900 fish (Alternative 3 Option 3). Selection of Alternative 3 Option 4 would not increase the base PSC limit but could allow an additional 900 Chinook to be taken in the Rockfish Program CV sector via an inter-annual rollover. The highest possible Chinook salmon PSC limit for a single year would be 37,640. That amount could be reached under the combination of Alternative 2 Option 3 with either Alternative 3 Option 3 or Alternative 3 Option 4 (36,740 + 900). This amount is below the threshold that would trigger ESA Section 7 consultation, per the incidental take statement referenced in Section 4.5.3.1 of this document.

It is critical to understand that incentive buffers do not increase the maximum average annual PSC level in the GOA trawl fishery over any set of consecutive years because the additional PSC provided by the buffer in one year are the result of equal or more Chinook PSC "savings" in the preceding year. Moreover, inseason reallocations under Amendment 103 do not increase the maximum possible PSC level because they represent the movement of Chinook PSC from one sector to another. Inter-annual rollovers (Option 4) would not increase average annual PSC because they similarly rely on PSC "savings" in the preceding year, and because the maximum rollover is capped (Suboptions 1 through 3). As a result – over any set of years – **the absolute maximum average annual Chinook PSC that could occur as a result of this action is 36,400 Chinook salmon**. That amount is equal to the current PSC limits for pollock and non-pollock CV and CP fisheries (25,000 plus 7,500) plus an additional 3,600 Chinook PSC that would result from selecting Option 3 under Alternatives 2 and 3 (3,000 additional Chinook PSC for the non-pollock non-Rockfish Program CV sector, and 900 additional Chinook PSC for the Rockfish Program CV sector).

2.3 Alternative 3: Increase the Central GOA Rockfish Program Chinook Salmon PSC Limit

Alternative 3 could increase the base Chinook salmon PSC limit for the Central GOA Rockfish Program CV sector of 1,200 by 300, 600, or 900 fish (Options 1 through 3), or allow a limited portion of the sector's unused base PSC limit to be rolled over for use in the following year (Option 4). Suboptions to Option 4 would cap the inter-annual rollover at 300, 600, or 900 fish. As with Alternative 2 Option 4, the amount of the rollover is determined annually based on performance relative to the existing base PSC limit of 1,200 Chinook salmon. The illustrations provided in the previous section (Table 4) also apply here, but with different values. For example, if the Council selects Option 4 Suboption 2 (maximum rollover of 600 fish) and the Rockfish Program CV sector records only 500 Chinook PSC in Year A, then the sector would have a PSC limit of 1,800 Chinook during Year B. If the sector records 1,000 Chinook PSC in Year B, it would have a PSC limit of 1,400 Chinook during Year C (1,200 + (1,200 – 1,000)). If the sector instead recorded 1,500 Chinook PSC in Year B, it would have a PSC limit of 1,200 Chinook during Year C (no rollover).

Table 6 shows the PSC limits and maximum inseason reallocations that the sector could receive. The table shows two different maximum PSC limits, depending on whether the Council chooses to scale the inseason reallocation mechanism to the original base limit (1,200 Chinook) or to the PSC limit as modified by Options 1 through 3. Unlike the non-pollock limited access CV sector, the Rockfish Program CV sector is not eligible to earn an incentive buffer that can be added to its PSC limit for one year based on performance below a PSC threshold in the preceding year.

Table 6 Central GOA Rockfish Program CV sector Chinook salmon PSC limits and maximum possible PSC available with all existing mechanisms applied (a), and with existing mechanisms unchanged (b)

Option	Base Limit	Maximum Reallocation (a)	Maximum Possible Limit (a)	Maximum Reallocation (b)	Maximum Possible Limit (b)
No action	1,200	600	1,800	600	1,800
Option 1	1,500	750	2,250	600	2,100
Option 2	1,800	900	2,700	600	2,400
Option 3	2,100	1,050	3,150	600	2,700
Option 4	1,200	600	2,700*	600	2,700*

*** 2.700 = base limit (1,200) + max. reallocation (600) + max. inter-annual rollover (900; Option 4 Suboption 3)**

As noted in Section 2.1, NMFS may reapportion any unused Rockfish Program CV sector Chinook salmon PSC to the non-pollock sector (less 150 fish) on October 1.[12] The Council should specify whether any Chinook PSC that is added to the Rockfish Program CV sector's base limit (Options 1 through 3) or rolled over from a previous year (Option 4) is eligible for the October 1 rollover. (Recall that all unused Chinook PSC in the Rockfish Program CV sector are automatically made available to the non-pollock CV sector when the Rockfish Program fishery closes by regulation on November 15, or when all cooperatives have checked out of the fishery.) If the additional PSC that is made available under Options 1 through 3 may not to be rolled over on October 1, then the minimum amount of unused Chinook PSC that must remain within the Rockfish Program CV sector past that date would be 450, 750, or 1,050 Chinook (as opposed to the current minimum of 150 Chinook). It is worth noting that the October 1 rollover provision was designed and implemented before NMFS inseason managers gained the ability to reapportion Chinook PSC between sectors based on its own discretion and management expertise. With Amendment 103 in place, there is less need to maintain precautionary inseason rollover limits to prevent a scenario where a sector cannot meet an unexpected need for Chinook PSC; NMFS managers now have to tools to prevent (or address) such an unforeseen scenario.

2.4 Comparison of Alternatives

Table 7 through Table 9 summarize the alternatives and potential impacts at a high level. For additional detail on potential impacts, refer to Section 3 and Section 4.7 of this document.

[12] NMFS determines whether or not to execute this rollover based on anticipated need for Chinook PSC.

Table 7 Summary of alternatives

	Alternative 1	Alternative 2	Alternative 3
	No action (status quo)	Modify non-pollock non-Rockfish Program CV sector Chinook PSC limit	Modify Rockfish Program CV sector Chinook PSC limit
PSC Limits	Non-pollock non-Rockfish Program CVs: 2,700 fish Rockfish Program CVs: 1,200 fish	Increase base PSC limit by: 1,000 fish 2,000 fish 3,000 fish, Or, allow inter-annual rollover of unused PSC relative to (suboptions) 25%/50%/75% of the base limit.	Increase by: 300 fish 600 fish 900 fish Or, allow inter-annual rollover of unused PSC relative to (suboptions) 25%/50%/75% of the base limit.
Flexibility Mechanisms and Council Decision Points	• Unused Rockfish Program (RP) PSC can roll over to non-RP CVs on Oct. 1 or Nov. 15. • NMFS *may* reallocate additional PSC between sectors inseason. • Non-pollock non-Rockfish program can use 360 additional Chinook if sector has fewer than 2,340 PSC the previous year.	• Does additional PSC (Options 1-3) affect incentive buffer and/or maximum inseason reallocation? • Does rolled-over PSC (Option 4) affect maximum inseason reallocation?	Does additional or rolled-over PSC affect: • Maximum inseason reallocation? • Amount of Oct. 1 or Nov. 15 rollovers to non-Rockfish Program CV sector?

Table 8 Summary of environmental impacts

	Alternative 1	Alternatives 2 & 3
Groundfish	Under the status quo, neither the level of mortality nor the spatial and temporal impacts of fishing on target stocks are likely to jeopardize the sustainability of groundfish.	Increased PSC limits are not likely to increase fishing pressure. Even if there is a redistribution of effort to avoid Chinook salmon, the fishery will likely remain within the established footprint of the non-pollock trawl fishing grounds. Consequently, these alternatives are not likely to result in adverse impacts to groundfish stocks.
Chinook salmon	No changes.	Chinook salmon PSC may increase slightly from the status quo. Any impact to the Chinook salmon stocks as a whole is likely to represent either no change from the status quo or to cause minor impact, as PSC levels either remain the same or are slightly increased. Under either action alternative, Option 4 would not increase the base PSC limit.
Marine mammals	No changes.	No substantial change in the number of incidental takes is expected under either alternative.
Seabirds	No changes.	Effects on seabird takes are not likely to change substantially, and impacts are expected to be negligible.
Habitat	No changes.	Neither alternative is likely to result in significantly adverse effects to habitat.
Ecosystem	No changes	No anticipated population-level impacts to marine species or change ecosystem-level attributes beyond the range of natural variation.

Table 9 Summary of socioeconomic impacts

	Alternative 1	Alternatives 2 & 3
Groundfish harvesters	Unpredictable frequency and timing of fishery closure; highly variable annual outcomes for non-pollock non-Rockfish Program CV sector. Likely to rely on inseason PSC reallocations and PSC rollovers from the Rockfish Program	Reduced uncertainty regarding ability to prosecute Central GOA Pacific cod B season and late-year flatfish fisheries. Change in expected outcomes is greater for non-pollock non-Rockfish Program CV sector than for Rockfish Program CV sector
Processors and communities	Uncertainty regarding business planning, investment, product flows, and public revenues. Possible concentration in the time span of a fishery. Possible reduced opportunity for shoreside workers.	Reduced uncertainty. Benefits concentrated in groups that participate in Central GOA fisheries.
Chinook salmon users	Impact to salmon stocks that provide commercial/charter/recreational/option values is limited. Distribution of benefits is not determined.	Potential for marginal increase in trawl PSC removals; frequency of years in which PSC would exceed status quo levels is not determined. Impact on specific stocks/runs is not determined.

3 Environmental Assessment

There are four required components for an environmental assessment. The need for the proposal is described in Chapter 1, and the alternatives in Chapter 2. This chapter addresses the probable environmental impacts of the proposed action and alternatives. Information with which to understand the affected environment for each resource component is also available in the Alaska Groundfish Fisheries Harvest Specifications Environmental Impact Statement (EIS) (NMFS 2007a), and the Final Programmatic Supplemental EIS on the Alaska Groundfish Fisheries (NMFS 2004a).

3.1 Methods

This chapter evaluates the direct, indirect, and cumulative impacts of the alternatives and options on the various resource components. The socio-economic impacts of this action are described in the Regulatory Impact Review (RIR) portion of this analysis (Chapter 4).

Recent and relevant information, necessary to understand the affected environment for each resource component, is summarized in the relevant section. For each resource component, the analysis identifies the potential impacts of each alternative, and uses criteria to evaluate the significance of these impacts. If significant impacts are likely to occur, preparation of an EIS is required. Although an EA should evaluate economic and socioeconomic impacts that are interrelated with natural and physical environmental effects, economic and social impacts by themselves are not sufficient to require the preparation of an EIS (see 40 CFR 1508.14).

An environmental assessment must consider cumulative effects when determining whether an action significantly affects environmental quality. The Council on Environmental Quality (CEQ) regulations for implementing NEPA define cumulative effects as:

> *"the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7*).

The concept behind cumulative effects analysis is to capture the total effects of many actions over time that would be missed if evaluating each action individually. Concurrently, the CEQ guidelines recognize that it is most practical to focus cumulative effects analysis on only those effects that are truly meaningful.

3.1.1 Documents incorporated by reference in this analysis

This EA relies heavily on the information and evaluation contained in previous environmental analyses, and these documents are incorporated by reference. The documents listed below contain information about the fishery management areas, fisheries, marine resources, ecosystem, social, and economic elements of the groundfish fisheries. They also include comprehensive analysis of the effects of the fisheries on the human environment and are referenced in the analysis of impacts throughout this chapter.

Alaska Groundfish Harvest Specifications Final Environmental Impact Statement (NMFS 2007a).

This EIS provides decision makers and the public an evaluation of the environmental, social, and economic effects of alternative harvest strategies for the federally managed groundfish fisheries in the GOA and the Bering Sea and Aleutian Islands management areas and is referenced here for an understanding of the groundfish fishery. The EIS examines alternative harvest strategies that comply with Federal regulations, the Fishery Management Plan (FMP) for Groundfish of the GOA, the Fishery Management Plan (FMP) for Groundfish of the BSAI Management Area, and the Magnuson-Stevens Fishery Conservation and Management Act. These strategies are applied using the best available scientific information to derive the total allowable catch (TAC) estimates for the groundfish fisheries. The EIS evaluates the effects of different alternatives on target species, non-specified species, forage species, prohibited species, marine mammals, seabirds, essential fish habitat, ecosystem relationships, and economic aspects of the groundfish fisheries. This document is available from https://alaskafisheries.noaa.gov/fisheries/groundfish-harvest-specs-eis.

Stock Assessment and Fishery Evaluation (SAFE) Report for the Groundfish Resources of the GOA (NPFMC 2017).

Annual SAFE reports review recent research and provide estimates of the biomass of each species and other biological parameters. The SAFE report includes the acceptable biological catch (ABC) specifications used by NMFS in the annual harvest specifications. The SAFE report also summarizes available information on the ecosystems and the economic condition of the groundfish fisheries off Alaska. This document is available from http://www.afsc.noaa.gov/refm/stocks/assessments.htm.

Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis to Revise Gulf of Alaska Halibut Prohibited Species Catch Limits (NPFMC 2012).

This analysis accompanied proposed Amendment 95 to the GOA Groundfish FMP, recommending a change to the process for setting halibut PSC limits applicable to GOA groundfish fisheries. The amendment also proposes reducing limits for the groundfish trawl gear sector, the groundfish catcher vessel hook-and-line sector, and the catcher processor hook-and-line sector. The environmental assessment includes an evaluation of the environmental impacts of the non-pollock trawl fisheries.

Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis to set GOA Chinook PSC limits for non-pollock trawl fisheries (NPFMC 2014).

This analysis accompanied proposed Amendment 97 to the GOA Groundfish FMP, recommending a process for setting Chinook salmon PSC limits applicable to GOA non-pollock trawl fisheries.

Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis to allow the reapportionment of Chinook salmon PSC between the pollock and non-pollock GOA trawl fisheries (NPFMC 2016).

This analysis accompanied proposed Amendment 103 to the GOA Groundfish FMP, recommending a process allowing NMFS to make inseason reallocations of Chinook salmon PSC between GOA trawl sectors based on projected use and need.

Final Programmatic Supplemental Environmental Impact Statement (PSEIS) on the Alaska Groundfish Fisheries (NMFS 2004).

The PSEIS evaluates the Alaska groundfish fisheries management program as a whole and includes analysis of alternative management strategies for the GOA and Bering Sea/Aleutian Islands (BSAI) groundfish fisheries. The EIS is a comprehensive evaluation of the status of the environmental components and the effects of these components on target species, non-specified species, forage species, prohibited species, marine mammals, seabirds, essential fish habitat, ecosystem relationships, and economic aspects of the groundfish fisheries. A Supplemental Information Report (NPFMC and NMFS 2015) was prepared in 2015 which considers new information and affirms that new information does not indicate that there is now a significant impact from the groundfish fisheries where the 2004 PSEIS concluded that the impact was insignificant. The PSEIS document is available from https://alaskafisheries.noaa.gov/node/33552, and the Supplemental Information Report from https://alaskafisheries.noaa.gov/sites/default/files/sir-pseis1115.pdf.

3.1.2 Cumulative effects analysis

This EA analyzes the cumulative effects of each alternative and the effects of past, present, and reasonably foreseeable future actions (RFFA). Each section below provides a review of the relevant past, present, and RFFA that may result in cumulative effects on the resource components analyzed in this document. The past and present actions are described in several documents and are incorporated by reference. These include the PSEIS (NMFS 2004), the EFH EIS (NMFS 2005), the harvest specifications EIS (NMFS 2007a), the Central Gulf of Alaska Rockfish Program EA (NPFMC 2011), the EA/RIR/IRFA to Revise GOA Halibut PSC Limits (NPFMC 2012), and the EA/RIR/IRFA to establish GOA Chinook Salmon PSC Limits (NPFMC 2014). This analysis provides a brief review of the RFFAs that may affect environmental quality and result in cumulative effects. Future effects include harvest of federally managed fish species and current habitat protection from federal fishery management measures, harvests from state managed fisheries and their associated protection measures, efforts to protect endangered species by other federal agencies, and other non-fishing activities and natural events.

In addition, the supplemental information report (SIR) NMFS prepares to annually review the latest information since the completion of the Alaska Groundfish Harvest Specifications EIS is incorporated by reference (NMFS 2017c). SIRs have been developed since 2007 and are available on the NMFS Alaska Region website. Each SIR describes changes to the groundfish fisheries and harvest specifications process, new information about environmental components that may be impacted by the groundfish fisheries, and new circumstances, including present and reasonably foreseeable future actions. NMFS reviews the reasonably foreseeable future actions described in the Harvest Specifications EIS each year to determine whether they occurred and, if they did occur, whether they would change the analysis in the Harvest Specifications EIS of the impacts of the harvest strategy on the human environment. In addition, NMFS considered whether other actions not anticipated in the Harvest Specifications EIS occurred that have a bearing on the harvest strategy or its impacts. The SIRs provide the latest review of new information regarding Alaska groundfish fisheries management and the marine environment since the development of the Harvest Specifications EIS and provide cumulative effects information applicable to the alternatives analyzed in this EA.

A summary table of these RFFAs is provided below (Table 10). The table summarizes the RFFAs identified applicable to this analysis that are likely to have an impact on a resource component within the action area and timeframe. Actions are understood to be human actions (e.g., a designation of northern right whale critical habitat in the Pacific Ocean), as distinguished from natural events (e.g., an ecological regime shift). CEQ regulations require consideration of actions, whether taken by a government or by private persons, which are reasonably foreseeable. This requirement is interpreted to indicate actions that are more than merely possible or speculative. In addition to these actions, this cumulative effects analysis includes the effects of climate change.

Actions are considered reasonably foreseeable if some concrete step has been taken toward implementation, such as a Council recommendation or NMFS's publication of a proposed rule. Actions only "under consideration" have not generally been included, because they may change substantially or may not be adopted, and so cannot be reasonably described, predicted, or foreseen. Identification of actions likely to impact a resource component within this action's area and time frame will allow the public and Council to make a reasoned choice among alternatives.

Table 10 Reasonably foreseeable future actions

Ecosystem-sensitive management	• Increasing understanding of the interactions between ecosystem components, and ongoing efforts to bring these understandings to bear in stock assessments • Increasing protection of ESA-listed and other non-target species components of the ecosystem • Increasing integration of ecosystems considerations into fisheries decision-making
Traditional management tools	• Authorization of groundfish fisheries in future years • Increasing enforcement responsibilities • Technical and program changes that will improve enforcement and management
Other federal, state, and international agencies	• Future exploration and development of offshore mineral resources • Reductions in United States Coast Guard fisheries enforcement activities • Continuing oversight of seabirds and some marine mammal species by the USFWS • Expansion and construction of boat harbors • Expansion of state groundfish fisheries • Other state actions • Ongoing EPA monitoring of seafood processor effluent discharges
Private actions	• Commercial fishing • Increasing levels of economic activity in coastal zone off Alaska • Expansion of aquaculture

3.2 Target species

3.2.1 Status

The non-pollock directed trawl fisheries in the GOA include rockfish species, arrowtooth flounder, Pacific cod, shallow water flatfish, rex sole, flathead sole and deep-water flatfish. The primary rockfish species harvested in the GOA are Pacific ocean perch, northern rockfish, and dusky rockfish (formerly part of the pelagic shelf rockfish complex). Shortraker, rougheye, and thornyhead rockfish are also caught incidentally in directed rockfish fisheries, as are “other rockfish” species. Pacific ocean perch is the highest biomass rockfish species, with a wide distribution throughout the Gulf of Alaska and beyond. The primary species in the shallow water flatfish complex are Northern rock sole and Southern rock sole; other shallow water flatfish species include Alaska plaice, starry flounder, yellowfin sole, sand sole, butter sole and English sole. Dover sole is the primary harvest species in the deep-water flatfish complex, with deep-sea sole and Greenland turbot making up the remainder.

Many of the non-pollock trawl fisheries are multi-species fisheries, and catch other groundfish species incidentally, in addition to the trip’s assigned target. The assessments also list non-FMP species that are caught incidentally in the non-pollock trawl fisheries, such as grenadiers. The SAFE report (NPFMC 2017) includes more information.

Annual stock assessments include a comprehensive evaluation of their biology and distribution. Consequently, the GOA Stock Assessment and Fishery Evaluation (SAFE) report is incorporated by reference (NPFMC 2017). All groundfish harvest during the GOA groundfish fisheries is counted toward the total allowable catch (TAC) for that species or species group. Groundfish stocks are assessed annually and are managed using conservative catch quotas. Biomass trends for each of the trawl target species are available in (NPFMC 2017).

TACs and harvests, especially in the GOA, are often set lower than they would be otherwise, in order to protect other species, especially halibut, which may be taken as incidental removals. Some flatfish quotas are set well below the acceptable biological levels (ABCs) due to halibut PSC constraints. Directed fishing for many species is frequently restricted before TACs are reached, in order to comply with PSC limits. Inseason management closes directed fisheries when TACs are harvested and restricts fishing in other fisheries taking the species as incidental removals when OFLs are approached.

3.2.2 Effects of the Alternatives

The effects of the GOA non-pollock trawl fisheries on groundfish stocks are assessed annually in the GOA SAFE report (NPFMC 2017) and were also evaluated in the Alaska Groundfish Fisheries Harvest Specifications EIS (NMFS 2007a). Table 11 and Table 12 describe the criteria used to determine whether the impacts on target and ecosystem component fish stocks are likely to be significant. The effects of the GOA non-pollock trawl fisheries on fish species that are caught incidentally have been comprehensively analyzed in the Alaska Groundfish Fisheries Harvest Specifications EIS (NMFS 2007a). These fisheries were also evaluated recently under the GOA halibut PSC EA/RIR/IRFA (NPFMC 2012) and the GOA Chinook salmon PSC EA/RIR/IRFA (NPFMC 2014). These analyses concluded that under the status quo, neither the level of mortality nor the spatial and temporal impacts of fishing on fish species or prey availability are likely to jeopardize the sustainability of the target and ecosystem component fish populations. The groundfish stocks are neither overfished nor subject to overfishing.

Table 11 Criteria used to determine significance of effects on target groundfish stocks

Effect	Criteria			
	Significantly Negative	**Insignificant**	**Significantly Positive**	**Unknown**
Fishing mortality	Changes in fishing mortality are expected to jeopardize the ability of the stock to sustain itself at or above its MSST (minimum stock size threshold)	Changes in fishing mortality are expected to maintain the stock's ability to sustain itself above MSST	Changes in fishing mortality are expected to enhance the stock's ability to sustain itself at or above its MSST	Magnitude and/or direction of effects are unknown
Stock Biomass: potential for increasing and reducing stock size	Reasonably expected to jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis.	Reasonably expected not to jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis.	Action allows the stock to return to its unfished biomass.	Magnitude and/or direction of effects are unknown
Spatial or temporal distribution	Reasonably expected to adversely affect the distribution of harvested stocks either spatially or temporally such that it jeopardizes the ability of the stock to sustain itself.	Unlikely to affect the distribution of harvested stocks either spatially or temporally such that it has an effect on the ability of the stock to sustain itself.	Reasonably expected to positively affect the harvested stocks through spatial or temporal increases in abundance such that it enhances the ability of the stock to sustain itself.	Magnitude and/or direction of effects are unknown
Change in prey availability	Evidence that the action may lead to changed prey availability such that it jeopardizes the ability of the stock to sustain itself.	Evidence that the action will not lead to a change in prey availability such that it jeopardizes the ability of the stock to sustain itself.	Evidence that the action may result in a change in prey availability such that it enhances the ability of the stock to sustain itself.	Magnitude and/or direction of effects are unknown

Table 12 Criteria used to determine significance of effects on ecosystem component (including prohibited) species

No impact	No incidental take of the ecosystem component species in question.
Adverse impact	There are incidental takes of the ecosystem component species in question
Beneficial impact	Natural at-sea mortality of the ecosystem component species in question would be reduced – perhaps by the harvest of a predator or by the harvest of a species that competes for prey.
Significantly adverse impact	An action that diminishes protections afforded to prohibited species in the groundfish fisheries would be a significantly adverse impact.
Significantly beneficial impact	No benchmarks are available for significantly beneficial impact of the groundfish fishery on the ecosystem component species, and significantly beneficial impacts are not defined for these species.
Unknown impact	Not applicable

Alternative 2 would increase the Chinook salmon PSC limit for the GOA non-pollock non-Rockfish Program CV sector of 2,700 by 1,000, 2,000, or 3,000 fish depending on the option selected. Option 4 under Alternative 2 would allow for an annual rollover of any unused Chinook salmon PSC in this sector relative to the base limit of 2,700. A lower PSC limit may result in the non-pollock trawl fisheries closing before the TACs are reached, while a higher PSC limit would allow for groundfish fishing at current levels, and impacts would likely be similar to the status quo fishery.

Alternative 3 would increase the Chinook salmon PSC for the Central GOA Rockfish Program CV sector of 1,200 by 300, 600, or 900 fish depending on the option selected. Option 4 under Alternative 3 would allow for an annual rollover of any unused Chinook salmon PSC in this sector relative to the base limit of 1,200 fish. As described in Section 2.3, Alternative 3 could be selected in combination with Alternative 2. At a maximum, Alternative 3 could increase the total GOA trawl Chinook salmon PSC limit by 900 fish (Alternative 3, Option 3). At that level, the highest possible Chinook salmon PSC limit for a single year would be 37,640 (36,740 + 900).

Under either action alternative, Option 4 would not increase the base PSC limit. Alternative 2 explicitly states that selecting that option would replace the incentive buffer mechanism for the non-pollock non-Rockfish Program CV sector.[13]

If the groundfish TACs are not fully harvested, fishing will have less impact on the stocks, and there will be no significantly adverse impact on the groundfish stocks from the fisheries. If PSC limits curtails the fisheries, it is likely the fall seasons that will be most impacted, that is, fishing in the early part of the year is most likely to remain unchanged, while fishing patterns may be altered later in the year when the fisheries are approaching the PSC limit. Changing fishery patterns or seasonal changes in the timing of the fishing pressure may result in the fisheries focusing on different ages of groundfish than would otherwise have been taken. These changes, however, would be monitored and updated in future stock assessments.

The risk to the stocks is considered minor, since conservation goals for maintaining spawning biomass would remain central to the assessments. None of the options considered the alternatives would affect the annual assessment process, and inseason monitoring of catch quotas. Thus, any changes in fishing patterns or the timing of fishing pressure would not be expected to affect the sustainability of the stocks. However, the change in fishing pattern could result in lower overall ABC and TAC levels, depending on how the age composition of the catch changed.

[13] The incentive buffer mechanism for the CP sector would not be affected.

The potential biological effects of the alternatives are expected to be correctly incorporated in the present groundfish stock assessment and harvest specifications system, and there is no anticipated adverse impact to the target or incidental catch groundfish stocks that would result from a fishery with lower catch per unit effort. Consequently, neither alternative is likely to result in adverse impacts to groundfish stocks and are likely insignificant.

Similarly, with respect to the ecosystem component and non-FMP species, increased PSC limits under the alternatives are not likely to increase fishing pressure, as even if there is a redistribution of effort to avoid Chinook salmon, the fishery, overall, will likely remain within the established footprint of the non-pollock trawl fishing grounds. If the fisheries close early because the PSC limit has been reached, impacts on these species may be reduced. The impacts of Alternatives 2 and 3 are expected to be insignificant compared to the status quo.

Cumulative Effects on Groundfish

RFFAs that may affect groundfish are shown in Table 11. Ecosystem management, rationalization, and traditional management tools are likely to improve the protection and management of target and prohibited species, including targets of the non-pollock trawl fleet and Chinook salmon, and are not likely to result in significant effects when combined with the direct and indirect effects of Alternatives 2 and 3. Ongoing research efforts are likely to improve our understanding of the interactions between the harvest of groundfish and salmon. NMFS is conducting or participating in several research projects to improve understanding of the ecosystems, fisheries interactions, and gear modifications to reduce salmon PSC. The State of Alaska manages the commercial salmon fisheries off Alaska. The State’s first priority for management is to meet spawning escapement goals to sustain salmon resources for future generations. Subsistence use is the highest priority use under both State and federal law. Surplus fish beyond escapement needs and subsistence use are made available for other uses, such as commercial and sport harvests. The State carefully monitors the status of salmon stocks returning to Alaska streams and controls fishing pressure on these stocks. Other government actions and private actions may increase pressure on the sustainability of target and prohibited fish stocks either through extraction or changes in the habitat or may decrease the market through aquaculture competition, but it is not clear that these would result in significant cumulative effects. Any increase in extraction of target species would likely be offset by federal management. These are further discussed in Sections 4.1.3 and 7.3 of the Harvest Specifications EIS (NMFS 2007a) and in the 2017 SIR (NMFS 2017c).

Considering the direct and indirect impacts of the proposed alternatives when added to the impacts of past and present actions previously analyzed in other documents that are incorporated by reference and the impacts of the reasonably foreseeable future actions listed above, the cumulative impacts of the proposed alternatives are determined to be not significant.

3.3 Chinook Salmon

3.3.1 Overview of Biology and Ecological Role

An overview of information on Chinook salmon can be found at: http://www.adfg.alaska.gov/index.cfm?adfg=chinook.main.

The Chinook salmon (*Oncorhynchus tshawytscha*) is the largest of all Pacific salmon species, with weights of individual fish commonly exceeding 30 pounds. In North America, Chinook salmon range from the Monterey Bay area of California to the Chukchi Sea area of Alaska. On the Asian coast, Chinook salmon occur from the Anadyr River area of Siberia southward to Hokkaido, Japan. In Alaska, they are abundant from the southeastern panhandle to the Yukon River. In summer, Chinook salmon concentrate around the Aleutian Islands and in the Western GOA. Chinook salmon typically have relatively small spawning populations and the largest river systems tend to have the largest populations. Major populations of Chinook salmon return to the Yukon, Kuskokwim, Nushagak, Susitna, Kenai, Copper, Alsek, Taku, and Stikine rivers with important runs also occurring in many smaller streams.

Like all species of Pacific salmon, Chinook salmon are anadromous. They hatch in fresh water and rear in main-channel river areas for one year. The following spring, Chinook salmon turn into smolt and migrate to the salt water estuary. They spend anywhere from one to five years feeding in the ocean, then return to spawn in fresh water. All Chinook salmon die after spawning. Chinook salmon may become sexually mature from their second through seventh year, and as a result, fish in any spawning run may vary greatly in size. Females tend to be older than males at maturity. In many spawning runs, males outnumber females in all but the 6- and 7-year age groups. Small Chinook salmon that mature after spending only one winter in the ocean are commonly referred to as "jacks" and are all males. Alaska streams normally receive a single run of Chinook salmon in the period from May through July.

Chinook salmon often make extensive freshwater spawning migrations to reach their home streams on some of the larger river systems. Yukon River spawners bound for the headwaters in Yukon Territory, Canada will travel more than 2,000 river miles during a 60-day period. Chinook salmon do not feed during the freshwater spawning migration, so their condition deteriorates gradually during the spawning run as they use stored body materials for energy and gonad development.

Each female deposits between 3,000 and 14,000 eggs in several gravel nests, or redds, which she excavates in relatively deep, fast moving water. In Alaska, the eggs usually hatch in the late winter or early spring, depending on time of spawning and water temperature. The newly hatched fish, called alevins, live in the gravel for several weeks until they gradually absorb the food in the attached yolk sac. These juveniles, called fry, wiggle up through the gravel by early spring. In Alaska, most juvenile Chinook salmon remain in fresh water until the following spring when they migrate to the ocean as smolt in their second year.

Juvenile Chinook salmon in freshwater feed on plankton and then later eat insects. In the ocean, they eat a variety of organisms including herring, pilchard, sand lance, squid, and crustaceans. Salmon grow rapidly in the ocean and often double their weight during a single summer season.

Food Habits and Ecological Role

For Pacific salmon, oceanic foraging conditions and food relationships are important to growth. They are omnivorous and opportunistic feeders. Major categories of prey found in stomach contents of Pacific salmon species usually include either one or a combination of fish, squid, euphausiids, amphipods, copepods, pteropods, larval crustaceans, zooplankton, polychaetes, ostracods, mysids, and shrimps. By switching their diets to micronekton (fish and squid), salmon can sustain themselves through seasons or years of low zooplankton production. At the same time, Pacific salmon are selective feeders. Prey selectivity in salmon is related to inter- and intra-specific differences in functional morphology, physiology, and behavior. In general, Chinook salmon tend to feed on large prey (Kaeriyama et al. 2000).

The Bering Sea-Aleutian Salmon International Survey (BASIS) is a program of pelagic ecosystem research on salmon and forage fish in the Bering Sea coordinated by the North Pacific Anadromous Fish Commission (NPAFC). A major goal of this program is to understand how changes in the ocean conditions affect the survival, growth, distribution, and migration of salmon in the Bering Sea. At this time, no such coordinated research plan exists for the GOA. As a result, ecological information specifically related to Chinook salmon in the GOA is limited.

Ocean salmon feeding ecology is highlighted by the BASIS program given the evidence that salmon are food limited during their offshore migrations in the North Pacific and Bering Sea. Increases in salmon abundance in North America and Asia stocks have been correlated to decreases in body size of adult salmon, which may indicate a limit to the carrying capacity of salmon in the ocean. International high seas research results suggest that inter- and intra-specific competition for food and density-dependent growth effects occur primarily among older age groups of salmon particularly when stocks from different geographic regions in the Pacific Rim mix and feed in offshore waters (Ruggerone et al. 2003).

Results of a fall study to evaluate food habits data in 2002 indicated Chinook salmon consumed predominately small nekton and did not overlap their diets with sockeye and chum salmon. Shifts in prey composition of salmon species between season, habitats, and among salmon age groups were attributed to changes in prey availability (Davis et al. 2004).

Stomach sample analysis of ocean age .1 and .2[14] fish from basin and shelf area Chinook salmon indicated that their prey composition was more limited than chum salmon. This particular study did not collect many ocean age .3-year or .4-year Chinook salmon although those collected were located predominantly in the basin. Summer Chinook salmon samples contained high volumes of euphausiids, squid, and fish while fall stomach samples in the same area contained primarily squid and some fish. The composition of fish in salmon diets varied with area with prey species in the basin primarily northern lamp fish, rockfish, Atka mackerel, pollock, sculpin, and flatfish while shelf samples contained more herring, capelin, pollock, rockfish, and sablefish. Squid was an important prey species for ocean age .1, .2, and .3 Chinook salmon in summer and fall. The proportion of fish was higher in summer than fall as was the relative proportion of euphausiids. The proportion of squid in Chinook salmon stomach contents was larger during the summer in year (even numbered) when there was a scarcity of pink salmon in the basin (Davis et al. 2004).

Results from the Bering Sea shelf on diet overlap in 2002 indicated that the overlap between chum and Chinook salmon was moderate (30%), with fish constituting the largest prey category, results were similar in the basin. However, notably on the shelf, both chum and Chinook salmon consumed juvenile pollock, with Chinook salmon consuming somewhat larger than those consumed by chum salmon. Other fish consumed by Chinook salmon included herring and capelin while chum salmon stomach contents also included sablefish and juvenile rockfish (Davis et al. 2004).

General results from the study found that immature chum salmon are primarily predators of macrozooplankton while Chinook salmon tend to prey on small nektonic prey such as fish and squid. Prey compositions shift between species and between seasons in different habitats and a seasonal reduction in diversity occurs in both chum salmon and Chinook salmon diets from summer to fall. Reduction in prey diversity was noted to be caused by changes in prey availability due to distribution shifts, abundance changes, or progression of life-history changes which could be the result of seasonal shift in environmental factors such as changes in water temperature and other factors (Davis et al. 2004).

Diet overlap estimates between Chinook salmon and sockeye salmon and Chinook salmon and chum salmon were lower than estimates obtained for sockeye and chum salmon, suggesting a relatively low level of inter-specific food competition between immature Chinook salmon and immature sockeye of chum salmon in the Bering Sea because Chinook salmon were more specialized consumers. In addition, the relatively low abundance of immature Chinook salmon compared to other species may serve to reduce intra-specific competition at sea. Consumption of nektonic organisms (fish and squid) may be efficient because they are relatively large bodied and contain a higher caloric density then zooplankton. However, the energetic investment required of Chinook salmon to capture actively swimming prey is large, and if

[14] Salmon age is expressed by the decimal system. The number preceding the decimal is the number of winters the salmon spent in freshwater and the number after the decimal is the number of winters the salmon has been in salt water. One year is added to the sum of the numbers on each side of the decimal to account for the embryonic stage. Thus, age 1.1 refers to a 3 year old salmon and .2 also refers to a three year old salmon.

fish and squid prey abundance is reduced, a smaller proportion of ingested energy will be available for salmon growth. It is hypothesized that inter- and intra-specific competition in the Bering Sea could negatively affect the growth of chum salmon and Chinook salmon particularly during spring and summer in odd-numbered years when the distribution of Asian and North American salmon stocks overlap. Decreased growth could lead to reduction in salmon survival by increasing predation, decreasing lipid storage to the point of insufficiency to sustain the salmon through the winter when consumption rates are low, and increasing susceptibility to parasites and disease due to poor salmon nutritional condition (Davis et al. 2004, 1998; Ruggerone et al. 2003).

3.3.2 Management and Assessment of Chinook Salmon Stocks

North Pacific Chinook salmon are the subject of commercial, subsistence, personal use, and sport/recreational (used interchangeably) fisheries. Chinook salmon are the least abundant of the five salmon species found on both sides of the Pacific Ocean and the least numerous in the Alaska commercial harvest. The majority of the Alaska commercial catch occurs in Southeast Alaska, Bristol Bay, and the Arctic-Yukon-Kuskokwim area. The majority of catch occurs with troll gear and gillnets. Approximately 90% of the subsistence harvest is taken in the Yukon and Kuskokwim rivers. Chinook salmon is one of the most highly prized sport fish in Alaska and is extensively fished by anglers in the Southeast and Cook Inlet areas. The sport fishing harvest of Chinook salmon averages over 170,000 fish annually with Cook Inlet and adjacent watersheds contributing over half. Unlike other Pacific salmon species, some Chinook salmon stocks rear in inshore marine waters and are, therefore, available to commercial and sport fishers all year round.

The State of Alaska manages subsistence, sport, commercial, and personal use harvests of salmon in waters throughout Alaska. 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 needs are made available for other uses. Throughout the state, salmon are a fully-allocated resource; multi-use salmon fisheries (commercial, sport, subsistence, and personal use) share a finite resource.

In the State's Policy for the Management of Mixed Stock Salmon Fisheries (5AAC 39.220), conservation of wild salmon stocks, consistent with sustained yield is given the highest priority. In the absence of a regulatory management plan that allocates or restricts harvest, and when it is necessary to restrict fisheries on stocks where there are known conservation problems, the burden of conservation shall be shared among all fisheries in close proportion to their respective harvest on the stock of concern. Assigning conservation burdens in mixed stock fisheries is accomplished through the application of specific fishery management plans set out in regulation. To this end, management plans are adopted by the State that work to both minimize and maximize allocations of specific salmon stocks, depending upon the conservation need identified. As such, management plans incorporate conservation burden and allocation of harvest opportunity that affects all users of the resource in Alaska. Management plan provisions such as net mesh size restrictions, weekly fishing periods, and size limits work to reduce the incidental catch of non-target salmon species in the salmon fishery so that stocks are able to achieve their established escapement goals.

The State manages salmon through the Alaska Board of Fisheries (Board), ADF&G, and the Alaska Commercial Fisheries Entry Commission (CFEC).

- The Board is responsible for considering and adopting regulations through a public process to conserve and allocate fisheries resources to various user groups; establishing fish reserves and conservation areas, fishing season quotas, bag limits and size restrictions; methods and means;

habitat protection; stock enhancement; and developing commercial, subsistence, sport and personal use fisheries;

- ADF&G is responsible for the protection, management, conservation, and restoration of Alaska's fish and game resources;
- CFEC helps to conserve and maintain the economic health of Alaska's commercial fisheries. Its primary duties are limiting the number of participating fishermen and issuing permits and vessel licenses to qualified individuals in both limited and unlimited fisheries.

The priorities of management are to first ensure adequate escapement to sustain future runs; second, provide reasonable opportunity for subsistence fishermen to meet their needs; and third, provide opportunity to commercial, sport, and personal use fishermen to harvest fish in excess of escapement and subsistence needs. Through its public process, the Board strives to manage for the potential conflicts that arise from the nature of competing interests in such a diverse fishery. The Board has adopted regulations that control the time, area of operation, and efficiency of salmon fisheries to address the unique challenges of managing mixed-stock resources.

ADF&G uses an adaptive management process to achieve these priorities that starts with development of management strategies based on pre-season forecasts, then transitions into evaluation of run strength in season, and adjusting management strategy implementation based on in-season performance of annual salmon runs. While forecasts and pre-season management strategies are made each year, these are frequently revised based on in-season run assessments. For example, the structure and implementation of fishing windows may be adjusted in-season by Emergency Order based on run strength and run timing estimates derived from in-season run assessment programs. Management decisions often need to be made before fish have reached the affected areas, districts, or communities. Managers use test fisheries, escapement monitoring projects, genetic stock identification and age-sex-length composition, and in-season harvest reports to assess and project salmon run timing and run strength in-season to inform management decisions.

ADF&G's fishery management activities fall into two categories: inseason management and applied science. For inseason management, the department employs fishery managers near the fisheries. Local fisheries managers are given authority to open and close fisheries to achieve two goals: the overriding goal is conservation to ensure an adequate escapement of spawning stocks, and the secondary goal is an allocation of fish to various user groups based upon management plans approved by the BOF. The BOF develops management plans in open, public meetings after considering public testimony and advice from various scientists, advisors, fishermen, and user interest groups (Woodby et al. 2005). Decisions to open and close fisheries are based on the professional judgment of area managers, the most current biological data from field projects, and fishery performance. Research biologists and other specialists conduct applied research in close cooperation with the fishery managers. The purpose of the department's research staff is to ensure that the management of Alaska's fisheries resources is conducted in accordance with the sustained yield principle and that managers have the technical support they need to ensure that fisheries are managed according to sound scientific principles and utilizing the best available biological data. The Division of Commercial Fisheries works closely with the Division of Sport Fisheries in the conduct of both management and research activities (http://www.adfg.alaska.gov/index.cfm?adfg=chinook.management).

By far, most salmon in Alaska are caught in commercial troll, gillnet, and purse seine fisheries in which participation is restricted by a limited entry system. Troll gear works by dragging baited hooks through the water. Gillnet gear works by entangling the fish as they attempt to swim through the net. Gillnets are deployed in two ways: from a vessel that is drifting and from an anchored system out from the beach. Purse seines work by encircling schools of fish with nets that are drawn up to create giant "purses" that hold the school until the fish can be brought aboard. Other kinds of gear used in Alaska's smaller fisheries include fishwheels, which scoop fish up as the wheel is turned by river currents (Woodby et al. 2005).

3.3.2.1 Escapement Goals and Stock of Concern Definitions

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 BOF 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 will be used by ADF&G and the BOF 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 of 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.

When stocks of concern are identified, ADF&G works with the BOF and public to develop action plans describing potential management actions and research programs to achieve stock re-building goals. Action plans for management may involve time and area restrictions for commercial fisheries judged to have significant impacts on the stock of concern, as well as sport fishery restrictions including bag limit changes, prohibiting use of bait or retention of a species, or closures of the fisheries. Subsistence fishing restrictions may also be considered in action plans.

In addition to measures affecting commercial and sport fishery management, stock of concern action plans also identify key research objectives designed to provide information necessary to make informed decisions.

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)).

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

Sustainable escapement goal (SEG) means a level of escapement, indicated by an index or an escapement estimate, that is known to provide for sustained yield over a 5- to 10-year period, and 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 determined by the ADF&G and will be stated as a SEG range or a lower bound SEG that takes into account data uncertainty. ADF&G 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)).

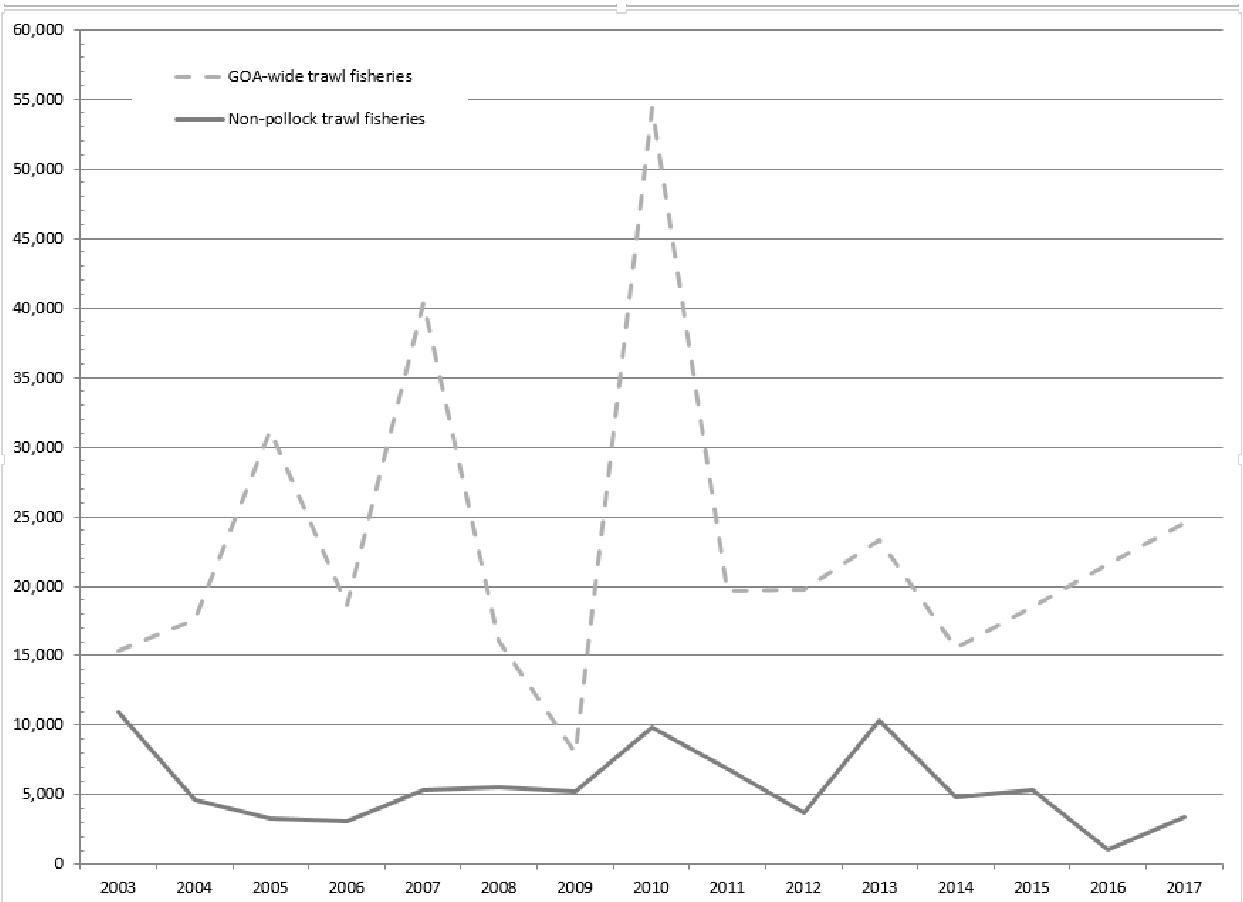
SET means a threshold level of escapement, below which the ability of the salmon stock to sustain itself is jeopardized. In practice, SET can be estimated based on lower ranges of historical escapement levels, for which the salmon stock has consistently demonstrated the ability to sustain itself. The 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)).

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. As such, 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.

3.3.3 Prohibited Species Catch of Chinook Salmon in the GOA Non-pollock Fisheries

Chinook salmon are prohibited species in the GOA trawl fisheries, however, they are incidentally taken as bycatch (or PSC) given their co-occurrence with GOA trawl fishery target species. While PSC levels are highly variable from year to year, on average, the GOA non-pollock trawl fisheries account for approximately one-quarter of total Chinook salmon PSC in the GOA trawl fisheries (Figure 2). The highest Chinook salmon PSC levels in the non-pollock trawl fisheries occurred in 2003, 2010 and 2013. It is assumed that salmon caught in groundfish fisheries have a 100% mortality rate.

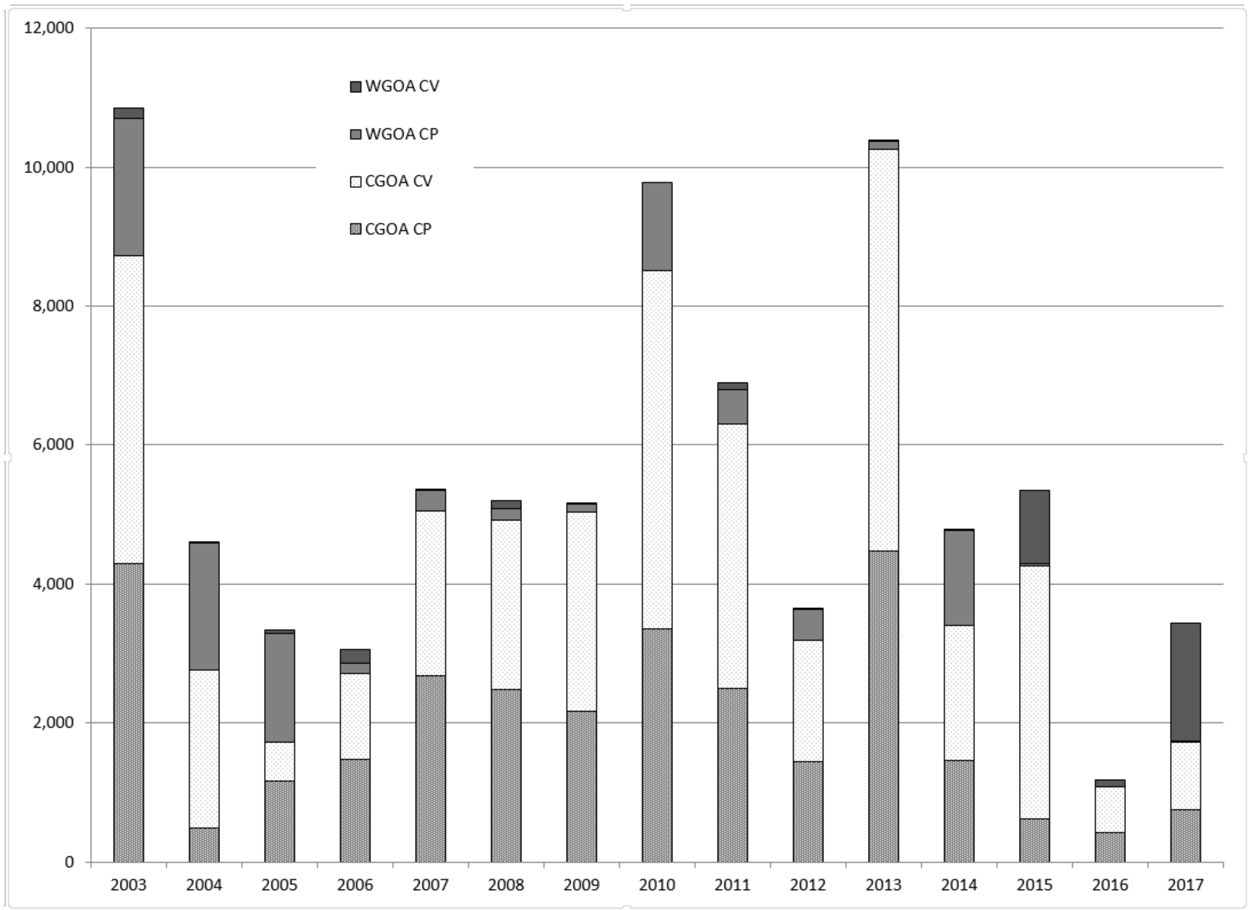
Figure 2 **Prohibited species catch of Chinook salmon in Gulf of Alaska non-pollock trawl fisheries, 2003 through 2017 (number of fish)**



Source: NMFS Alaska Region Catch Accounting System, January 17, 2018

Historical Chinook salmon PSC is discussed in detail in the RIR. Figure 3 illustrates Chinook salmon PSC in the non-pollock trawl fisheries for 2003 through 2017 among catcher vessels and catcher processors in the Western and Central GOA. Additional data for Western GOA catcher vessels is seen in more recent years in part due to the observer program restructuring that was implemented starting in 2013.

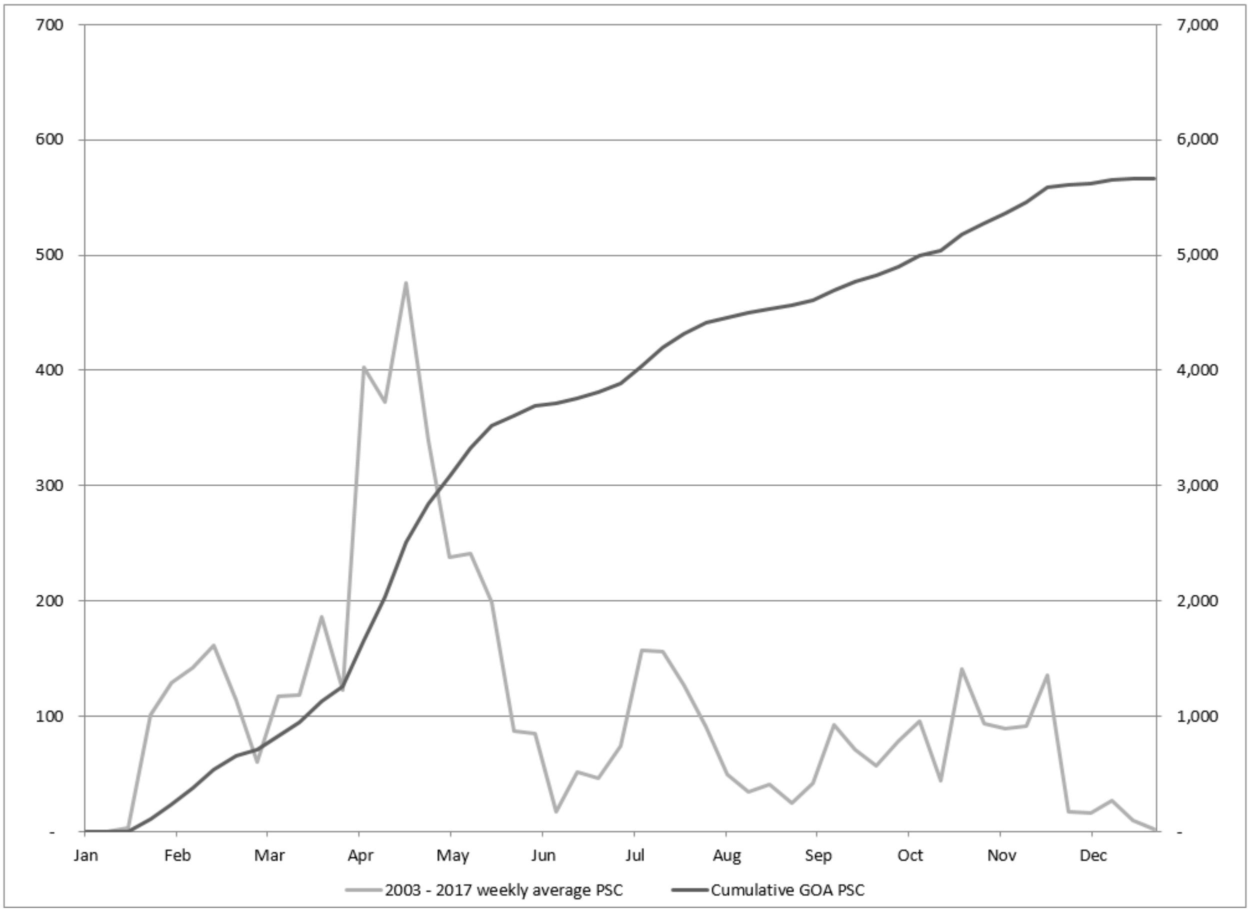
Figure 3 Annual estimated Chinook salmon PSC in non-pollock groundfish fisheries, 2003 to 2017, for the Western (WG) and Central GOA (CG), catcher processors (CP) and catcher vessels (CV)



Source: NMFS Alaska Region Catch Accounting System, January 17, 2018

Figure 4 illustrates the distribution of non-pollock trawl Chinook salmon PSC throughout the calendar year, based on 2003 to 2017. In the general pattern, Chinook PSC is first taken in the Pacific cod A season fishery in January and early February. The early spring (March – April) spike in PSC represents increasing PSC in the rex sole fishery, as well as the most intense period of arrowtooth flounder-related PSC. The rockfish fishery drives non-pollock PSC from the typical season opening in May, through August (when rockfish volume falls off significantly, although the fishery can occur as late as November). Some additional PSC during the late spring occurs in the arrowtooth and rex sole fisheries, but rockfish trips are the predominant source of summer PSC. Much of the September and October PSC is recorded in B season Pacific cod trips, though shallow water flatfish trips emerge as a PSC source in late-September and continue through November, once the cod season has ended. After the end of the cod season, trips targeting arrowtooth also contribute to increased Chinook catch.

Figure 4 Seasonal distribution of GOA Chinook salmon PSC, average Chinook PSC from 2003 to 2017



Source: NMFS Alaska Region Catch Accounting System

3.3.3.1 Size and Weight of Chinook Salmon Prohibited Species Catch

Information on the length and weight of Chinook salmon PSC in the GOA trawl fisheries is available from observer sampling and coded wire tag (CWT) information. As described in section 3.3.4.1, observer samples of Chinook salmon PSC are representative of the PSC population for the GOA pollock trawl fishery since 2014 and for the Central GOA Rockfish Program CV fishery since 2013. Observer samples of Chinook salmon PSC are also available for the arrowtooth flounder trawl CP fishery, however these samples are collected opportunistically and resulting data from these samples reflect the distribution of the sample only. The analysis prepared for the Council's consideration of Amendment 97 cited a study based on observer samples taken opportunistically between 2002 and 2012 that placed the average weight of GOA trawl Chinook salmon PSC between five and nine pounds (NPFMC 2014). Increased sampling of Chinook salmon PSC since 2013 has resulted in the availability of more granular information on the size of Chinook salmon PSC in the GOA trawl fisheries. The AFSC provided frequency distributions of Chinook salmon PSC length (cm) and weight (kg) from the GOA pollock trawl fishery, the Central GOA Rockfish Program CV sector, and the arrowtooth flounder trawl CP fishery from 2013 through 2017 (Figure 5 through Figure 9). Table 13 summarizes that data in terms of average and median length/weight.[15] Data from 2013 are not shown in the figures for the pollock and rockfish fisheries but are

[15] Observers collect snout to fork lengths (SNF) (AFSC 2017c) and ADF&G reports mid-eye to fork lengths (MEF). Pahlke (1998) provides a conversion for SNF to MEH for ocean caught Chinook salmon in Southeast Alaska. On average, SNF reported lengths are approximately 1 cm longer than MEF lengths.

included in Table 13. Data from the arrowtooth flounder trawl CP fishery in 2016 and 2017 is not available due to a low number of voluntary samples submitted for observer sampling.

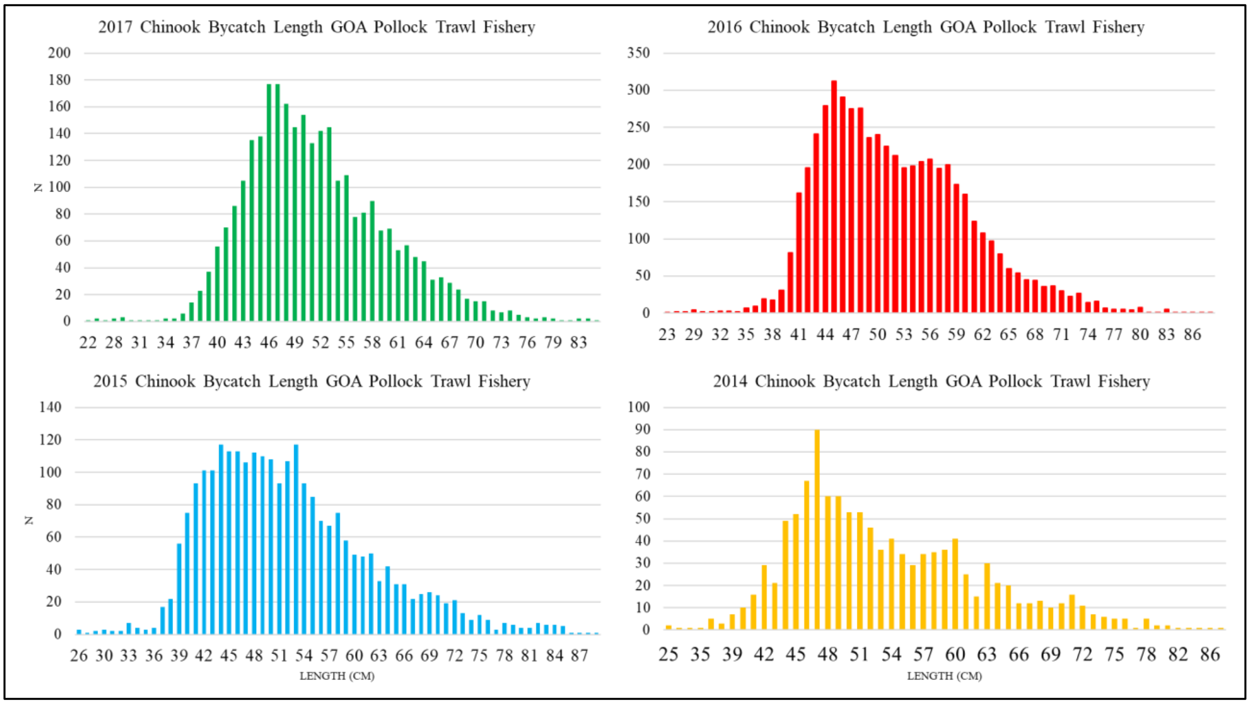
From 2013 through 2017, observers measured roughly 14,200 Chinook salmon samples from the GOA pollock trawl fishery, 4,000 samples from the Central GOA Rockfish Program CV sector fishery, and 1,350 samples from the CP sector's arrowtooth flounder trawl fishery. The median Chinook salmon sampled from the GOA pollock trawl fishery was 50 cm in length (19.7 in.) and 1.7 kg in weight (3.7 lbs.); average values were 52 cm (20.5 in.) and 2.0 kg (4.4 lbs.). Samples of Chinook salmon PSC from the Rockfish Program CV sector were slightly larger, with annual median values around 57 cm in length (22.4 in.) and 2.3 kg in weight (5.1 lbs.). The middle range for Chinook PSC sampled from the Rockfish Program fishery displayed greater variance and a *relatively* greater proportion of larger fish, noting that the total number of fish sampled (N) was smaller. The average length of Chinook salmon sampled from the CP trawl arrowtooth flounder fishery from 2013 through 2015 was around 55 cm in length (21.7 in.); sampled weights were not available. The modest difference in the size of Chinook salmon taken as PSC in pollock versus non-pollock fisheries might be attributed to different fishing depths or fishing at different times of year. However, the size difference could also be explained by unobserved factors, so it is not possible to make a definitive distinction at this time.

Table 13 Descriptive statistics for Chinook salmon PSC snout to fork (SNF) length and weight by fishery, 2013 through 2017

Fishery			2013	2014	2015	2016	2017
Pollock	Length (cm)	Samples (N)	740	1,355	2,606	5,524	3,959
		Average	55	54	52	52	51
		Median	52	51	50	51	59
	Weight (kg)	Samples (N)	740	1,351	2,604	5,442	3,959
		Average	2.2	2.4	2.0	2.1	1.9
		Median	1.8	1.8	1.6	1.7	1.5
Rockfish Prog.	Length (cm)	Samples (N)	2,099	466	635	505	299
		Average	60	58	58	54	57
		Median	60	57	56	52	57
	Weight (kg)	Samples (N)	2,096	465	635	505	301
		Average	3.2	3.0	2.4	2.2	2.4
		Median	2.9	2.7	2.1	1.9	2.0
Arrowtooth CP	Length (cm)	Samples (N)	602	446	316		
		Average	55	54	56		
		Median	69	54	56		

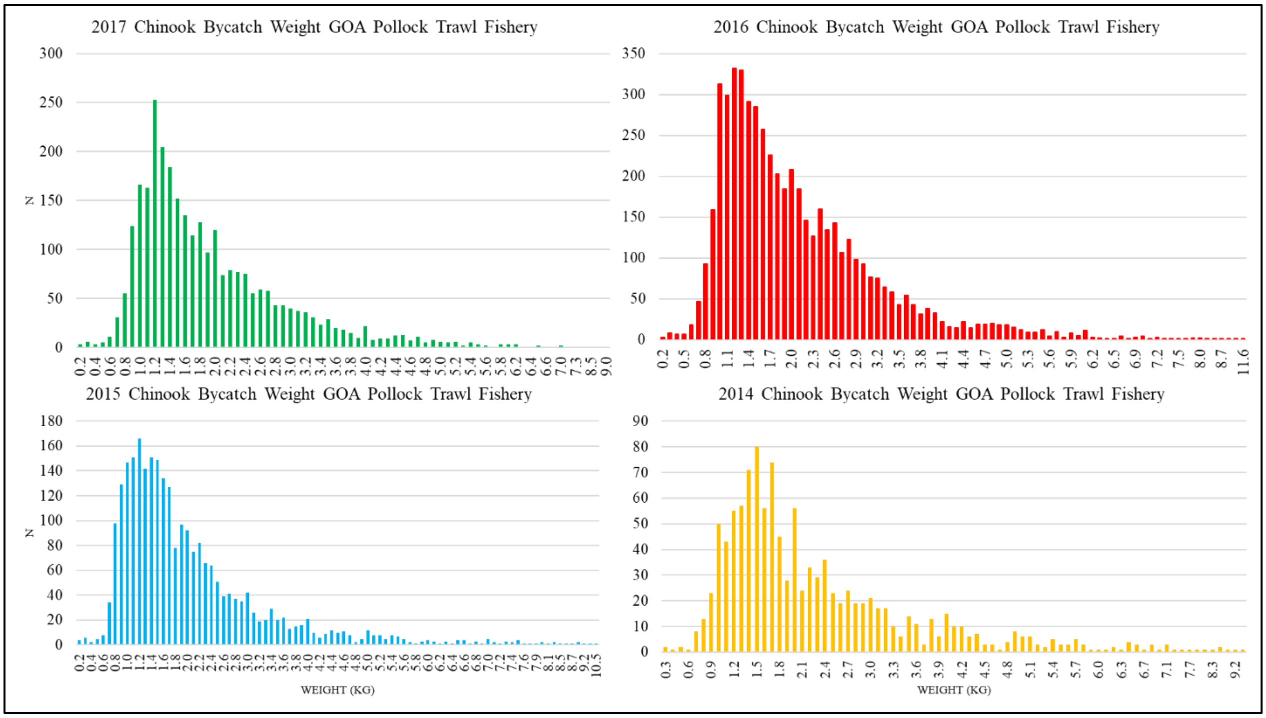
Source: Pollock data: NMFS Catch Accounting System data accessed March 2, 2018 and compiled by Alaska Fisheries Information Network for AFSC; Rockfish Program data: Alaska Groundfish Databank; Arrowtooth CP data: Alaska Seafood Cooperative.

Figure 5 Snout to fork length (cm) of sampled Chinook PSC in GOA pollock trawl fishery, 2014 through 2017



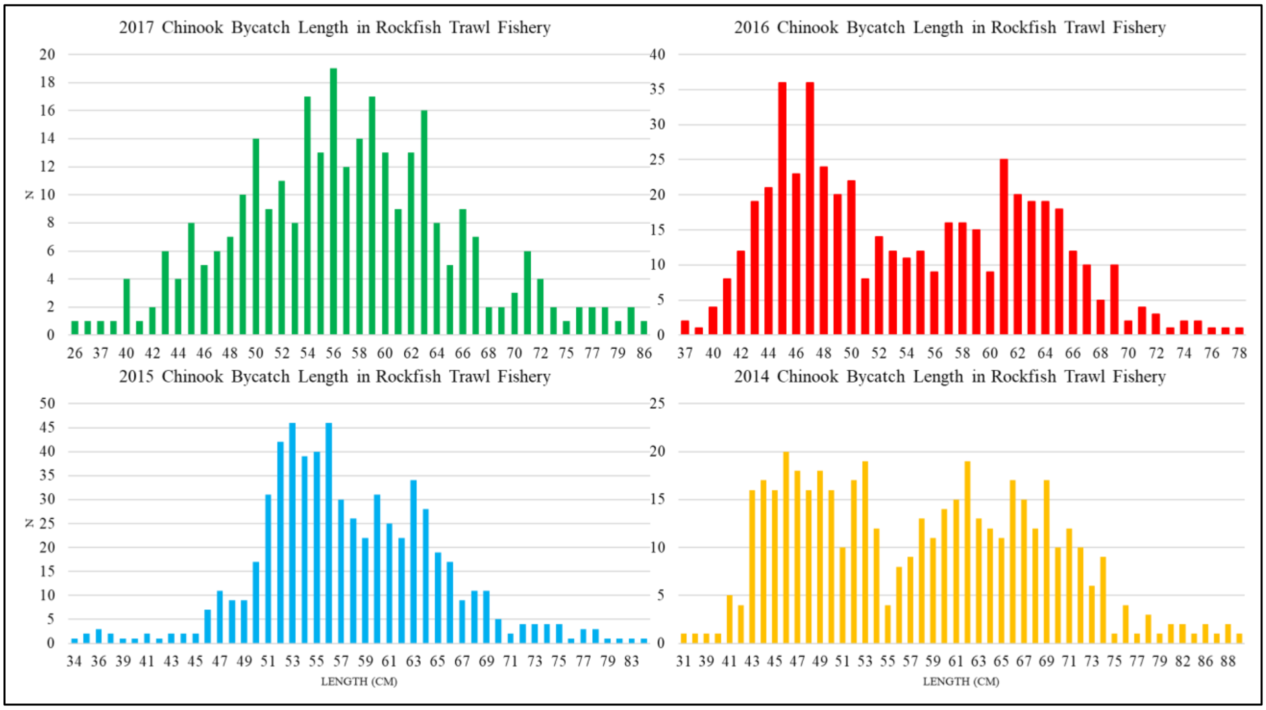
Source: NMFS Catch Accounting System data accessed March 2, 2018 and compiled by Alaska Fisheries Information Network for AFSC.

Figure 6 Weight (kg) of sampled Chinook PSC in GOA pollock trawl fishery, 2014 through 2017



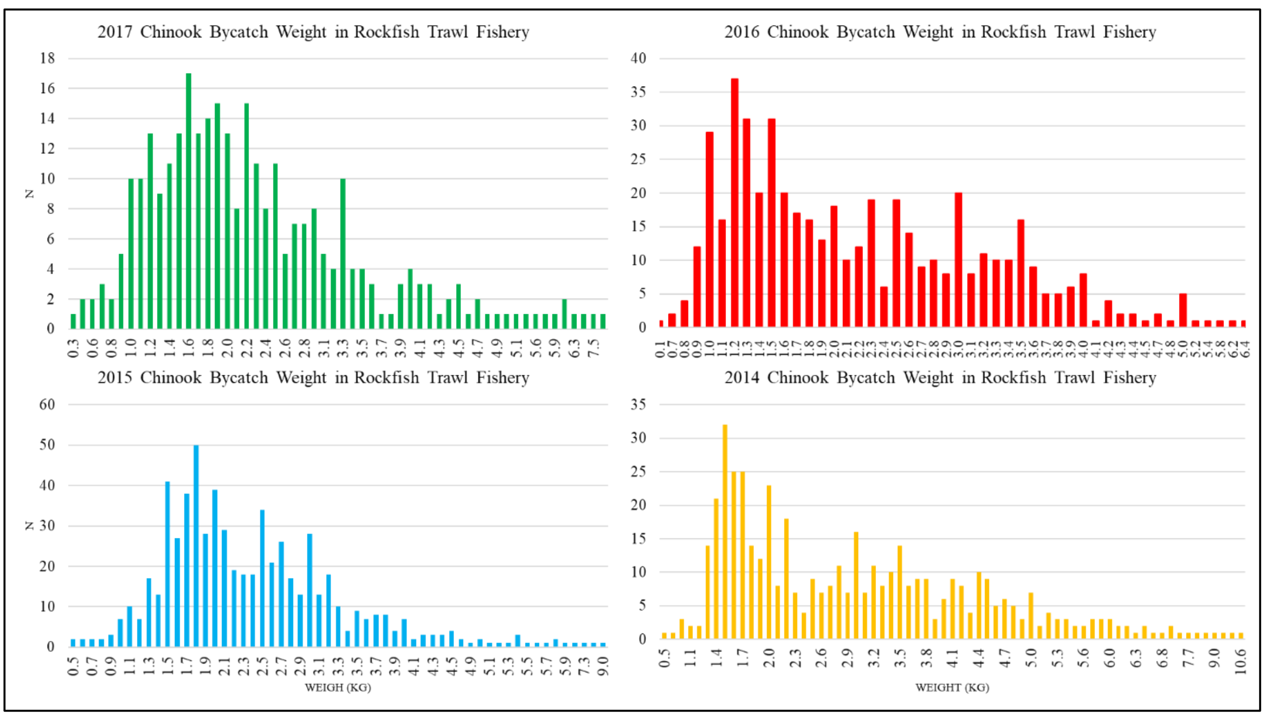
Source: NMFS Catch Accounting System data accessed March 2, 2018 and compiled by Alaska Fisheries Information Network for AFSC.

Figure 7 Snout to fork length (cm) of sampled Chinook PSC in Rockfish Program trawl fishery, 2014 through 2017



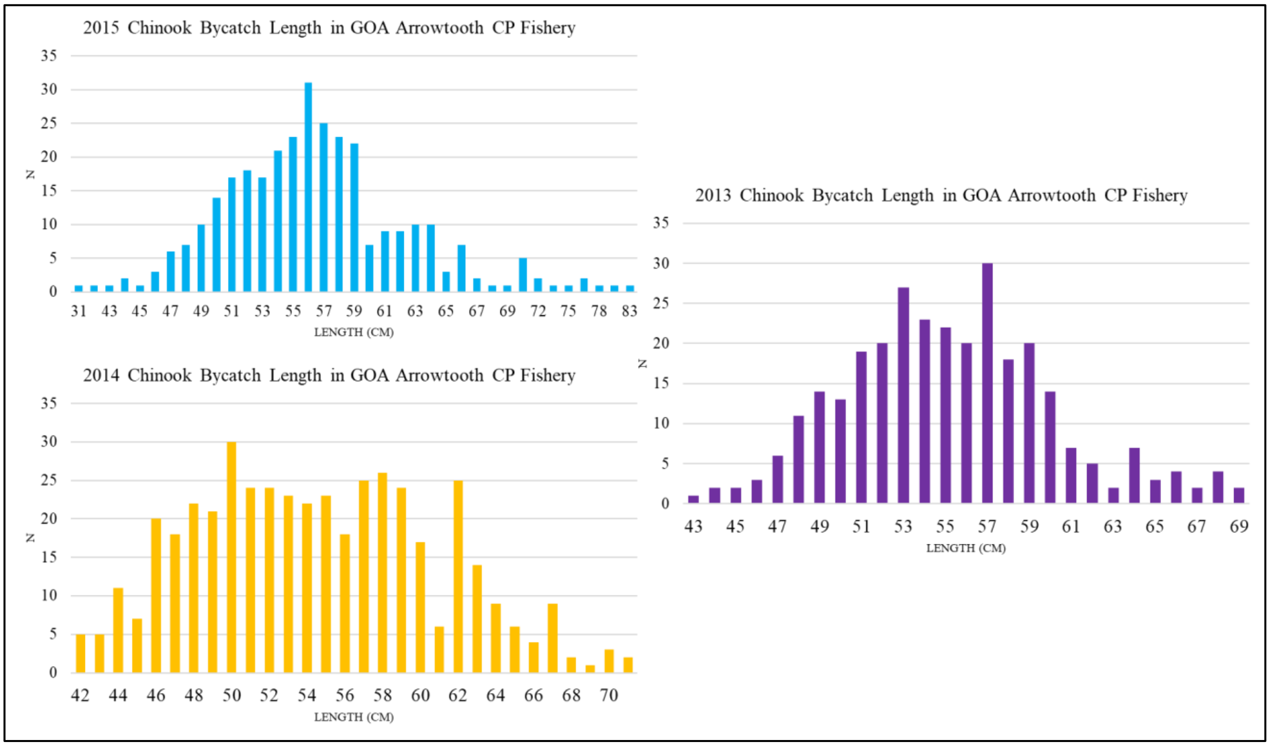
Source: Information provided to AFSC by Alaska Groundfish Data Bank (Julie Bonney and Katy McGauley, Personal Communication 2018).

Figure 8 Weight (kg) of sampled Chinook PSC in Rockfish Program trawl fishery, 2014 through 2017



Source: Information provided to AFSC by Alaska Groundfish Data Bank (Julie Bonney and Katy McGauley, Personal Communication 2018).

Figure 9 Snout to fork length (cm) of sampled Chinook PSC in arrowtooth trawl CP fishery, 2013 through 2015



Source: Data provided to AFSC by the Alaska Seafood Cooperative (John Gauvin, personal communication, 2018).

Much context is required to interpret the corresponding age classes and time-to-maturity for Chinook salmon encountered in the GOA trawl fisheries. Among Pacific salmon, Chinook salmon exhibit the greatest variation in size at age and age at maturity (Roni and Quinn 1995). For example, in a study of n = 108 North America Chinook salmon populations from 42 to 65° north latitude, the range in mean length at age was more than 20 cm in most age-groups and up to 26 cm for male Chinook salmon at age 1.2[16] (Roni and Quinn 1995). Moreover, Chinook salmon length-at-age varies considerably among populations (Roni and Quinn 1995) and several studies have documented steadily decreasing size and age at maturity of Chinook salmon since the 1930s (Ricker 1980, 1981) which appears to be continuing today (Lewis et al. 2015, Ohlberger et al. 2018).

Though length at age and age composition of a spawning class may vary considerably among Chinook salmon populations, we provide some examples of age and length information from ADFG escapement sampling for additional context about the GOA trawl Chinook salmon PSC length distributions. It is important to note that salmon sampling can be size or sex selective depending on the method used (Roni and Quinn 1995) so results should be interpreted with caution and in a qualitative manner.

The ADFG Mark, Tag and Age Lab maintains a detailed database of salmon coded wire tag tracking and age determination information from many forms of sampling, including escapement sampling. The database includes information dating back to the late 1970s and represents data from over a million

[16] The decimal age system is used in the U.S. to represent Chinook salmon age and life history. An age of 1.2 refers to a fish that spent one year in fresh water and two years in the ocean. A year is added for the time as an embryo and as such age 1.2 translates to a 4 year old fish, 1.3 translates to a 5 year old fish and so on.

salmon from 222 locations throughout Alaska.[17] Here, we provide an example of this information from Chilkat River salmon escapement sampling. The Chilkat River is one of the principal producers of Chinook salmon in Southeast Alaska (McPherson et al. 2003).

Figure 10 **Average length (SNF) at age of ≥ age 1.2 Chinook salmon returning to the Chilkat River by sex, 1991 through 2017. Dotted lines represent the time series' average length for each age and solid lines represent the average length for each age by year. Data source: Brian Elliot, ADFG, personal communication, March 12, 2018. Note: lengths were provided in MEF, mm and converted to SNF, cm using conversions in Pahlke (1998).**

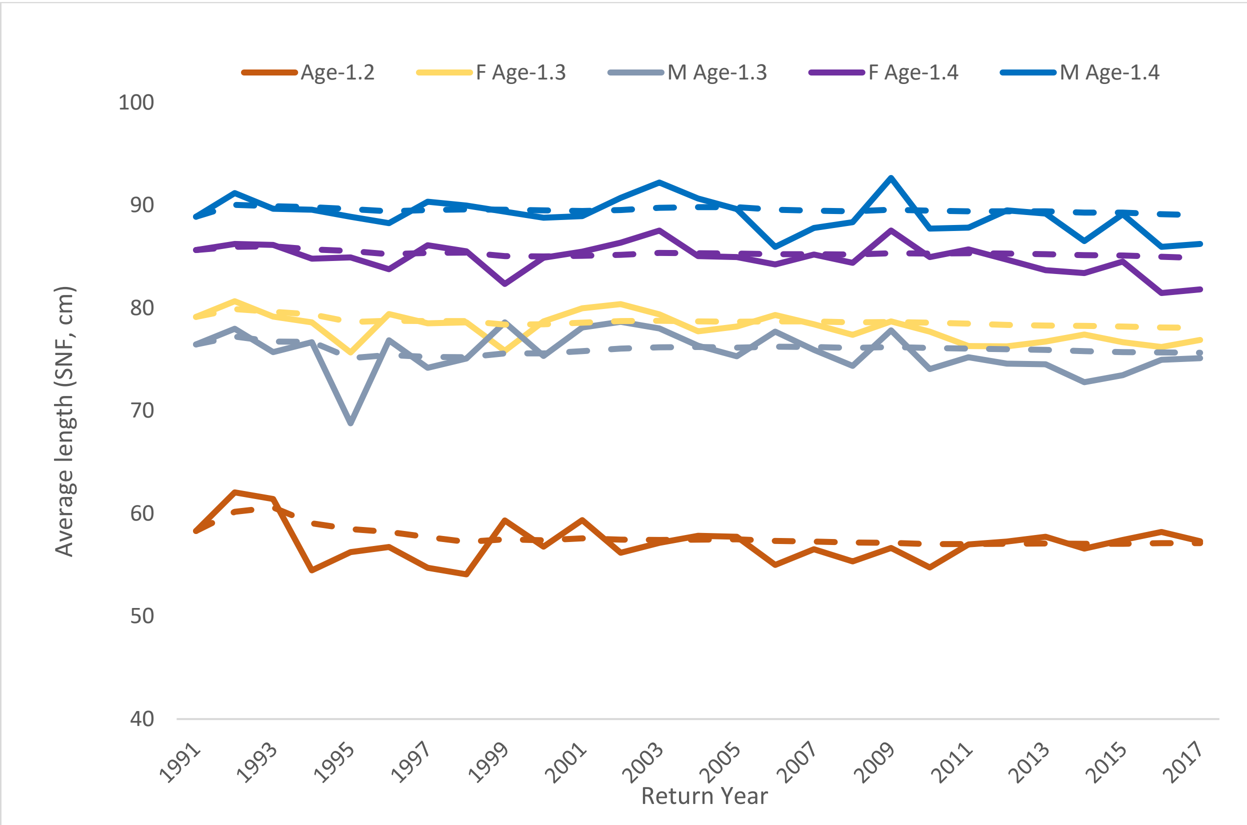


Table 14 **Estimated in-river run of Chinook salmon in the Chilkat River, shown as a percentage by age and sex for 2010 and 2011. Source: Chapell (2013, 2014). Note, standard error estimates are provided in Chapell (2013, 2014).**

		Age				
Year	**Sex**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**
2011	Males	13.5	43.7	32.0	10.8	0.0
	Females	0.0	3.2	60.6	35.3	0.8
	All Fish	8.7	29.4	42.2	19.5	0.3
2010	Males	42.1	24.2	18.6	15.1	0.0
	Females	0.0	5.1	41.6	48.2	5.1
	All Fish	26.1	15.4	28.2	29.9	0.4

The average length of adult Chinook salmon sampled in the Chilkat River tend to be greater than 55 cm (Figure 10). However, as shown in Table 14, in 2010, more than 42 percent of males (26 percent of all

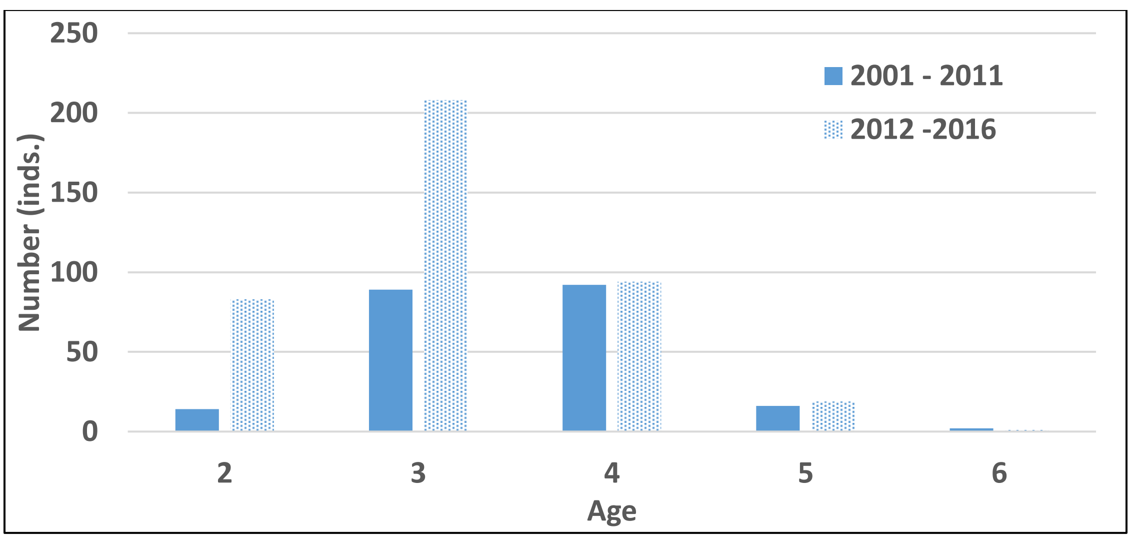
[17] More information on the database is available on the ADFG Mark, Tag and Age website: https://mtalab.adfg.alaska.gov/CWT/Default.aspx.

salmon) in the Chilkat River escapement survey were age 1.1 fish (brood year = 2007), which would be smaller than age 1.2 fish shown in Figure 10. For additional context, data from the Chena River in 2015, show that age 1.1 male Chinook salmon (while only one percent of the population sampled), ranged from 34 to 38 cm, age 1.2 male Chinook salmon ranged from 46 to 66 cm and age 1.3 males ranged from 58 to 80 cm in length (Stuby and Tyers, 2016). Among all age classes combined, the inriver length of male Chinook salmon in the Chena River in 2015 ranged from 34 to 100 cm (Stuby and Tyers, 2016).

Available lengths for Chinook salmon PSC in the GOA trawl fisheries range from 22 to 88 cm and average between 51 and 60 cm (Table 13 and Figure 5, Figure 7, and Figure 9). If we assume the size at age distribution of the bycatch is similar to the size at age distribution for the Chilkat River, the GOA trawl fisheries would primarily be taking age 1.1 and 1.2 Chinook salmon, with a small proportion of younger and older fish. However, this is provided for illustrative purposes only as we know not all GOA trawl Chinook salmon bycatch originates from Southeast Alaska (see section 3.3.4.1) and that size at age distributions vary among systems. Factors affecting size at age and maturity are likely influenced by variables affecting growth and survival, including competition, food availability, predation, disease, temperature and harvest intensity.

Information obtained from recoveries of coded-wire tags from Chinook salmon PSC in the GOA trawl fisheries provides additional age information for Chinook salmon PSC in the GOA (Mausda 2017). The age information provided in Figure 11 is not representative of the entire GOA Chinook salmon PSC due to current and prior coded-wire tag sampling methods used by the Observer Program in the GOA trawl fisheries (see section 3.3.4.2 and Masuda 2017 in NMFS 2017a); however, these data reflect the age distribution of the Chinook salmon recovered with coded-wire tags. The coded-wire tag age distribution corresponds with the estimated ages from the length information described above and ranges from two to six years, with 2-, 3- and 4-year-olds being the most commonly occurring age classes from 2012 through 2016.[18]

Figure 11 **Number of coded-wire tagged Chinook salmon PSC recovered by NMFS certified observers in the GOA groundfish fisheries, by age from 2001 through 2011 (n=213) and 2012 through 2016 (n=405). Age was calculated by subtracting the brood year of the coded-wire tagged recovery from the recovery year and includes freshwater and saltwater residency. Source: Table 6 in Masuda (2017 in NMFS 2017a).**



[18] The 2001 through 2011 and 2012 through 2016 periods are separated due to different Observer Program sampling regimes between these two epochs. See Section 4.5.1 and Masuda (2017) for details.

In sum, many factors complicate interpretation of the age classes and time until spawning of the Chinook salmon taken as bycatch in the GOA trawl fisheries. The available information allows us to understand that the fisheries likely take immature and almost mature Chinook salmon of many age classes.

3.3.3.2 Using Adult Equivalents (AEQ) to Estimate Impacts of Bycatch

The relationship between trawl PSC and the number of Chinook salmon that would not return to their spawning stream is complex and plays out over a number of years. Estimating effects requires some knowledge of where the Chinook taken as PSC originated (available information on the origins of GOA trawl Chinook salmon PSC is included in Section 3.3.4 of this document). In addition to genetic stock origin, the impact of bycatch on spawning production is also determined by the age of the fish when they are taken, the distribution of ages at which salmon reach sexual maturity (which varies within and among river systems), and rates of natural mortality for Chinook at a given age. Simply interpreting trawl bycatch as a direct same-year impact on Chinook salmon stocks would overestimate the effect of PSC and would ignore the effects of PSC that was taken in previous years.

Adult equivalents (AEQ) models are a methodology for discounting bycatch based on salmon age and maturity to estimate reduced spawning potential while accounting for time-lagged effects. Those models can be paired with stock of origin information to estimate fishing impacts at whatever level of granularity is supported by available stock identification. Previous and ongoing studies to estimate fishing impacts on Chinook salmon stocks have employed AEQ models for the Bering Sea pollock trawl fishery and the Southeast Alaska troll fishery. This section uses those efforts as examples of the information needed to develop an AEQ model, and provides simplified examples based on observer data from the GOA trawl fishery.

The foundational step of an AEQ analysis is to assess the age distribution of the Chinook salmon that are taken as PSC in the fishery of interest. As noted in Section 3.3.3.1, observer data on salmon length is the best available indicator of age-at-capture, but length and age are not perfectly correlated. Table 13 indicates that the average Chinook salmon taken in the GOA trawl fishery tends to be 50 to 60 cm in length; Figures Figure 5, Figure 7, and Figure 9 indicate that relatively few sampled Chinook PSC are less than 40 cm or greater than 70 cm. Length-at-age can vary, but relevant example ranges are available from studies of river systems in Alaska. A study of the lower Kuskokwim River subsistence fishery from 2008 through 2011 showed that the age-classes of Chinook salmon with a mean length of less than 70 cm were age-4 or younger (Liller 2013, Table 6). A study of the Chilkat River drainage in 2010 shows that age-4 Chinook had a mean length of 56 cm (7 cm standard deviation) while age-3 Chinook had a mean length of 38 cm (3 cm standard deviation) and age-5 Chinook had a mean length of 77 cm (7 cm standard deviation) (Chapell 2013, Table 9). The available information suggests that many of the Chinook salmon taken as GOA trawl PSC are in the age-3 to age-5 range. This supposition is generally in line with studies of bycatch in the Bering Sea pollock fishery. Witherell et al. (2002) cites a 1998 analysis where 56% of Bering Sea pollock trawl Chinook bycatch was estimated at age-4 and 26% was estimated at age-5 (p.55). Ianelli and Stram (2014) stated that bycatch in the BS pollock fishery is “predominantly age-4” (p.4). While Ianelli and Stram caution that age-length relationships should not be taken as a constant over multiple years due to the influence of variability in relative year-class strengths and environmental factors, it is reasonable to proceed with a mental model that the age distribution GOA Chinook PSC centers around age-4 fish.

The next piece to consider is the at-sea natural mortality of Chinook salmon at different ages. Natural mortality (e.g., predation) reflects the fact that, in the absence of a trawl fishery, many Chinook salmon would not survive to spawn in their natal streams. The typical natural mortality rates that ADF&G applies to Chinook cohort analyses are 40% for age-3 Chinook, 30% for age-4 Chinook, and 10% for age-5 and age-6 Chinook (Bob Clark (ADF&G), pers. comm., Feb. 2018). Natural mortality rates can also be thought of in the inverse as survival rates. For example, age-3 Chinook could be said to have a 60% chance of surviving to spawn, while age-5 Chinook have a 90% chance. Estimates of at-sea natural mortality in other studies vary slightly from the ADF&G figures. Ianelli and Stram (2014) list Chinook salmon mortality rates at 30% for age-3, 20% for age-4, 10% for age-5 and age-6, and 0% for age-7 (Table 7, p.7). Witherell et al. (2002) assumed that the natural mortality rate was 20% for age-4 Chinook salmon and 10% for age-5.

AEQ models also depend on the maturation rate of Chinook salmon. The maturation rate reflects the proportion of fish in a certain age-class that are ready to spawn. For example, if the maturation rate for age-3 Chinook salmon is 0.04 then one expects 4% of age-3 Chinook to be reproductive. Available literature indicates that maturation rates for Chinook salmon approach 1.00 around age-6 or age-7. Maturation rates are conditioned on the values for mean in-river maturity and at-sea natural mortality rates.[19] These rates account for the relative impact of taking an age-3 Chinook salmon versus an age-6 Chinook salmon. An ADF&G AEQ model under development for fishing impacts on the Stikine and Taku river systems uses the following maturation rates: age-3 = 0.04, age-4 = 0.15, age-5 = 0.63, age-6 = 1.00 (Bob Clark (ADF&G), pers. comm., Feb. 2018). Ianelli and Stram (2014) use the following rates: age-3 = 0.002, age-4 = 0.192, age-5 = 0.500, age-6 = 0.942, age-7 = 1.000.

An AEQ model assembles this information as described in the following recursive equation:

$$AEQ_{BY,a-1} = MatRte_{BY,a-1} + (1 - MatRte_{BY,a-1})Surv_a AEQ_{BY,a}$$

"*MatRte*" denotes maturation rate and "*Surv*" denotes survival rate (one minus the natural mortality rate). An age-class (or brood year, *BY*) of the salmon in the population taken as PSC is denoted by the subscript *a*. The equation is recursive, meaning that the AEQ multiplier for one age class (*a-1*) is influenced by the AEQ multiplier for the age-class that is one year older (*a*). In words, the equation says that AEQ mortality for a given brood year equals the sum of the Chinook salmon taken as PSC that would have spawned in that year, plus a portion of those that were not sexually mature but would have survived to spawn eventually. The survival rate and the AEQ multiplier for older salmon are the factors that discount the spawning potential of Chinook salmon that were not ready to reproduce in the year they were taken as PSC. For age-classes where the maturation rate is 100%, AEQ mortality equals gross PSC – i.e., all Chinook salmon that are taken as PSC would have reproduced so the term to the right of the plus sign equals zero. To compute the model, one must calculate AEQ mortality for each age-class in the PSC population, and then sum adjusted mortality across age-classes.

Ideally, one would estimate the impact of trawl PSC on a particular river system using stock-specific information on size-at-age and in-river maturity, as well as a robust distribution of age-at-capture for the population of Chinook salmon taken as PSC in the analyzed fishery. This information would be used to tune the time-lagged effects of PSC on future spawning potential. Those results would be applied to the total amount of PSC, as apportioned to each river system or salmon stock based on genetic and tagging studies. After apportioning AEQ-adjusted Chinook salmon removals to each system, one could calculate a bycatch "impact rate" by comparing AEQ mortality to run size, as was done for the analysis of BSAI Groundfish FMP Amendment 110. However, given the limited information available for this analysis, this section focuses on several illustrative examples that employ parameters from BSAI and Southeast Alaska fisheries as well as southeastern and western Alaska salmon stocks. The following examples show

[19] Information on the age distribution of Chinook salmon sampled in tributaries of the Chilkat River system and the lower Kuskokwim River subsistence fishery is available in Table 9 of Chapell 2013 and Table 6 of Liller 2013, respectively. During the analyzed years for the Chilkat study, 46% of Chinook were age-5 fish, 30% were age-6 fish, and 17% were age-4 fish. Age-5 fish also predominated in the Kuskokwim study, accounting for between 35% and 54% of the sampled Chinook in the individual years; age-6 fish were the second most common.

how a generic sample of 100 GOA trawl Chinook salmon PSC should be discounted for time-lagged effects. The reader could then apportion those adjusted removals (net salmon that would otherwise have spawned) across the various regions from which Chinook salmon taken in the GOA trawl fishery originate based on the percentages presented in Section 3.3.4.[20]

Table 15 lists the age-specific Chinook salmon maturation rates and mortality rates that are used for the illustrative examples in Table 16 and Table 17. The parameters on the left (ADF&G model) were provided through personal communication; the parameters on the right are published in Ianelli and Stram (2014). The two parameter sets reflect general agreement that Chinook salmon throughout the North Pacific reach sexual maturity around age-6, and that expected natural mortality attenuates around age-5 or age-6. Testing several sets of parameters allows the reader to observe the relative weight of one parameter versus another. In addition to the results shown in Table 16 and Table 17, the analysts also ran AEQ examples that mixed the Southeast Alaska study's maturation rate with the Bering Sea study's mortality rate, and vice versa. That cross-check changed total AEQ-adjusted removals by only one Chinook salmon in either direction, allowing the analyst to conclude that the results are driven primarily by the age distribution of Chinook PSC ("PSC-at-age") and the assumed mortality rates.

Table 16 and Table 17 each have two panels that differ only in the age-distribution of the 100 Chinook PSC. The first panel in each table (age distribution #1) shows age normally distributed around age-4, which reflects the general conclusions of observer sampling in the GOA trawl fishery (see Section 3.3.3.1). The second panel (age distribution #2) shows an age distribution that skews younger. By way of example, the top panel in Table 16 results in an adjustment from 100 Chinook PSC to an AEQ mortality of 78 Chinook removed from spawning potential. AEQ-adjusted removals for each column (age-class) is the product of PSC-at-age and the AEQ multiplier; 78 Chinook is the sum of AEQ-adjusted removals across all age-classes. The result is highly contingent on the age-distribution of the Chinook PSC sample; for example, if all 100 Chinook PSC were age-2, the total AEQ-adjusted removals would have been 37 (100*0.37 + 0*0.58 + …). The bottom panel in Table 16 calculates that 100 Chinook PSC result in 69 AEQ-adjusted removals. The lower result is mainly a function of more young fish that were taken as PSC but, had they not been, would have experienced natural mortality before reaching sexual maturity. Though not shown, a panel with an age distribution that skews older would have resulted in total AEQ-adjusted mortality that is greater than 78 and less than 100. Table 17 shows higher estimates of AEQ-adjusted mortality relative to Table 16 because the natural mortality at each age-class is assumed to be lower. Table 17 shows the same relationship between the top and bottom panels, where adjusted mortality is lower when the age-distribution includes a greater proportion of young Chinook salmon.

Because the examples below are based on a model of 100 Chinook salmon, the reader could think of the result as a percentage and map this sketch onto actual GOA trawl CV PSC levels. For example, the top panel of Table 16 implies that 78% of the Chinook salmon taken in the trawl fishery would have eventually reproduced in their natal stream. The coast-wide impact on spawning potential of taking 3,000 Chinook salmon PSC would be estimated at 2,340 fewer reproductive salmon (3,000*0.78). Those 2,340 Chinook could then be apportioned to regions of origin based on the information provided in Section 3.3.4. For example, if one presumes that 15% of GOA trawl PSC are salmon that originate from Southeast Alaska then the impact on that region would be 351 fewer reproductive Chinook (2,340*0.15). Those 351 Chinook could be further apportioned across river systems to the extent allowed by tagging studies or more granular genetic identification when and if such work is developed in the future.

[20] Roughly 80% of GOA trawl Chinook PSC originate in British Columbia and the Pacific Northwest, 15% originate in Southeast Alaska, and the remainder originate in the northwest GOA. A negligible proportion of the Chinook taken as GOA trawl PSC originate in western Alaska or trans-Pacific river systems.

Table 15 Parameters for example AEQ models: Chinook maturation rate and mortality rate by age-class

ADF&G Model for impacts on Stikine & Taku Rivers

Age	3	4	5	6	7
Maturation Rate	4%	15%	63%	100%	100%
Mortality Rate	40%	30%	20%	10%	0%

Ianelli & Stram (2014) Model for BS Pollock Trawl impacts

Age	3	4	5	6	7
Maturation Rate	0%	19%	50%	94%	100%
Mortality Rate	30%	20%	10%	10%	0%

Table 16 Example AEQ mortality for 100 Chinook salmon PSC, using parameters from ADF&G model (see Table 15)

PSC age-distribution #1

Age	2	3	4	5	6	7	Total
PSC-at-age	5	20	50	20	3	2	**100**
AEQ multiplier	0.37	0.58	0.80	0.96	1.00	1.00	
AEQ-adjusted Removals	2	12	40	19	3	2	**78**

PSC age-distribution #2

Age	2	3	4	5	6	7	Total
PSC-at-age	10	40	40	5	3	2	**100**
AEQ multiplier	0.37	0.58	0.80	0.96	1.00	1.00	
AEQ-adjusted Removals	4	23	32	5	3	2	**69**

Table 17 Example AEQ mortality for 100 Chinook salmon PSC, using parameters from Ianelli & Stram (2014) model (see Table 15)

PSC age-distribution #1

Age	2	3	4	5	6	7	Total
PSC-at-age	5	20	50	20	3	2	**100**
AEQ multiplier	0.50	0.71	0.88	0.95	1.00	1.00	
AEQ-adjusted Removals	2	14	44	19	3	2	**85**

PSC age-distribution #2

Age	2	3	4	5	6	7	Total
PSC-at-age	10	40	40	5	3	2	**100**
AEQ multiplier	0.50	0.71	0.88	0.95	1.00	1.00	
AEQ-adjusted Removals	5	28	35	5	3	2	**78**

3.3.3.3 Chinook Salmon Abundance in the Gulf of Alaska

Relating Chinook salmon PSC abundance with a broader metric of GOA Chinook abundance in a given year is complicated by several measures (e.g., multiple age classes and many stocks of origin), though relationships are apparent. The Pacific Salmon Commission Joint Chinook Technical Committee (CTC) tracks landed catches of Chinook in the Pacific Salmon Treaty (PST) area (Oregon to SE Alaska). These catches can serve as a proxy for abundance by region of catch (CTC 2017) and exhibit a range of correlations with Chinook PSC by GOA trawl fisheries. Using data from 2003 – 2016, Chinook PSC from the non-pollock trawl fishery was generally more correlated with PST landed catches than Chinook PSC from the pollock fishery (Table 18), with the strongest relationships occurring between Chinook PSC and PST landed catches in the following year (i.e., lagged by one year). Differences in fishing effort by the trawl fisheries can be coarsely accounted for by standardizing Chinook PSC to the weight of target catch in each year (i.e., number of Chinook PSC / weight of target species catch). Correlations for the normalized Chinook PSC catches are described here while correlations for both normalized and non-normalized (i.e., absolute numbers of Chinook PSC) are presented in Table 18. The strongest relationship (Pearson ρ = 0.81) occurred between the non-pollock trawl Chinook PSC and PST landed catches of Chinook reported for West Coast Vancouver Island aggregate abundance-based management (AABM). However, these catches accounted for one of the smaller fractions of the total Treaty area catches (~ 10%). Non-pollock trawl Chinook PSC (standardized) was also relatively strongly correlated to the total Canadian and overall total landed Chinook catches from the PST area (Pearson ρ = 0.58 and 0.49). Breaking down GOA Chinook PSC further (not shown) suggests strong positive relationships between the catcher processor sector in the western GOA and both Canadian and southeast Alaskan catches in the PST area.

Further analyses are necessary to explore how the stock and age compositions compare between those of the PST landed catches and the PSC. Chinook PSC in the GOA non-pollock trawl was highest in 2003, 2010, and 2013 while estimates of PST landed catch for U.S. and Canada Chinook stocks spiked in 2004, 2011, and 2014 – 2015 (CTC 2017). Such extrema may align with non-pollock trawl PSC of immature Chinook in the previous years, though other years of relatively high landed catch during the same time series did not necessarily align with higher Chinook PSC. Certain Chinook stocks may drive the Chinook PSC during these years and intra- and inter-annual variability in the overlap between Chinook stocks and trawl fisheries may vary as functions of the environment, fishery management, bycatch avoidance efforts, and fishery sector.

Table 18 shows Pearson correlations between Chinook PSC of GOA pollock and non-pollock trawl and groups of landed catches from the Pacific Salmon Treaty area. Regions include Southeast Alaska (SEAK), all United States, Northern British Columbia (NBC), West Coast Vancouver Island (WCVI), and all Canada for Aggregate Abundance Based Management (AABM), non-treaty catches, and Individual Stock Based Management (ISBM). Pearson correlations are reported for Chinook PSC between the pollock and non-pollock trawl fisheries and annual landed catches reported from the Pacific Salmon Treaty area. Lags represent landed catches 1 and 2 years after reported PSC from trawl fisheries, which typically occurs for younger fish. Correlations compare landed Chinook catches to unstandardized PSC (number of Chinook) and to standardized PSC (number of Chinook / weight of target catch). Absolute correlations between 0.3 and 0.6 are in light grey and greater than 0.6 in dark grey. Data from NMFS Catch Accounting (3/7/2018) and PSC (2017).

Table 18 Pearson correlations between Chinook PSC of GOA pollock and non-pollock trawl and groups of landed catches from the Pacific Salmon Treaty area.

		Lag 0		Lag 1		Lag 2	
	Catch sector	Pollock	Non-Pollock	Pollock	Non-Pollock	Pollock	Non-Pollock
Number of Chinook	SEAK AABM	-0.04	-0.35	-0.24	0.38	-0.29	0.09
	SEAK nontreaty	0.08	-0.08	0.09	-0.11	-0.23	0.30
	US ISBM	-0.15	0.28	-0.22	0.37	-0.24	0.37
	US Total	-0.14	0.11	-0.28	0.46	-0.31	0.35
	NBC AABM	0.05	-0.35	-0.32	0.25	-0.41	0.19
	WCVI AABM	-0.08	0.04	0.19	0.69	-0.37	0.01
	Canada ISBM	-0.20	-0.20	0.15	0.32	-0.36	0.34
	Canada Total	-0.08	-0.22	-0.02	0.46	-0.46	0.24
	Total Landed Catch	-0.14	0.00	-0.23	0.55	-0.42	0.38

	Lag 0		Lag 1		Lag 2	
Number of Chinook / Weight of Target Catch — Catch sector	Pollock	Non-Pollock	Pollock	Non-Pollock	Pollock	Non-Pollock
SEAK AABM	-0.11	-0.26	-0.37	0.42	-0.40	0.13
SEAK nontreaty	0.26	0.05	0.21	0.08	-0.13	0.51
US ISBM	-0.40	0.14	-0.38	0.19	-0.35	0.17
US Total	-0.39	0.02	-0.47	0.32	-0.45	0.19
NBC AABM	-0.06	-0.23	-0.39	0.36	-0.46	0.25
WCVI AABM	0.02	0.12	0.26	0.81	-0.30	0.16
Canada ISBM	-0.14	-0.10	0.08	0.40	-0.32	0.47
Canada Total	-0.07	-0.10	-0.06	0.58	-0.45	0.37
Total Landed Catch	-0.33	-0.02	-0.39	0.49	-0.53	0.30

Seasonal abundance and migration data are limited throughout the GOA. Much of the information comes from catches of Chinook in targeted Southeast Alaska and British Columbia troll fisheries, which are temporally limited and are biased towards the movements of larger fish (i.e., commercially retained). Additional information is increasingly available from genetic analyses of Chinook PSC from the pollock trawl and rockfish fisheries (see Guthrie et al. 2018) for a limited discussion of inter- and intra-annual variability of stock composition). However, limited genetic information or CWT data are available from the non-pollock, non-rockfish trawl fisheries due to sample size limitations for genetic analyses. A comprehensive migration model is lacking for the GOA due to the number of stocks, but limited movement data can be gleaned through these data sources.

3.3.4 River of Origin Information and Prohibited Species Catch Composition Sampling

Salmon may migrate far from their stream of origin during their ocean phase and stocks intermingle in ocean foraging areas (for example, see Figure 16 through Figure 21). Existing information sources to infer (or in some cases to know) stock of origin of Chinook salmon PSC in the GOA trawl fisheries include: genetic analysis, coded-wire tag recoveries, and analyses of otoliths for thermal marking. Life history information encoded in scale and otolith annuli can also indicate whether a salmon is from a stock with an ocean-type or freshwater-type early life history phase. This early life history information can provide clues about which systems the salmon may have originated from and which systems can be eliminated based on known life history strategies from individual systems. In this section we discuss the available information sources to infer the stocks of origin of the Chinook salmon taken as PSC in the GOA trawl fisheries.

3.3.4.1 Genetic Analysis of Salmon Prohibited Species Catch

Genetic analyses are used to understand which salmon stocks are incidentally taken as PSC in the groundfish fisheries off Alaska. Genetic inference is a continually improving science. Currently, the available single nucleotide polymorphisms (SNPs) baseline (see Guthrie et al. 2017) allows stocks to be identified to a general region as shown in Figure 12. Given the continual advancement in the genetics science, researchers anticipate being able to distinguish stock origin on a more precise scale in the future using genetic information than is currently possible.

Efforts to improve genetic sampling of Chinook salmon PSC in the GOA trawl fisheries were instituted in 2011 and the available information on the stock composition of Chinook salmon PSC in the GOA trawl fisheries has increased over time (Table 12). For example, from 2011 to 2016, the proportion of the total Chinook salmon PSC successfully genotyped increased from 1.2 percent in 2011 to 22.4 percent in 2016. Presently, the majority of available samples to estimate GOA Chinook salmon PSC stock composition come from the pollock fisheries, followed by the Rockfish Program CV trawl fishery. A smaller subset of opportunistic samples are also available from the non-pollock, non-rockfish trawl CP fisheries (primarily the arrowtooth flounder fishery) beginning in 2013.

In January 2012, vessels agreed to voluntarily retain all salmon encountered while directed fishing for pollock in the Western and Central GOA in anticipation of Amendment 93 to the GOA FMP, which now requires 100% retention of all salmon caught in Western and Central GOA pollock fisheries. However, non-Rockfish Program GOA trawl CVs are not in the 100% observer coverage category, thus not all GOA pollock trips are observed at-sea (Guthrie et al. 2017). In light of that, starting in 2014, the observer program implemented a simple random sampling protocol with respect to trip for the collection of Chinook salmon PSC genetic samples in the GOA pollock fisheries (Faunce et al. 2014). This method randomly samples from trips and censuses the salmon PSC encountered in each associated delivery to the processor (Faunce 2015). Since 2014, the estimated stock composition of the Chinook salmon PSC samples in the GOA pollock fishery is considered to be representative of the entire Chinook salmon PSC in that fishery. Due to sampling limitations prior to 2014, the stock composition estimates from 2011 through 2013 were only representative of the sampled Chinook salmon PSC and were not interpreted as a reflection of the stock composition of the entire pollock fishery's Chinook salmon PSC (Guthrie et al. 2018).

Since 2013, on a voluntary basis, the Alaska Groundfish Data Bank (AGDB) has collected Chinook salmon PSC in the Central GOA rockfish CV trawl fishery for genetic analysis. AGDB implemented a census approach for collecting genetic samples and biological information from every Chinook salmon encountered in the fishery. Because of the census, all Chinook salmon PSC stock composition estimates from these samples are considered to be representative of the stock composition of the Chinook salmon PSC in the rockfish CV trawl fishery (Guthrie et al. 2018).

Some CP vessels participating in the GOA non-pollock trawl fisheries, particularly for arrowtooth flounder, have collected tissue samples from Chinook salmon PSC on a voluntary basis for genetic analysis. Opportunistically collected samples are available from one CP vessel in 2013, two CP vessels in 2014, and several CP vessels 2015. Samples were also collected from the arrowtooth flounder fishery in 2016, however the sample size (n=82) was too small for estimating stock composition of the Chinook salmon PSC sample. It is important to note that stock composition estimates for the arrowtooth CP fishery only reflect the composition of the samples because of the opportunistic nature in which the samples were collected.

Table 19 Number of Chinook salmon genetic samples available from GOA groundfish trawl fisheries, 2011 to 2016

Year	Number of samples genotyped	Percentage of total GOA Chinook Salmon PSC successfully genotyped (%)[1]	Notes
2011	240	1.2	13 from area 610, 143 from area 620. 84 from area 630
2012	948	4.7	334 from area 610, 394 from area 620, 236 from area 630, 5 from area 640, and 36 from area 649
2013[2]	3,001	12.9	Pollock fishery n=693; Rockfish CV fishery n=2,029; non-pollock CP fishery n=279
2014[3]	1,965	12.5	Pollock fishery n=1,163; Rockfish CV fishery n=398; non-pollock CP fishery n=404
2015	3,391	18.3	Pollock fishery n=2,414; Rockfish CV fishery n=635; non-pollock CP fishery n=342
2016	5,455	22.4	Pollock fishery n=4,962; Rockfish CV fishery n=493, non-pollock CP fishery n=82. Non-pollock CP sample size precluded stock composition estimate for that fishery.

[1] Based on total Chinook salmon PSC in the GOA trawl fisheries (source: NMFS Alaska Region CAS, queried March 2, 2018).

[2] First year implementation of voluntary Chinook salmon PSC census and samples from Rockfish Program CVs.

[3] First year implementation of simple random sample of Chinook salmon PSC with trip as primary unit in the pollock fishery.

Table 20 Years in which genetic information is available for Chinook salmon PSC in the GOA trawl fisheries, including which years the sample protocol and sample size are sufficient for stock composition estimates of the entire PSC across the fishery.

Fishery	Years Systematically – Collected Genetic Data Available	Years Stock Composition Estimates Represent Stock Composition of the Entire PSC
GOA Pollock Trawl	**2011, 2012, 2013, 2014, 2015, 2016**	**2014, 2015, 2016**
GOA Rockfish CV	**2013, 2014, 2015, 2016, 2017**	**2013, 2014, 2015, 2016**
GOA Non-Pollock Trawl CP	**2013, 2014, 2015, 2016**	**--**

A description of the methods used to genotype the collected samples for stock composition analysis are provided in Guyon et al. (2015a and 2015b) and Guthrie et al. (2016, 2017, and 2018). Methods used to compile the rangewide Chinook salmon SNPs baseline are described in Templin et al. (2011). Figure 12 shows the SNP baseline regions which are useful in interpreting the results from the fishery PSC genetic stock composition analyses. Results of the genetic stock composition analyses from the GOA trawl fisheries are shown in Table 21 and Table 22 and Figure 13, Figure 14 and Figure 15.

Figure 12 Locations of Chinook salmon collected to generate the rangewide SNP baseline. Source: Templin et al. (2011).

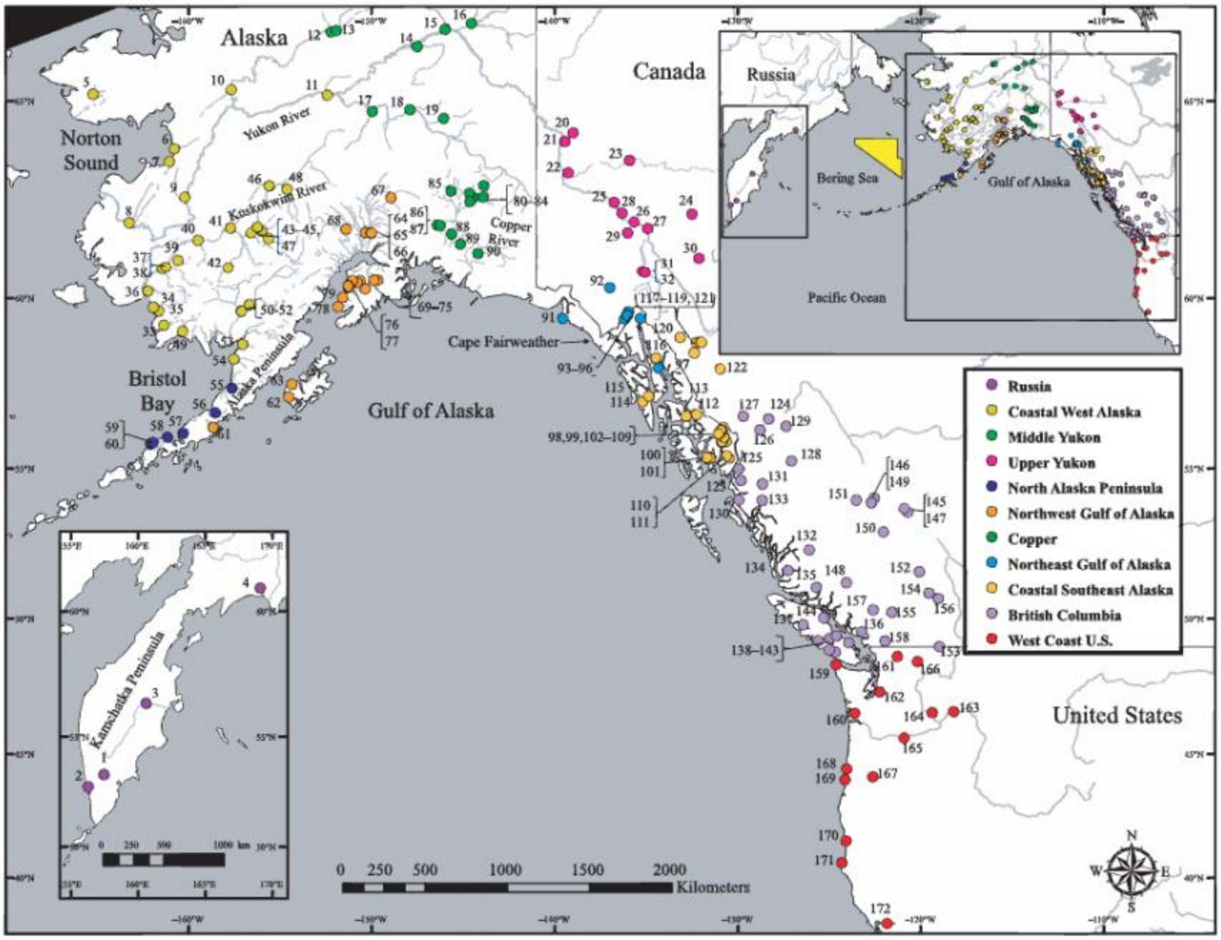


Figure 13 **Stock composition estimates of Chinook salmon PSC in the GOA pollock trawl CV fisheries, 2011 - 2016 with BAYES 95% credible intervals. Note: Only stock composition estimates from 2014 through 2016 are representative of the entire GOA pollock trawl CV fishery Chinook salmon PSC stock composition. Source: Guthrie et al. (2018).**

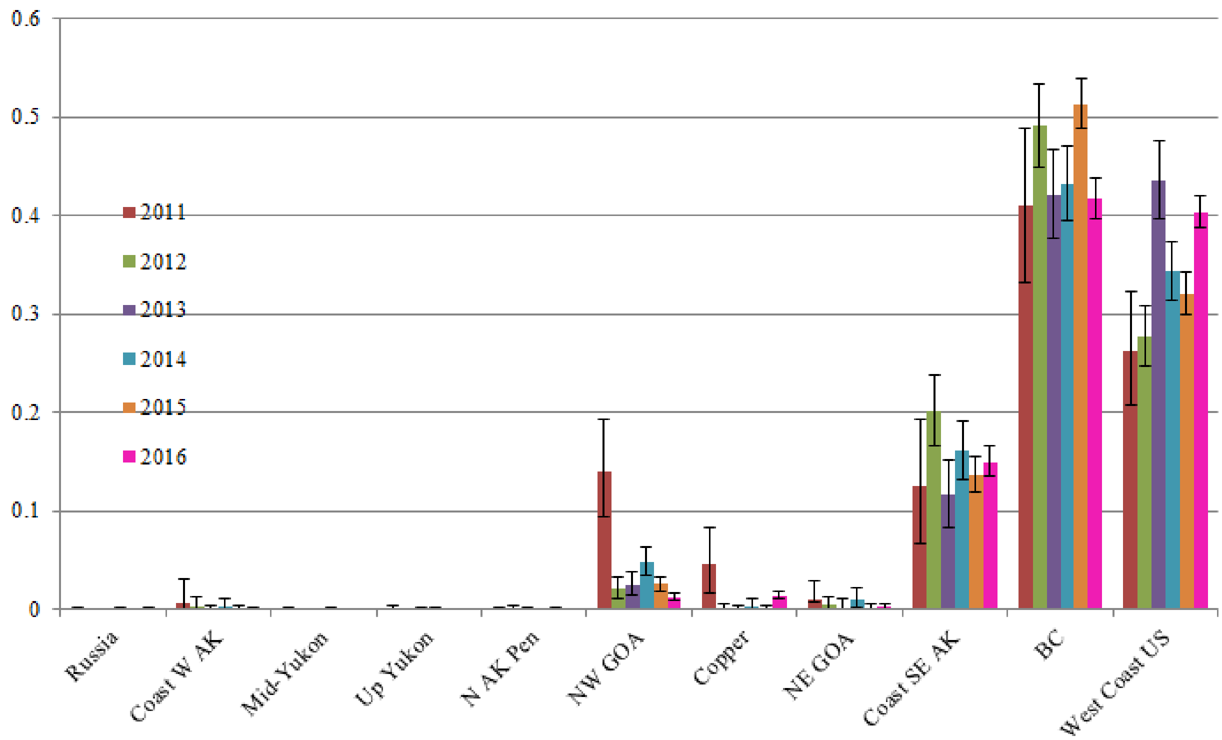


Table 21 **Stock composition of GOA pollock trawl fishery Chinook salmon PSC from 2014 through 2016. Source: Guthrie et al. (2016, 2017, and 2018)**

	2014	2015	2016
Sample Size	1,163	2,414	4,962
British Columbia	43%	51%	42%
West Coast US	35%	32%	40%
Coastal Southeast Alaska	16%	14%	15%
Northwest GOA	5%	3%	

From 2014 through 2016, Chinook salmon originating from British Columbia, the West Coast of the US (WA/OR/CA), coastal Southeast Alaska, and from the Northwest GOA occurred in the GOA pollock fishery PSC. Guthrie et al. (2018) states that over 99% of sampled Chinook taken as PSC in GOA trawl fisheries were from GOA/Pacific coastal regions. During this time period, the greatest proportion of the Chinook salmon PSC consistently originated from British Columbia (approximately 45% on average) followed by the west coast of the US (approximately 36% on average). Consistently, about 15% of the Chinook salmon PSC in the GOA pollock trawl fishery originated from coastal Southeast Alaska streams and a small percentage originated from streams in the Northwest GOA.

Figure 14 **Stock composition estimates of Chinook salmon PSC in the GOA Rockfish CV trawl fishery, 2013 - 2016 with BAYES 95% credible intervals. Source: Figure 14 in Guthrie et al. (2018).**

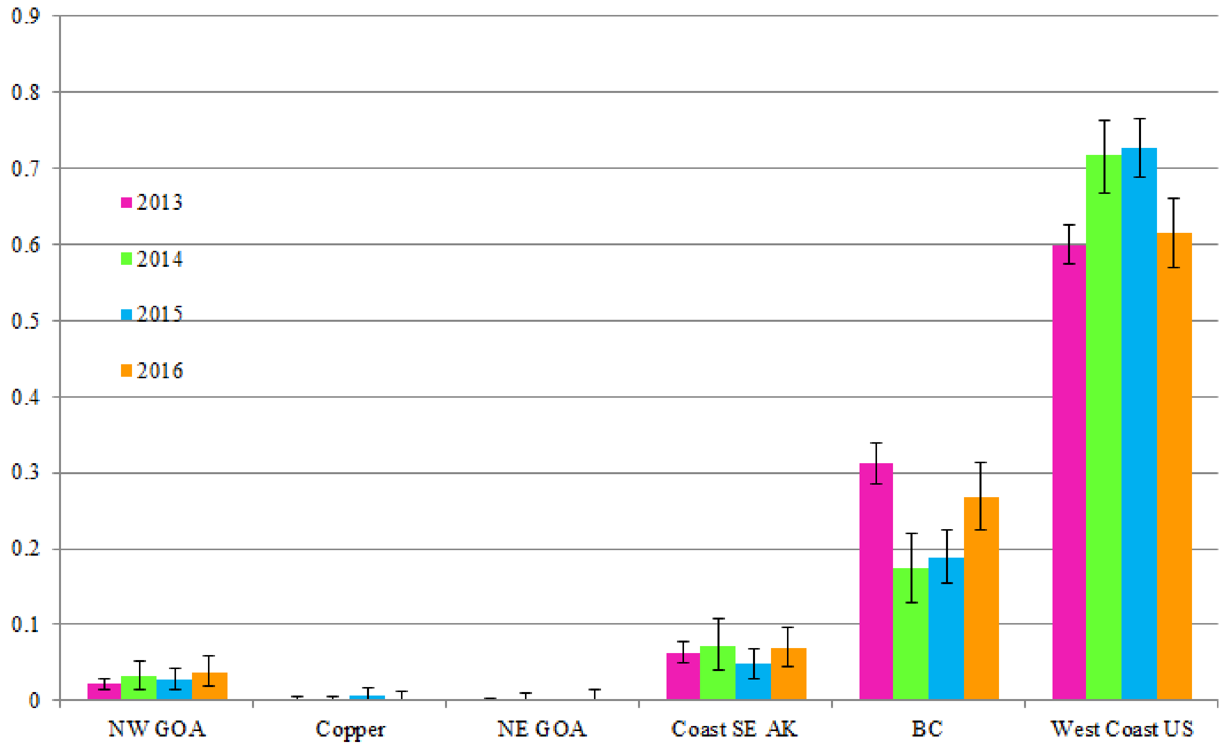
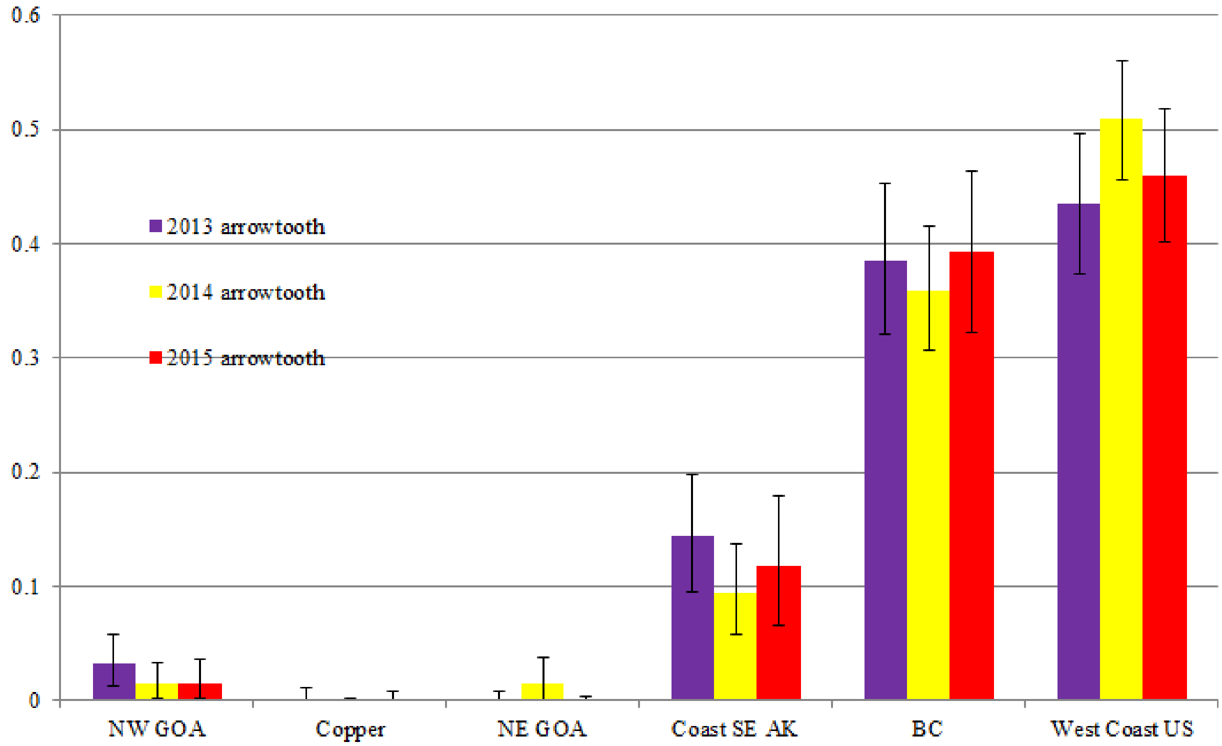


Table 22 **Stock composition of GOA rockfish CV fishery Chinook salmon PSC from 2014 through 2016. Source: Guthrie et al. (2016, 2017, and 2018).**

	2013	2014	2015	2016
Sample Size	2,029	398	635	493
British Columbia	31%	17%	19%	27%
West Coast US	60%	72%	73%	62%
Coastal Southeast Alaska	6%	7%	5%	7%
Northwest GOA	2%	3%	3%	4%

From 2013 through 2016, Chinook salmon originating from British Columbia, the west coast of the US (WA/OR/CA), coastal Southeast Alaska, and from the Northwest GOA occurred in the GOA rockfish CV fishery PSC. Over this time period, the greatest proportion of the Chinook salmon PSC consistently originated from the west coast of the US (approximately 67 percent on average) followed by British Columbia (approximately 24 percent on average). Consistently, about 6 percent of the Chinook salmon PSC in the GOA rockfish CV fishery originated from coastal Southeast Alaska streams and a small percentage originated from streams in the Northwest GOA.

Figure 15 **Stock composition of Chinook salmon PSC samples from the GOA non-pollock trawl CP fishery, 2013 through 2015 with BAYES 95% credible intervals. Source: C. Guthrie, AFSC, personal communication, March 5, 2018.**



The stock composition of Chinook salmon PSC samples from the arrowtooth fishery from 2013 through 2015 also shows consistency in the proportion of PSC originating from various regions each year. The composition is similar to what was observed in the GOA rockfish CV fishery, with a smaller difference between the proportion originating from the west coast of the US and British Columbia. It is important to note that these proportions only reflect the stock composition of the sampled salmon due to the opportunistic nature of sampling in this fishery.

Currently, there are no Chinook salmon PSC stock composition data from the GOA non-pollock non-Rockfish Program trawl CV fisheries. Similarities in the Chinook salmon PSC stock composition between the pollock and rockfish CV fishery and among years suggest that the stock composition of Chinook salmon PSC in the non-pollock non-Rockfish Program trawl CV fisheries likely consists of salmon from the west coast US and British Columbia, with a lower percentage from coastal southeast Alaska and the northwest GOA.

The authors of the regional stock composition analyses provide a note of caution for interpreting the results of their study regarding the level impact on regional Chinook populations or on particular stocks. The authors state that the extent to which any stock is impacted by bycatch in GOA trawl fisheries depends on many factors including (1) the overall amount of bycatch, (2) the age of the salmon taken as bycatch, (3) the age of salmon that are returning to spawn, and (4) the total escapement of the affected stocks (taking into account lag time for maturity and returning to the river. Due to the many factors involved, “a higher contribution [proportion of a stock in the PSC] one year does not necessarily imply greater impact than a smaller estimate the next” (Guthrie 2018, p.21). In other words, the impact of trawl PSC on stocks in a particular region is not directly correlated to the representation of fish from that region in the bycatch.

3.3.4.2 Origins of Coded-Wire Tagged Chinook Salmon in the GOA

Coded-wire tags (CWTs) are an important source of information for the stock-specific ocean distribution of those Chinook salmon stocks that are tagged and caught as PSC in the BSAI and GOA groundfish fisheries. CWT programs were established to achieve various program goals; these include the evaluation of hatchery survival and returns, ESA stock management, ocean survival studies, Pacific Salmon Treaty issues, and tracking of indicator stocks that aid in modeling for incidental catch salmon targets.

CWTs are small pieces (0.25 x 0.5 or 1.0 mm) of stainless steel wire that are injected into the snouts of juvenile salmon. Each tag is etched with a decimal or binary code that identifies its release group. Until recently all tagged fish also had their adipose fin removed. The adipose clip is intended to be the external flag identifying which fish bear a CWT.

At present, CWTs are primarily used for tagging hatchery-reared fish. Of 26 million coded-wire tagged Chinook salmon released since 1992, 88% were hatchery origin and 12% were wild stocks. Coded-wire tagged Chinook salmon from wild stocks are primarily from Southeast Alaska. Outside of Alaska, 98% of coded-wire tagged Chinook salmon from 1992 through present are from hatcheries (Masuda 2017 in NMFS 2017a). Therefore, CWT recovered salmon are likely either from a hatchery or a wild stock in Southeast Alaska.

The Regional Mark Processing Center maintains a coastwide database for CWT releases and recoveries, as well as associated catch and sample data. Over 50 million salmonids with CWTs are released yearly by 54 federal, provincial, state, tribal, and private entities. This database dates back to the 1970s and contains data contributed by the states of Alaska, Washington, Oregon, Idaho, and California; the province of British Columbia; federal agencies including NMFS, U.S. Fish and Wildlife Service, and Canadian Department of Fisheries and Oceans; and tribal groups including the Columbia River Inter-Tribal Fish Commission, Metlakatla Indian Community, and the Northwest Indian Fisheries Commission. The coastwide CWT database is the authority on the historic and current use of CWTs in West Coast salmon populations, both wild and hatchery. For a complete overview of the Regional Mark Processing Center and the coastwide CWT database go to: http://www.rmpc.org/.

Through this coordinated coastwide system, CWT recovery data have enabled scientists and managers to determine exploitation patterns for individual groups of fish and to assist in decision-making to manage salmon populations. CWTs have been used for cohort analysis into simulation models, identification of migration and exploitation patterns, estimating and forecasting abundance, and in-season regulation of fisheries. CWTs are increasingly being used with other stock identification technologies such as genetic markers, scale pattern, and otolith banding to provide a better analysis of salmonid population dynamics.

After the CWT tags are decoded, processed, and validated, data from the "observed recoveries" are made available for use in preliminary reports. This includes expansion of the observed recoveries into "estimated recoveries" for the given area time stratum once the catch sample data are available (Nandor et al. 2010). The estimated recoveries and expansion factors are explained below in the discussion on ESA-listed salmon.

Ideally, it would be preferable to calculate a total estimated contribution of Chinook salmon from ESA-listed ESUs harvested in the GOA in order to determine the impact of the fishery on these stocks. Total estimated contributions for CWT recoveries can be calculated in a two-step process involving a sampling expansion factor and a marking expansion factor. For an explanation of Recovery Estimation Technique see Appendix 1 in Masuda (2017 in NMFS 2017a).

CWT recoveries provide reliable documentation of the presence of a stock that is caught by the groundfish fisheries and can inform presence of stocks at the ESU-level, where genetic sampling may not. However, the recoveries to date cannot be used to establish the relative abundance of stocks, nor can they be used to estimate the number of salmon harvested from any one stock as PSC, due to sampling issues (see Appendix 2 of Masuda 2017 in NMFS 2017a). CWTs do not represent the true composition of all stocks of Chinook salmon PSC in the GOA groundfish fisheries. Rather, they represent the composition of the samples that are taken, that originate from the sites where a CWT program is in place. In other words, the available CWT data can confirm the presence of a particular stock, but they do not provide information about the relative proportion of that stock in the PSC nor do they inform the absence of a stock in the PSC. Not all Chinook salmon stocks along the Pacific coast are marked at equal rates. Exploitation rates for naturally spawning populations (referred to as wild stocks, or the wild component of a system's spawning population) of Chinook salmon are difficult to estimate.

Until 2012, the only sampling for CWTs in GOA trawl fishery Chinook salmon PSC was through visual inspection for missing adipose fins of salmon in the observer's species composition samples. In recent years, these samples have been augmented with electronic detection of CWTs through research projects and voluntary collections in the central GOA Rockfish Program CV fishery. Electronic detection allows CWTs to be recovered from salmon irrespective of whether the fish had an adipose fin clip. A small percentage of salmon are released from hatcheries with a CWT but without an adipose fin clip and electronic detection is the only way to recover these fish (Masuda 2017 in NMFS 2017a).

Observer sampling methods for collecting snouts from adipose-clipped salmon were updated in 2012 (Masuda 2017 in NMFS 2017a). Therefore, the CWT information derived from observer sampling is broken out between 2001 through 2011 and 2012 through 2016 to reflect the different sampling methods among those periods. Despite the refined sampling methods implemented in 2012, the available CWT information cannot be considered to be representative of the entire Chinook salmon PSC in the GOA trawl fisheries due to sampling constraints (Masuda 2017 in NMFS 2017a).

Table 23 Number of Chinook salmon sampled, number with clipped adipose fins (ad-clipped), and number with readable coded-wire tags (CWTs) in the various sampling programs in the Gulf of Alaska (GOA) in 2015 and 2016. The number of Chinook salmon with readable CWTs that were also ad-clipped is in parentheses. Only sampling programs based on electronic detection can be expected to recover CWTs from fish that are not ad-clipped.

Region	Year	Fishery and gear	Sampling program	Detection method	Number sampled	Number ad-clipped	Number with readable CWTs
GOA	2015	Research trawl	National Marine Fisheries Service	Electronic and visual	93	84	25 (19)
GOA	2016	Groundfish trawl	Observer Program	Visual	5,542[1,2]	932[2]	234 (234)
		Rockfish trawl	Alaska Groundfish Data Bank	Electronic	496	86	23 (20)
		Survey midwater trawl	National Marine Fisheries Service	Electronic	-	1	2 (1)

Source: Masuda (2017 in NMFS 2017a)

[1]Total number of Chinook salmon sampled by observers in the pollock and non-pollock fisheries.

[2]Source: AFSC Observer Program.

GOA trawl fisheries

CWTs confirmed the presence of Chinook salmon from stocks originating from Alaska, British Columbia, Washington, Idaho and Oregon in the GOA trawl fishery PSC (Table 24 and Table 25). Tagged Chinook salmon in the GOA have historically originated from two regions, Cook Inlet and Southeast Alaska (Table 26). CWT of Cook Inlet Chinook salmon has been intermittent since the 2008 brood year (2010 release) and currently most coded-wire tagged Chinook salmon taken as PSC in the GOA from 2012 through 2016 originated from Southeast Alaska (Table 26).

As would be expected, based on the predominance of hatchery coded wire tagging programs, most of the Chinook salmon represented by CWTs and harvested in the GOA originated from hatchery production (Table 30).

Table 24 Observed and CWT mark-expanded numbers of coded-wire tagged Chinook salmon captured in the bycatch of the Gulf of Alaska groundfish fisheries, by run year and state or province of origin, 2001 through 2011.

	Alaska		British Columbia		Idaho		Oregon		Washington		Total	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2001	10	100.2	6	74.8	0	0	12	16.5	4	4	**32**	**195.6**
2002	10	47.2	5	113	0	0	4	4.3	3	3.7	**22**	**168.2**
2003	2	22.4	2	28.6	0	0	4	8.3	1	1	**9**	**60.3**
2004	3	30.5	4	22	0	0	5	16.9	1	1.1	**13**	**70.6**
2005	3	33.6	4	86.5	0	0	2	3.1	2	2.2	**11**	**125.4**
2006	10	58.3	7	158.3	0	0	2	2.1	5	14.5	**24**	**233.1**
2007	13	99.1	3	50.9	0	0	2	2.1	5	21.3	**23**	**173.3**
2008	6	52.3	1	1	0	0	3	9.3	12	12.9	**22**	**75.5**
2009	5	41.4	2	5.2	0	0	2	2.8	4	4.5	**13**	**53.9**
2010	10	81.3	4	4	0	0	10	25.9	12	23.7	**36**	**135**
2011	3	32.3	1	51.4	0	0	2	13.4	2	2	**8**	**99.2**
Mean	**6.8**	**54.4**	**3.5**	**54.2**	**0**	**0**	**4.4**	**9.5**	**4.6**	**8.3**	**19.4**	**126.4**
%total averaged over years	**34%**	**46%**	**20%**	**38%**	**0%**	**0%**	**23%**	**9%**	**23%**	**7%**		

Source: Masuda (2017)

Table 25 Observed and CWT mark-expanded numbers of coded-wire tagged Chinook salmon captured in the bycatch of the Gulf of Alaska groundfish fisheries and sampled by NMFS certified observers, by run year and state or province of origin, 2012 through 2016

	Alaska		British Columbia		Idaho		Oregon		Washington		Total	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2012	11	78	13	34.7	1	2	25	135.1	30	59.2	**80**	**309**
2013	5	25.9	9	38.1	0	0.4	7	69.4	5	7.4	**27**	**140.7**
2014	5	54.9	10	48.8	1	1	13	77.9	5	6.7	**34**	**189.4**
2015	27	305.8	30	176.2	0	0	15	15.9	30	48.7	**102**	**546.6**
2016	55	356.6	64	261.4	0	0	48	234.8	67	95.3	**234**	**948.1**
Mean	**20.6**	**164.2**	**25.2**	**111.8**	**0.4**	**1.5**	**21.6**	**106.6**	**27.6**	**43.5**	**95.4**	**426.8**
%total averaged over years	**19%**	**33%**	**27%**	**25%**	**1%**	**0%**	**26%**	**32%**	**26%**	**9%**		

Source: Masuda 2017 in NMFS 2017a.

Table 26 **Observed and CWT mark-expanded numbers of coded-wire tagged, Alaska-origin Chinook salmon captured in the bycatch of the Gulf of Alaska groundfish fisheries and sampled by NMFS certified observers by run year and release region.**

	Cook Inlet, Alaska		Southeast Alaska		Alaska Total	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2001	2	2	8	98.2	**10**	**100.2**
2002	1	1	9	46.2	**10**	**47.2**
2003	0	0	2	22.4	**2**	**22.4**
2004	0	0	3	30.5	**3**	**30.5**
2005	0	0	3	33.6	**3**	**33.6**
2006	0	0	10	58.3	**10**	**58.3**
2007	0	0	13	99.1	**13**	**99.1**
2008	2	2	4	50.3	**6**	**52.3**
2009	1	1	4	40.4	**5**	**41.4**
2010	0	0	10	81.3	**10**	**81.3**
2011	0	0	3	32.3	**3**	**32.3**
2001-11 Mean	*0.5*	*0.5*	*6.3*	*53.9*	***6.8***	***54.4***
2012	0	0	11	78	**11**	**78**
2013	0	0	5	25.9	**5**	**25.9**
2014	0	0	5	73.2	**5**	**73.2**
2015	0	0	27	305.8	**27**	**305.8**
2016	0	0	42	356.6	**42**	**356.6**
2012-16 Mean	*0*	*0*	*18.0*	*167.9*	***18.0***	***167.9***

Source: Masuda (2017 in NMFS 2017a).

Table 27 **Observed numbers of coded-wire tagged Chinook salmon captured in the bycatch of the Gulf of Alaska groundfish fisheries and sampled by NMFS certified observers by rearing type and state or province of origin.**

		Rearing type		
	Origin	**Hatchery**	**Mixed**	**Wild**
2001 - 2011	Alaska	59	0	6
	British Columbia	33	0	0
	Idaho	0	0	0
	Oregon	36	0	0
	Washington	35	10	2
	% of total	**90%**	**6%**	**4%**
2012 - 2016	Alaska	93	0	5
	British Columbia	113	0	0
	Idaho	1	0	0
	Oregon	83	0	1
	Washington	109	0	1
	% of total	**98%**	**0%**	**2%**

Source: Masuda 2017 in NMFS 2017a.

Rockfish Program Trawl CV Fishery

Recoveries of coded-wire tagged Chinook salmon from the GOA Rockfish Program trawl CV fishery (collected voluntarily via electronic detection by Alaska Groundfish Databank from 2013 through 2016) also originated from Alaska, British Columbia, Idaho, Oregon and Washington (Table 28).

Table 28 Observed and CWT mark-expanded numbers of coded-wire tagged Chinook salmon PSC in the GOA Rockfish Program trawl CV fishery, 2013 – 2016, by run year and state or province of origin. Source: Masuda (2017 in NMFS 2017a).

	Alaska		British Columbia		Idaho		Oregon		Washington		Total	
Run year	Num. Observed	CWT mark expanded num.	Num. Observed	CWT mark expanded num.	Num. Observed	CWT mark expanded num.	Num. Observed	CWT mark expanded num.	Num. Observed	CWT mark expanded num.	Num. Observed	CWT mark expanded num.
2013	4	26.8	9	61.7	5	7.3	28	136.4	67	110.8	**113**	**343.1**
2014	3	34.7	1	4.4	0	0.0	10	38.0	3	4.6	**17**	**81.8**
2015	3	75.3	2	17.0	1	2.0	13	39.8	8	9.9	**27**	**144.0**
2016	1	1.0	4	20.6	0	0.0	7	12.5	11	14.0	**23**	**48.1**
Mean	**2.8**	**34.5**	**4.0**	**25.9**	**1.5**	**2.3**	**14.5**	**56.7**	**22.3**	**34.8**	**45.0**	**154.2**
% of total avgeraged over years	**9%**	**26%**	**10%**	**19%**	**2%**	**1%**	**41%**	**35%**	**39%**	**19%**		

Salmon Excluder Device Testing (2013 – 2014) and U.S. Pollock Acoustic Trawl Survey

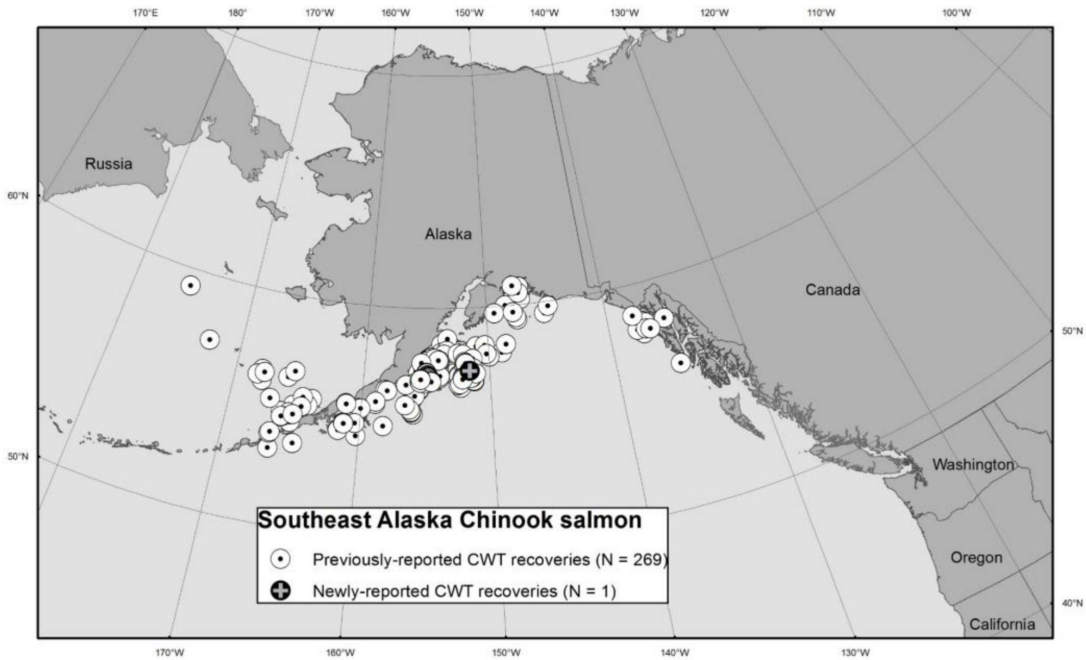
Recoveries of coded-wire tagged Chinook salmon caught in the salmon excluder device testing in the GOA in 2013 through 2014 are summarized by state or province of origin (Table 29). Recoveries of two Chinook salmon in the NMFS pollock acoustic trawl survey in Shelikof Strait in the GOA originated in British Columbia and Washington (Masuda 2017 in NMFS 2017a).

Table 29 Observed and CWT mark-expanded numbers of coded-wire tagged Chinook salmon PSC in the salmon excluder device testing in the GOA, 2013 -2014, by run year and state or province of origin. Source: Masuda (2017 in NMFS 2071a).

	Alaska		British Columbia		Idaho		Oregon		Washington		Total	
Run year	Num. Observed	CWT mark expanded num.	Num. Observed	CWT mark expanded num.	Num. Observed	CWT mark expanded num.	Num. Observed	CWT mark expanded num.	Num. Observed	CWT mark expanded num.	Num. Observed	CWT mark expanded num.
2013	3	15.5	6	36.2	1	2.1	6	10.5	24	47.2	**40**	**111.5**
2014	2	15.3	1	1.0	0	0.0	1	2.0	2	2.0	**6**	**20.3**

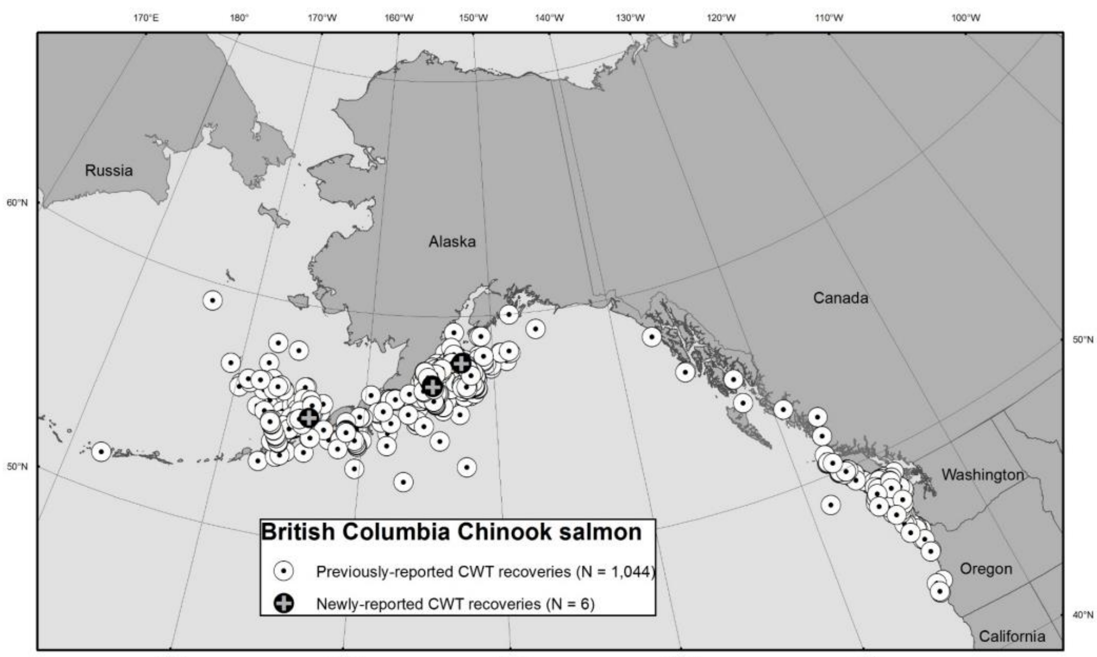
Maps of CWT Chinook salmon distribution in the North Pacific Ocean, GOA, and Bering Sea by state or province of origin are shown (Figure 16 through Figure 21). These maps are compiled from CWT recoveries from high seas commercial fisheries and research surveys, 1981 through 2016, and are updated annually (Masuda et al. 2017). High seas commercial fisheries include fisheries that occur in the exclusive economic zone (EEZ) off Alaska.

Figure 16 Ocean distribution for Southeast Alaska Chinook salmon from CWT recoveries in high seas commercial fisheries and research surveys, 1981 through 2016. Points reflect recovery locations.



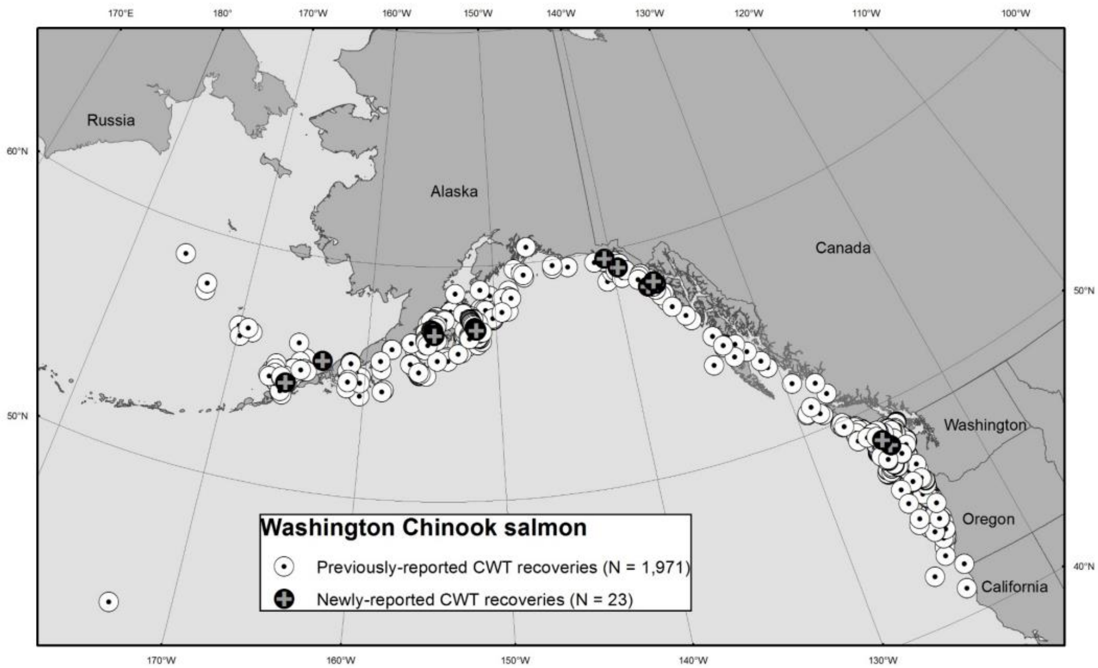
Source: Masuda et al. 2017

Figure 17 Ocean distribution for British Columbia Chinook salmon from CWT recoveries in high seas commercial fisheries and research surveys, 1981 through 2016. Points reflect recovery locations.



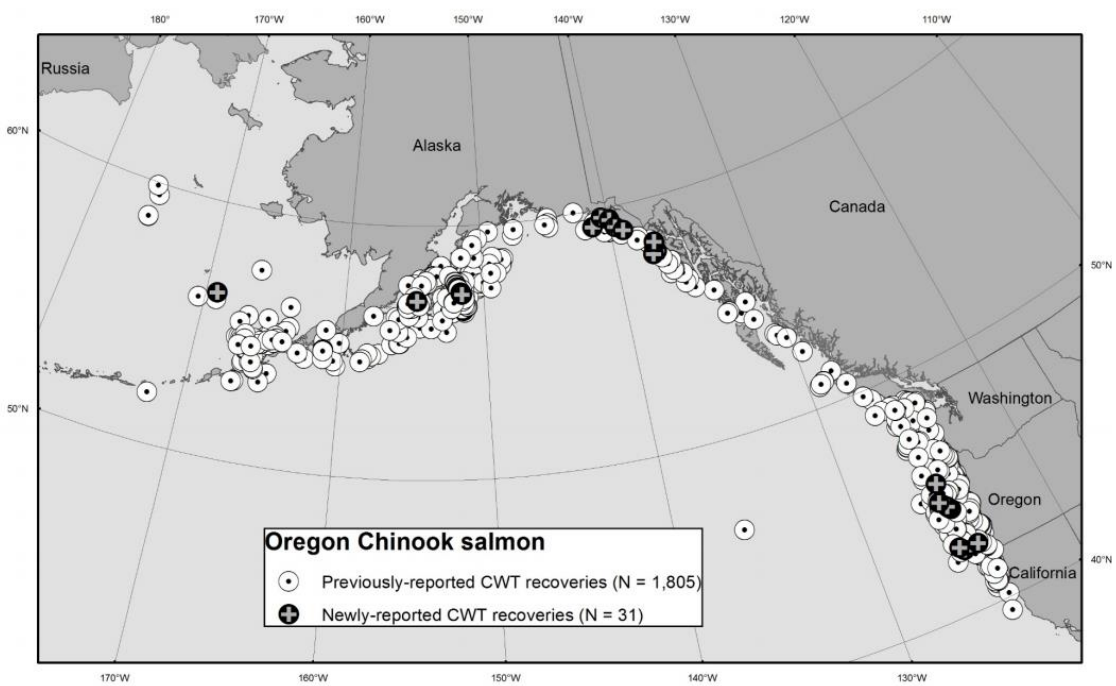
Source: Masuda et al. 2017

Figure 18 Ocean distribution for Washington Chinook salmon from CWT recoveries in high seas commercial fisheries and research surveys, 1981 through 2016. Points reflect recovery locations.



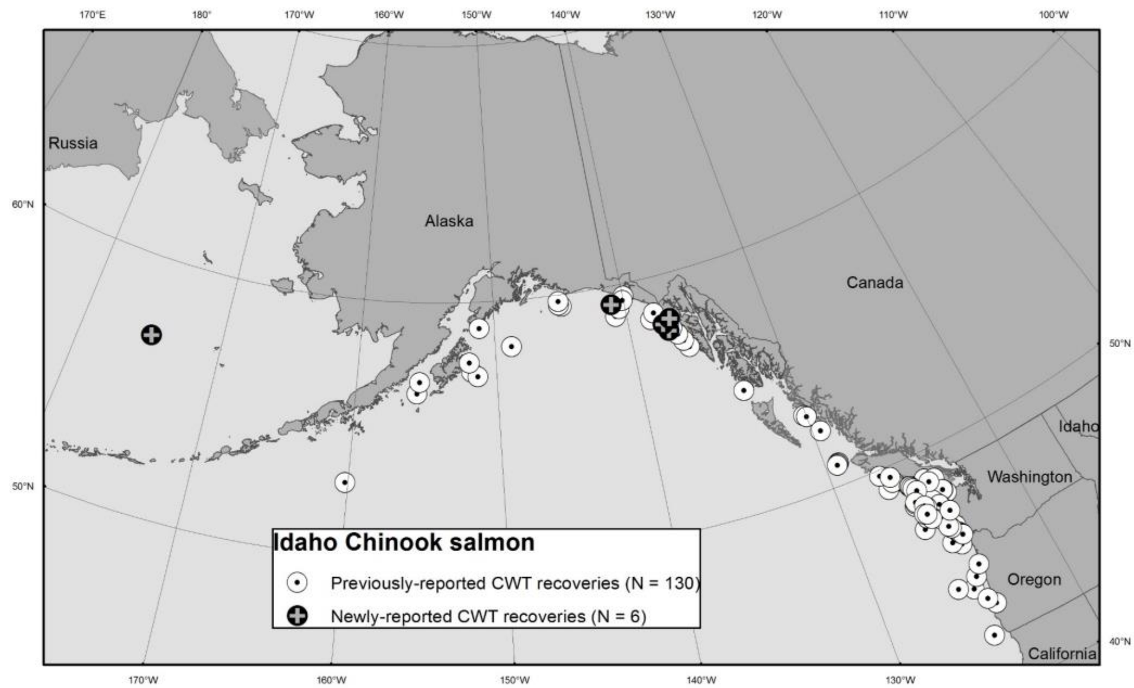
Source: Masuda et al. 2017

Figure 19 Ocean distribution for Oregon Chinook salmon from CWT recoveries in high seas commercial fisheries and research surveys, 1981 through 2016. Points reflect recovery locations.



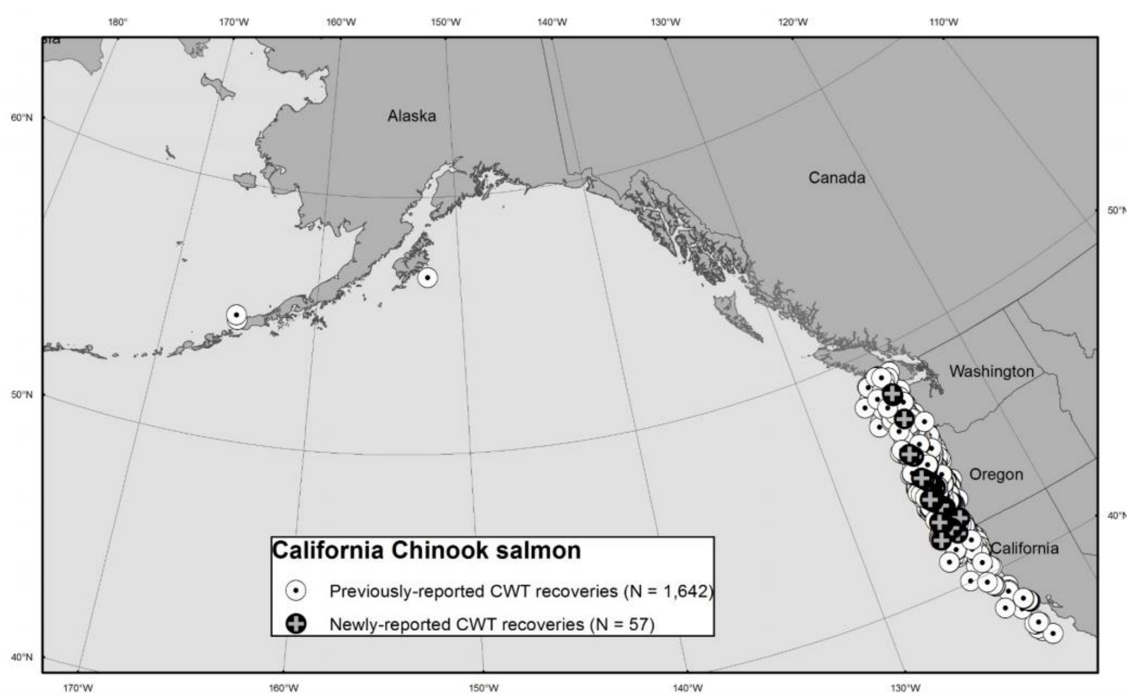
Source: Masuda et al. 2017

Figure 20 Ocean distribution for Idaho Chinook salmon from CWT recoveries in high seas commercial fisheries and research surveys, 1981 through 2016. Points reflect recovery locations.



Source: Masuda et al. 2017

Figure 21 Ocean distribution for California Chinook salmon from CWT recoveries in high seas commercial fisheries and research surveys, 1981 through 2016. Points reflect recovery locations.



Source: Masuda et al. 2017

Most of the Chinook salmon represented by CWTs and harvested in the GOA originated from hatchery production (Table 30). Overall since 1995, 95% of the CWT Chinook salmon PSC was of hatchery origin, 3% from wild stocks, and 2% of mixed hatchery-wild stocks. For Alaska-origin CWT Chinook salmon however, wild stocks increased to 9% of the PSC of Alaskan stocks in the GOA, with hatcheries providing the other 91%. For all the CWT Chinook salmon that have been released in Alaska from the 1992 brood onward, 87% were of hatchery origin, and 13% were from wild stocks. Washington was the only other state of origin for wild stocks recovered in the GOA. However, as discussed above, CWTs do not represent the true composition of all stocks of Chinook salmon in the PSC of GOA groundfish fisheries.

Table 30 Observed numbers of coded-wire tagged Chinook salmon captured in the bycatch of the Gulf of Alaska groundfish fisheries (excluding augmented sampling in the rockfish trawl fishery, 2013–2016, and salmon excluder device testing, 2013–2014) by rearing type and state or province of origin. Source: Masuda (2017 in NMFS 2017a).

		Rearing type		
	Origin	**Hatchery**	**Mixed**	**Wild**
2001 - 2011	Alaska	59	0	6
	British Columbia	33	0	0
	Idaho	0	0	0
	Oregon	36	0	0
	Washington	35	10	2
	% of total	**90%**	**6%**	**4%**
2012 - 2016	Alaska	93	0	5
	British Columbia	113	0	0
	Idaho	1	0	0
	Oregon	83	0	1
	Washington	109	0	1
	% of total	**98%**	**0%**	**2%**

Chinook salmon represented by CWTs and recovered in the GOA were composed of a variety of run-types, and the observed numbers of CWT Chinook salmon of each run-type varied by state or province of origin (Table 31). The different designated run-types are determined by the tagging agency. Overall, the most prevalent run-type of CWT Chinook salmon in the GOA was spring, followed by fall, summer, and small numbers of late fall.

Table 31 **Observed numbers of coded-wire tagged Chinook salmon captured in the bycatch of the Gulf of Alaska groundfish fisheries (excluding augmented sampling in the rockfish trawl fishery, 2013–2016, and salmon excluder device testing, 2013–2014) by run type and state or province of origin. Source: Masuda (2017 in NMFS 2017a).**

	Run type			
Origin	Spring	Summer	Fall	Late fall upriver bright
Alaska	67	0	0	0
British Columbia	7	12	20	0
Idaho	0	0	0	0
Oregon	20	0	25	3
Washington	1	18	29	3
% of 2001-11 total	**46%**	**15%**	**36%**	**3%**
Alaska	95	3	0	0
British Columbia	8	81	24	0
Idaho	0	0	0	1
Oregon	52	0	30	2
Washington	11	49	42	8
% of 2012-16 total	**41%**	**33%**	**24%**	**3%**

3.3.4.3 Stock of Origin of Thermal Marked Otoliths

The Alaska Groundfish Databank in Kodiak provided otoliths from Chinook salmon PSC in the 2017 Rockfish Program trawl CV fishery to the ADF&G Mark, Tag, and Age Laboratory. Hatcheries use thermal marking of salmon otoliths because it is a quick and effective identification method (Hagen et al. 1995). The ADF&G received 298 otolith samples and 294 of these samples were readable for thermal marking. Of these 294 samples, 24 (8.16%) were thermal marked and representative of Chinook salmon that originated from hatcheries in Alaska, British Columbia, Washington and Oregon (Table 32 and Table 33). Two additional otoliths were marked, but the marks were unidentifiable (Agler and Wilson, 2018). Fourteen of the 298 bycatch samples had CWTs, but only one of these CWT fish also had thermal marks (Agler and Wilson, 2018).

Table 32 **Mark types of Chinook salmon collected during the 2017 GOA Rockfish Program trawl CV fishery. Source: (Agler and Wilson, 2018).**

Mark type	#	%
Coded wire tagged (CWT)[1]	14	4.7%
Thermal mark	24	8.1%
No thermal mark or CWT	257	86.2%
Missing otoliths, no CWT	2	0.7%
Otoliths not readable, no CWT	1	0.3%
Total	298	100%

Table 33 Origin of thermal-marked Chinook salmon otoliths collected in 2017 GOA Rockfish Program trawl CV fishery. Source: (Agler and Wilson, 2018).

Country	State/Province	Area	#
U.S.	Alaska	Southcentral	1
U.S.	Alaska	Southeast	9
U.S.	Washington	Central	1
U.S.	Oregon	Willamette	2
Canada	British Columbia	Vancouver Island	9
Unknown	Unknown		2
Total			24

3.3.4.4 Stock of Origin Life History Information from Chinook Salmon PSC Scales

Scales from Chinook salmon taken as PSC in the GOA trawl fisheries have also been collected by the Observer Program. These scales have been used to verify the observer's species identification, to age the salmon, and to identify life history characteristics. A report prepared for the Council in 1983 found higher percentages of ocean-type (freshwater age-0) Chinook salmon in the GOA than in the Bering Sea (Myers and Rogers, 1983). Freshwater age-0 fish are more common in the Pacific Northwest and California. However, hatcheries in Alaska have also released freshwater age-0 Chinook salmon. This small bit of information provides another small clue into the stock of origin of Chinook salmon PSC in the GOA trawl fisheries.

3.3.5 Chinook Salmon Stocks by area

This section provides an overview of Chinook salmon stocks by area. The information available on individual stocks and run strengths varies greatly by river and management area. Escapement goals are provided by river for each ADF&G management area as of 2017. Information on stock status and abundance for non-Alaskan Chinook salmon populations is periodically published by the North Pacific Anadromous Fish Commission. The subsections that follow are organized according to the regions that are identified in the stock of origin research summarized in Section 3.3.4. That work suggests that the origins of Chinook PSC taken in the GOA trawl fishery during recent years breaks down *approximately* in the following distribution: U.S. west coast – 40-50%; British Columbia – 30-40%; Southeast Alaska – 15%; Northwest GOA – <5%; Copper River and Northeast GOA – <1%; Western Alaska and Trans-Pacific – <1%.

Chinook salmon runs in Alaska have been below average since 2007, and management of the fisheries has been conservative in many systems. Implementation of strict fishery management actions has been necessary to meet escapement objectives, and many fisheries have been curtailed to protect Chinook salmon. These restrictions have resulted in significant forgone subsistence, personal use, sport, and commercial fishing opportunity resulting in negative effects across coastal and interior Alaska communities. These hardships have been most profound in Western Alaska where early Chinook salmon returns provide the first fresh fish after the winter, in mixed-stock salmon fisheries where Chinook salmon conservation measures have resulted in lost harvest opportunity on more abundant species of salmon, and in sport fisheries where opportunity to harvest Chinook salmon in popular and easily accessible sport fisheries has been eliminated in recent years.

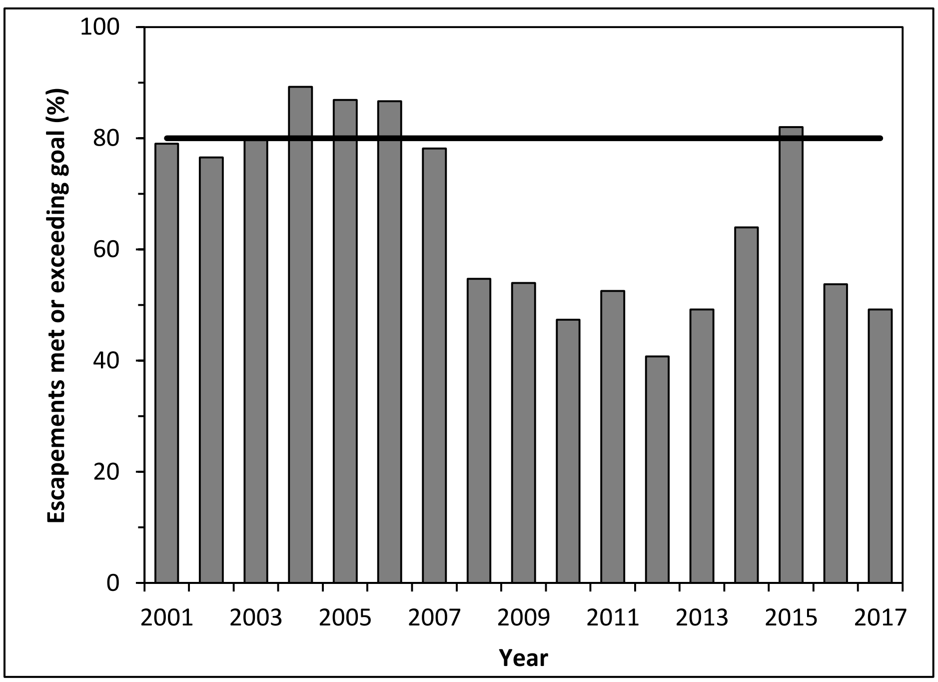
There are currently 66 stock-specific Chinook salmon escapement goals set by ADF&G. In 2017, 49% of the Chinook salmon escapement goals were met or exceeded statewide. This is a decrease from 54% in 2016 and the second year of decline since an increasing trend between 2012 and 2015 (Figure 22).

Chinook salmon stock status across Alaska is expected to be below average in 2018 with Southeast Alaska predicted to experience the worst returns on record.[21]

Geographically, the percentage of Alaska Chinook salmon escapement goals met or exceeded are as follows:

- Southeast Alaska - 17% (2 of 12 goals met)
- Copper River and NE GOA
    - Prince William Sound - 100% (1 goals met)
- NW GOA
    - Upper Cook Inlet - 32% (6 of 19 goals met)
    - Lower Cook Inlet - 100% (All 3 goals met)
    - Kodiak, Chignik, Alaska Peninsula - 0% (0 of 4 goals met)
- Not present in GOA Trawl Chinook PSC
    - AYK Region - 85% (17 of 20 goals met)
    - Bristol Bay - 50% (1 of 2 goals met)

Figure 22 Percentage of Chinook salmon escapement goals in Alaska that were met or exceeded from 2001 through 2017



Source: Alaska Department of Fish & Game

[21] http://www.adfg.alaska.gov/index.cfm?adfg=pressreleases.pr12222017

3.3.5.1 Southeast Alaska and Yakutat (Southeast Alaska)

Native Chinook salmon stocks occur throughout Southeast Alaska and Yakutat, primarily in the large mainland rivers and their tributaries. Of the 34 known rivers that produce runs of Chinook salmon the Situk, Alsek, Taku, Stikine, Chilkat, King Salmon, Andrew Creek and the Behm Canal rivers (i.e., Unuk, Chickamin, Blossom, and Keta rivers) are monitored annually (Pahlke 2010). Some of these rivers are transboundary systems which originate in Canada and flow through Alaska to the Pacific Ocean. The Pacific Salmon Commission, under the terms of the Pacific Salmon Treaty, address shared ownership and coordinated management of the Taku, Stikine, and Alsek rivers. Four additional rivers are also subject to the Pacific Salmon Treaty: the Situk, Chilkat, Unuk, and Chickamin.

Commercial Chinook salmon harvests are based on three components: (1) the all-gear Pacific Salmon Treaty defined harvest ceiling, based on coastwide abundance forecasts; (2) directed fisheries on returns to the Stikine and/or Taku rivers, also based on forecasts and harvest sharing agreements contained in the Pacific Salmon Treaty; and (3) production from Alaska enhancement programs (Der Hovanisian et al. 2011). In addition to commercial fisheries, Chinook salmon are also taken in sport, personal use, and subsistence fisheries. The majority of the Chinook salmon sport harvest occurs in the Ketchikan, Sitka, and Juneau areas.

Spawning escapement is monitored on 11 river systems with BEGs (Munro and Volk 2017) and some of these counts are used as indicators of relative salmon abundance as part of the coast-wide Pacific Salmon Commission Chinook Model. In 2016 and 2017, only two of the 11 Chinook salmon index systems monitored in Southeast Alaska met or exceeded the lower bound of spawning escapement goals. This was a reduction from 2015, when nine of the 11 index systems were within BEG goals. The two river systems that were within BEG ranges in 2016 were the Keta River, a clearwater stream located on the south end of Misty Fjords National Monument near Ketchikan, and the King Salmon River, a small non-glacial system located near the head of Seymour Canal on Admiralty Island (Hagerman et al. 2017). The two river systems that were within BEG ranges in 2017 were the Keta River and the Situk River near Yakutat.

<u>Stocks of Concern</u>

Three of the 13 Chinook salmon Stocks of Concern are located in Southeast Alaska: Chilkat, King Salmon, and Unuk river. All are Stocks of Concern designated in 2017. In response to these Stock of Concern designations a suite of management measures designed to conserve and rebuild these stocks will be implemented for the 2018 and future fishing seasons.

1) The Pacific Salmon Treaty Table 1 all-gear harvest limit will be reduced by 10% which is equivalent to language in Pacific Salmon Treaty Ch. 3, Paragraph 13 specific to recommended percentage reductions for 2 stock groups failing to achieve their management objectives in two consecutive years. These actions are explicitly intended to not increase harvest rates on other stocks of Chinook subject to the PST by transfer of catch from one season to another season and further support obligations as described in TCCHINOOK(04)-3 that details the standardized fishing regime for Southeast Alaska Chinook fisheries (CTC 2004).
2) The spring troll fishery will be closed in May and June. However, terminal harvest areas may open when Alaska hatchery Chinook salmon are in abundance and exercised to minimize impacts on non-Alaska hatchery Chinook salmon when opening terminal harvest areas using time and area authority.
3) The sport fishery will be closed April 1 through June 14 in Districts 101, 102, 106, 107, 108, 110, 111, 112, 114 (with the exception of Cross Sound) and District 115. However, terminal harvest areas may open when Alaska hatchery Chinook salmon are in abundance and exercised to minimize impacts on non-Alaska hatchery Chinook salmon when opening terminal harvest areas

using time and area authority. A map of the aforementioned districts is available at: http://www.adfg.alaska.gov/static/fishing/PDFs/commercial/fig_4_fishing_districts.pdf.

4) Prior to opening terminal harvest areas, managers must describe the conditions under which terminal harvest areas will be opened and closed in meeting the requirement to minimize impacts on non-Alaska hatchery Chinook during May and June of 2018 while allowing the harvest of surplus Alaska hatchery Chinook.
5) For the Alsek stock of Chinook salmon, the Dry Bay commercial fishery will be closed in weeks 1 and 2.

The following specific management measures will be implemented using EO authority for stocks of concern in the Chilkat and King Salmon river systems. A map of the Chilkat and King Salmon rivers and nearby fishing districts is shown in Figure 23 below.

Commercial Troll Fishery

- Close the waters of Section 15-A in Lynn Canal/Chilkat Inlet north of the latitude of Sherman Rock to commercial trolling from April 15 to December 31; close the waters of Sections 15-C and 12-B to troll gear April 15–30; Sections 15-C and 12-B closed to spring troll fisheries during May and June.
- Close the waters of Section 11-B south of the latitude of Grave Point Light, Section 11-C, and Section 11-D, to troll gear April 1–30; waters of District 11 closed to spring troll fisheries during May and June.
- Delay initial opening dates from May 1 to June 15 for Homeshore, South Passage, and Cross Sound spring troll fisheries.
- Reduce initial opening lengths during SW 18–22 for Point Sophia and Hawk Inlet spring troll fisheries from 7 days/week to 3 days/week in May.
- Limit Port Althorp spring troll fishery to opening lengths of 2 days/week through SW 22, and limit Lisianski Inlet fishery to opening lengths of 3 days/week through SW 22.
- Reduce initial opening length of Chatham Strait spring troll fishery from 7 days/week to 4 days/week during May, and keep opening lengths during June at less than 7 days/week.
- Close Tebenkof Bay spring troll fishery.
- May close regionwide spring troll fishery from May 29 to June 14.

Commercial Net Fisheries

- Reduce the open area in northern Chilkat Inlet during the first 5 weeks of the District 15 drift gillnet season by implementing and exceeding conservation measures of the *Lynn Canal and Chilkat River King Salmon Fishery Management Plan* by closing the area north of Eldred Rock Lighthouse.
- Close western half of Section 15-A in first through fifth week of the District 15 drift gillnet fishery.
- Impose 6-inch maximum mesh restriction in Section 15-A in the first through third weeks of the District 15 drift gillnet fishery.
- Impose night closures between 10:00 p.m. and 4:00 a.m. in first through fourth week of the season in Section 15-A and Section 15-C of the District 15 drift gillnet fishery.
- Limit time and area open to 2 days/week in the "postage stamp" area only in the first week of the season in Section 15-C in the District 15 drift gillnet fishery.
- Limit time and area open to 2 days/week in the area south of the latitude of Vanderbilt Reef in the second week of the season in Section of 15-C in the District 15 drift gillnet fishery.
- Impose 6-inch maximum mesh restriction in first and second weeks of the season in Section 15-C in the District 15 drift gillnet fishery.
- By regulation, the inside area of Boat Harbor THA (west of marker) is open 7 days/week in first through fourth week of the season.

- Open outside of Boat Harbor THA only 2 days/week during first and second weeks of the season.
- Impose 6-inch maximum mesh restriction in first and second week in outside area of Boat Harbor THA.
- Impose non-retention of king salmon over 28 inches in regional purse seine fisheries.
- Reduce area open in Taku Inlet for the first 5 weeks of the District 11 drift gillnet fishery; close Taku Inlet north and west of a line from Point Greely to Cove Point for first week and north of Point Greely, Cooper Point or Jaw Point for second through fifth week of the season.
- Do not open Section 11-C to drift gillnetting.
- Impose night closures between 10:00 p.m. and 4:00 a.m. in Subdistrict 111-31, and Section 11-C if open.
- Impose 6-inch maximum mesh size restriction for the first 3 weeks of the District 11 drift gillnet fishery.

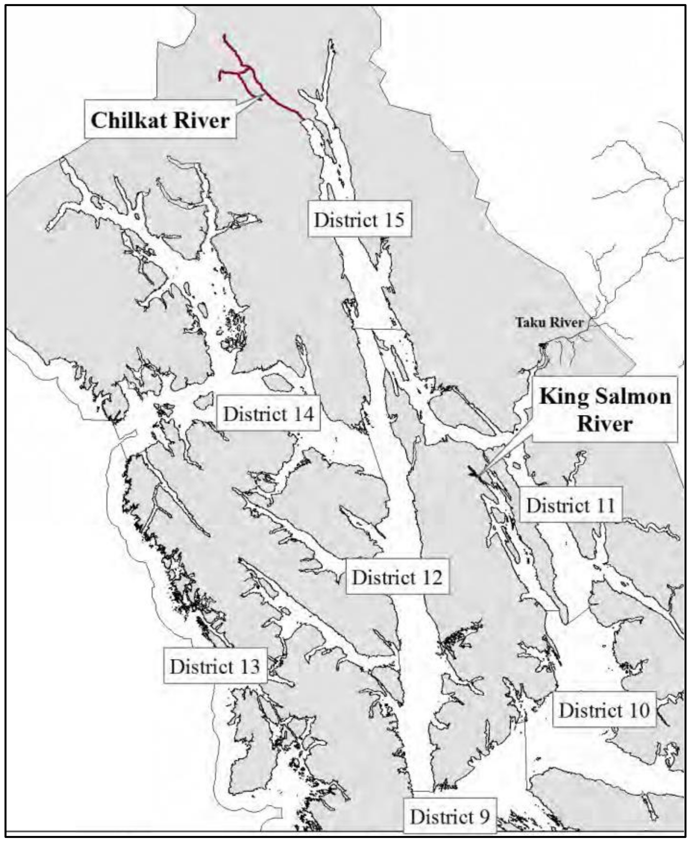
<u>Sport Fishery</u>

- District 15: Section 15-A, April 15–December 31, no retention of king salmon; Sections 15-B and 15-C, April 15–June 14, no retention of king salmon. Chilkat Inlet, north of Seduction Point, April 15–June 30, closed to king salmon fishing (5 AAC 33.384 (e)(2)(B)(i)).
- District 12: Section 12-B, April 15–June 14, no retention of king salmon.
- District 11: Sections 11-A, 11-B and 11-C, April 15–June 14, no retention of king salmon; Section 11-D closed to king salmon fishing April 15–June 30.
- THA near Juneau: If surplus hatchery king salmon return to the DIPAC Hatchery in excess of broodstock needs, the designated sport THA near Juneau will be liberalized with a bag and possession limit of 2 king salmon any size, no annual limit June 15–August 31.

<u>Subsistence Fishery</u>

- Reduce time and area open to subsistence fishing in Chilkat Inlet and in the Chilkat River during the first 5 weeks of the season by implementing and exceeding conservation measures of the *Lynn Canal and Chilkat River King Salmon Fishery Management Plan*.
- Open entire Chilkat River to subsistence fishing June 1–14.
- Close Chilkat River to subsistence fishing June 15–July 31, except for the portion of the river between Haines Highway mile 19 and the Wells Bridge; this section open only 4 days/week.
- Close Chilkat Inlet to subsistence fishing until July 22.

Figure 23 Locations of Chilkat River, King Salmon River, and nearby fishing districts



The Unuk River is located northeast of Ketchikan and runs across the Alaska-Canada border. For the Unuk River Chinook salmon stock the following specific management measures will be implemented:

Commercial Net Fisheries

- Close Neets Bay THA for 6 days during SWs 24–27;
- Impose regional non-retention of king salmon over 28 in for purse seine fisheries (requires adoption of non-retention provisions attached.

Commercial Troll Fishery

- Winter Troll: Notwithstanding any remaining seasonal guideline harvest level, the winter troll fishery will be closed by EO in all waters of Southeast Alaska/Yakutat on March 15.
- Spring Troll: Using EO authority, opportunities during May and June spring troll king salmon fisheries will be limited to THAs, waters in close proximity to hatchery facilities or release sites, and in areas that have been identified as having low proportional harvests of wild stock Southeast Alaska/Yakutat king salmon. Spring troll chum fisheries, as provided for in the *District 12 and District 14 Enhanced Chum Salmon Troll Fisheries Management Plan*, will begin June 15, with retention of king salmon prohibited.
- Summer Troll:
  - The first retention period for king salmon during the general summer troll fishery will open July 1 to target 70% of the remaining troll king salmon annual allocation, minus the number of treaty king salmon harvested in winter and spring troll fisheries.

- o The second summer retention period for king salmon, occurring in August, would open by EO to target any remaining portion of the annual troll allocation following the first retention period.

Sport Fishery

- North and Northeast Behm Canal: In Behm Canal and the contiguous bays enclosed to the north by a line from the western entrance of Bailey Bay to the northern tip of Hassler Island, and a line from Fin Point to Dress Point to a line from Cactus Point to Point Eva, January 1–December 31, closed to salmon fishing.
- West Behm Canal: In West Behm Canal and the contiguous bays enclosed to the north by a line from the western entrance of Bailey Bay to the northern tip of Hassler Island, and a line from Fin Point to Dress Point, and to the south by a line from Indian Point to Mike Point, April 1–August 14, no retention of king salmon.
- Southeast Behm Canal and Southern Revillagigedo Channel: In the waters of southern Revillagigedo Channel enclosed from a line from Lucky Point to Middy Point, continuing to the latitude of Beaver Point, and from Point Rosen to Quadra Point, and in southeast Behm Canal from Cactus Point to Eva Point, April 1–August 14, no retention of king salmon.
- Remainder of Ketchikan Area: In the marine waters of Ketchikan north and east from the International Boundary Line at Dixon Entrance from 54°42.48’ N. lat., 130°36.92’ W. long to 54°40’ N. lat., 131°45’ W. long, continuing north to Caamano Point and enclosed to the north by a line from Indian Point to Mike Point and to the southeast from Lucky Point to Middy Point, continuing to the latitude of Beaver Point, and from Point Rosen to Quadra Point, April 1–August 14, the bag and possession limit is one king salmon 28 in or greater in length for all anglers; nonresident annual limit of 3 king salmon or lower.
- Herring Bay THA: In the waters of Herring Bay west of a line from the southernmost entrance of Hole-In-The-Wall harbor to ADF&G markers located ½ mile north of Whitman Creek to the fresh/salt water boundary signs located at the mouth of Herring Cove Creek, June 1–July 31, the bag and possession limit is 6 king salmon, with no size limit or annual limit.
- Neets Bay THA: East of the longitude of the eastern most tip of Bug Island the bag and possession limit is one king salmon, 28 in or greater in length for all anglers; annual limit of 3 king salmon or lower.

Personal Use Fishery

- Prohibit the retention of king salmon in the Yes Bay and Unuk River personal use fisheries.

3.3.5.2 Prince William Sound (Copper River and Northeast GOA)

The Prince William Sound (PWS) management area encompasses all coastal waters and inland drainages entering the north Central GOA between Cape Suckling and Cape Fairfield. Chinook salmon are harvested in commercial fisheries (primarily by drift gillnets), sport, personal use, and subsistence fisheries. The entire Chinook salmon run originates from wild upriver stocks in the Copper River (Botz et al. 2010).

The Copper River is the only river in the PWS area where Chinook salmon escapement is monitored. In 2003 the Department established a SEG of 24,000 Chinook salmon for the Copper River. With the exception of 2005, 2010, 2014, and 2016, this lower bound SEG has been achieved in all years since implementation.

There are no Chinook salmon stocks of concern in the PWS management area, but numerous restrictions to sport, commercial, subsistence, and personal use fisheries have been implemented in recent years to conserve Copper River Chinook salmon. Due to the extremely poor 2017 Copper River Chinook salmon forecast, commercial closed waters described in the Copper River District were expanded to include inside waters west of Grass Island Bar and east of Kokinhenik Bar, essentially closing all waters inside barrier islands across the entire district. These closures were maintained through June 18, affecting the first nine fishing periods, seven fishing periods beyond the regulatory requirement. In addition, fishing period frequency was limited to two per week and duration was maintained at 12 or fewer hours per period through late June. Through the end of July, the commercial fishery was open 403 hours, 264 hours less than the recent 10-year average.

In the Glennallen Subdistrict subsistence fishery, a limit of 2 Chinook salmon taken by fish wheel was established for 2017 and the limit for Chinook salmon taken by dip net was reduced to 2 fish prior to July 15 by EO prior to the start of the subsistence season due to a king salmon return forecast of 29,000 fish. These restrictions were rescinded 3 days after the start of the season when inseason abundance indices showed a stronger than expected return allowing for a sustainable harvest surplus in the subsistence fishery. Glennallen Subdistrict subsistence Chinook salmon harvest has declined over 50% since the early 2000s.

In general, Copper River sport fisheries for Chinook salmon have been closed or restricted annually from 2009 through 2017 and sport fishery harvest as declined from several thousand fish annually in the early 2000s to several hundred fish in recent years.

3.3.5.3 Northwest GOA

Stock of origin identification studies estimate that Chinook salmon from Northwest GOA river systems account for approximately less than 5% of GOA trawl PSC.

3.3.5.3.1 Cook Inlet

The Cook Inlet management area is divided into two areas, the Upper Cook Inlet (Northern and Central districts) and the Lower Cook Inlet. The Upper Cook Inlet commercial fisheries management area consists of that portion of Cook Inlet north of the latitude of the Anchor Point Light. Chinook salmon are harvested in the commercial fishery by set and drift gillnet gear and are an important component of subsistence and sport fisheries in the area.

Stocks of Concern

Seven of 13 Chinook salmon Stocks of Concern are located in Upper Cook Inlet: Chuitna River (management, 2011), Theodore River (management, 2011), Lewis River (management, 2011), Alexander Creek (management, 2011), Willow Creek (yield, 2011), Goose Creek (yield, 2011; management, 2014), and Sheep Creek (management, 2014). These stocks are harvested in a subsistence fishery at Tyonek, the Northern District commercial fishery, and in-river sport fisheries. Since 2011 sport fisheries on these rivers have been managed with a combination of closures, annual limits, prohibitions on use of bait, and prohibition of retention, resulting in harvest reductions of over 70% in some years.

In Upper Cook Inlet, there are two commercial fisheries where the majority of Chinook salmon are harvested, the set gillnet fisheries in the Northern District and in the Upper Subdistrict of the Central District. Moderate improvements have been seen in Chinook salmon numbers for the past three years, still, runs were again expected to be below average in watersheds throughout Southcentral Alaska during the 2017 season. In the Northern District, management actions in the Northern District directed Chinook salmon set gillnet fishery have included area closures, time restrictions, and/or regularly scheduled fishing period closures in order to reduce the harvest of northern Cook Inlet Chinook salmon since 2011.

Because Chinook salmon escapements have improved modestly in the Northern District in recent years, there has been a relaxation of some sport fishery restrictions in the Deshka and Little Susitna rivers.

Harvest and escapement data over recent years, in combination with recent strength of age class relationships derived from data collected at the Deshka and Little Susitna weirs, indicated that additional harvest over 2013–2016 levels was sustainable for these systems only. Therefore, the 2017 Northern District directed Chinook salmon commercial fishery started the season fishing regularly scheduled 12-hour fishing periods. In total, there were four periods scheduled during the directed Chinook salmon commercial fishery: May 29, and June 5, 12, and 19. The Deshka River is the primary system in northern Cook Inlet where Chinook salmon escapement has been monitored inseason with a weir to meet an SEG of 13,000–28,000 fish. Based on weir counts of approximately 6,400 fish through June 17, achieving the SEG in the Deshka River was uncertain without a reduction in harvest of this stock. Therefore, the final Northern District set gillnet commercial fishing period on June 19 was reduced from 12 hours to 6 hours in duration. Bait was removed from the Deshka River sport fishery via EO a few days later. The estimated final escapement of Chinook salmon in the Deshka River was approximately 11,400 fish, which was below the lower end of the SEG and was 34% less than the previous 10 year average of 17,195 fish.

The Alaska Board of Fisheries adopted a new Chinook salmon SEG of 2,100–4,300 fish for the Little Susitna River at its 2017 UCI finfish meeting. The estimated escapement in 2017 was approximately 2,500 Chinook salmon, which meant the SEG was achieved.

The estimated Chinook salmon harvest in the Northern District directed fishery in 2017 was 1,927 fish, nearly identical to the previous 10-year average annual harvest of 1,926 fish.

Kenai River late-run Chinook salmon fisheries are managed to meet an SEG of 13,500–27,000 large (>75 cm mid eye to tail fork) fish. If restrictions are implemented in the sport fishery in order to achieve the SEG (from July 1–31), restrictive actions are also required in the east side set gillnet fishery (ESSN). In August, after the Kenai River sport fishery is closed, the ESSN fishery was to be managed to meet both Chinook and sockeye salmon escapement goals. The 2017 preseason forecast was for a total run of approximately 33,600 “large” Kenai River late-run Chinook salmon. Few, if any, restrictive actions were anticipated in either the sport or commercial ESSN fishery if the total run was close to forecast. No restrictions were made to either fishery for Chinook salmon conservation in 2017. The estimated 2017 ESSN Chinook salmon harvest was 4,631 fish.

Large late-run Chinook salmon passage in the Kenai River was enumerated at the River Mile 14 sonar site. The total estimated in-river mortality (harvest and catch and release mortality) above the sonar was 6,082 fish with an estimated number of Chinook salmon spawning downstream of the sonar of 829 fish. This resulted in a preliminary escapement estimate of 20,731 Chinook salmon, which was within the SEG of 13,500 to 27,000 large fish.

Similar to 2016, harvest of Chinook salmon was allowed in the Kenai River during the early-run Chinook salmon sport fishery. An emergency order opened the lower 18 miles of the Kenai River with bait from June 21–June 30. The estimated passage of early-run large Chinook salmon was 7,237 fish; the OEG for Kenai River early-run large Chinook salmon is 3,900–6,600 fish. Therefore, after harvest above the River Mile 14 sonar site is subtracted from the passage estimate, it is likely the upper end of the OEG was exceeded.

In all of UCI, approximately 7,369 Chinook salmon were commercially harvested in 2017, which was 22% less than the previous 10-year (2007–2016) average annual harvest of 9,427 fish.

The Lower Cook Inlet management area is comprised of all waters west of the longitude of Cape Fairfield, north of the latitude of Cape Douglas, and south of the latitude of Anchor Point. Chinook salmon are not a commercially important species in Lower Cook Inlet and most of the catch occurs incidental to fisheries targeting sockeye salmon (Hammarstrom and Ford 2010), however, Chinook salmon are very important to the marine sport fishery which occurs in this area. Fishing occurs year-round, mainly within 3 miles of shore. Sport fishery harvest of Chinook salmon in Cook Inlet marine waters has been around 20,000 fish in recent years.

Chinook salmon escapement is monitored in Lower Cook Inlet: Deep Creek, and Anchor and Ninilchik rivers and SEGs have been established for each of these drainages. Escapement goals have generally been met for these stocks in recent years and there are no Chinook salmon stocks of concern in Lower Cook Inlet.

3.3.5.3.2 Kodiak

The Kodiak Management Area (KMA) comprises the waters of the Western GOA surrounding the Kodiak Archipelago and that portion of the Alaska Peninsula bordering the Shelikof Straight between Cape Douglas and Kilokak Rocks. The majority of commercial Chinook salmon harvest is taken by seine fishermen during June and early July in the Afognak, Northwest Kodiak, Eastside Kodiak and Mainland districts. Chinook salmon harvest also occurs in sport and subsistence fisheries.

Chinook salmon occur in six streams and biological escapement goals are established for both the Karluk and Ayakulik rivers. Karluk River Chinook salmon was declared a Stock of Management Concern in 2011. In 2012 fisheries targeting sockeye salmon occurred along the Westside of Kodiak Island and in the Outer Karluk Section of the Southwest Kodiak District. During these fishing periods non-retention of Chinook salmon by purse seine gear was implemented from Cape Kuliuk to Low Cape. After not achieving the escapement goal from 2007-2010, Karluk Chinook salmon escapement was within the escapement goal range of 3,000 to 6,000 fish in 2011, 2012, and 2016. Ayakulik Chinook salmon were below the escapement goal of 4,000 to 9,000 fish in 2009, 2013 through 2015, and 2017.

In an attempt to increase Chinook salmon escapement ADF&G has prohibited retention of Chinook salmon 28 inches or greater in length by seine gear during fisheries in the Inner Karluk, Outer Karluk, Inner Ayakulik, and Outer Ayakulik sections and that portion of the Central Section south of the latitude of Cape Kuliuk when weir counts indicate inadequate escapement. Chinook salmon 28 inches or greater in length caught in KMA from June 1 to July 5 may not be retained from purse seine gear. Low abundance of Chinook salmon in KMA and restrictive management measures resulted in a 2017 KMA commercial Chinook salmon harvest of just under 7,100 fish which is less than half the most recent 10-year average.

Karluk and Ayakulik river Chinook salmon sport fisheries have been managed with severe restrictions since the late 2000s. There has been no sport fishery harvest of Chinook salmon from the Karluk River since 2007 and on average less than 400 fish per year are caught and released incidental to fishing for other species. Sport fishery harvest of Ayakulik River Chinook salmon has averaged less than 70 fish per year since 2006.

3.3.5.3.3 Chignik

The Chignik Management Area encompasses all coastal waters and inland drainages of the northwest GOA between Kilokak Rocks and Kupreanof Point. Chinook salmon are harvested in commercial, sport, and subsistence fisheries.

The Chignik River is the only stream with substantial Chinook salmon production in the Chignik area. Aside from 2013 and 2017 when it was slightly below the lower bound, the BEG has been met or exceeded in all years since implementation. At 1,137 fish, the Chinook salmon escapement in 2017 was below the BEG range of 1,300–2,700 fish (Munro and Volk 2017). Sport fisheries for Chinook salmon in the Chignik River have either been restricted to catch and release only or closed in 2017 due to low returns. Commercial Chinook salmon harvest in the Chignik Management Area in 2017 (3,946 fish) was about 58% of the most recent 10-year average.

3.3.5.3.4 Alaska Peninsula

The North Alaska Peninsula portion of the Alaska Peninsula Management Area includes those waters of the Alaska Peninsula from Cape Sarichef to Cape Menshikof. The majority of Chinook salmon harvest occurs incidental to sockeye salmon fisheries, although limited directed fisheries do occur. Sport and subsistence fisheries also harvest Chinook salmon in the North Alaska Peninsula area although they are relatively small because of the remoteness of the area and limited number of communities in the area. There are no Chinook salmon stocks of concern in the Alaska Peninsula area and fisheries have generally not been constrained due to Chinook salmon abundance concerns.

Nelson River is the only river on the North Alaska Peninsula with a Chinook salmon escapement goal. The 2017 Nelson River Chinook salmon escapement of 1,852 fish did not meet the BEG range of 2,400–4,400 fish (Munro and Volk 2017).

The South Alaska Peninsula Area includes waters from Kupreanof Point west to Scotch Cap. There are no known Chinook salmon spawning streams along the South Alaska Peninsula waters. Chinook salmon are commercially harvested by purse seine, drift gillnet, and set gillnet gear. Most of the Chinook salmon are taken by seine gear incidental to other fisheries. The harvest for Chinook salmon, for all gear combined, ranged from 5,412 in 2006 to 12,683 in 2017.

3.3.5.4 Other Alaska

Chinook salmon from the following regions have not been identified as a significant portion of GOA trawl PSC.

3.3.5.4.1 Bristol Bay

The Bristol Bay Area includes all coastal waters and inland waters east of a line from Cape Newenham to Cape Menshikof. The area is further divided into five fishing districts: Togiak, Nushagak, Naknek-Kvichak, Egegik, and Ugashik. Harvests of Chinook salmon in the commercial fishery predominantly occur in the Nushagak District (Morstad et al. 2010). Chinook salmon are popular targets in both the sport and subsistence fisheries.

Alagnak and Nushagak river Chinook salmon are the only Bristol Bay Chinook salmon stocks currently managed with escapement goals. The Nushagak River Chinook salmon SEG range of 55,000 to 120,000 fish has been met every year since 2008. The Alagnak River Chinook salmon Lower Bound SEG of 2,700 fish has not been met the past three years. There are no stocks of concern in Bristol Bay.

Most commercial Chinook salmon harvest in Bristol Bay occurs in the Nushagak District. 2017 Nushagak District Chinook salmon harvest was 32,234 fish which is about 20% below the long-term average. The Nushagak District commercial Chinook salmon fishery is managed conservatively early in the fishing season to provide subsistence fishing opportunity and meet escapement needs. The directed Chinook salmon fishery is controlled through use of time, area, and gear restrictions based on daily escapement counts. Nushagak drainage Chinook salmon sport fisheries have experienced bag limit reductions or liberalizations depending on inseason abundance estimates based on Portage Creek sonar passage.

3.3.5.4.2 Kuskokwim

The Kuskokwim Management Area consists of all waters of Alaska between Cape Newenham and the Naskonat Peninsula, including Nunivak and St. Matthew Islands.

The large size of the Kuskokwim River drainage and the distances between the fisheries and escapement monitoring projects throughout the drainage adds complexity to the management of Kuskokwim River. Chinook salmon begin entry into the Kuskokwim River in late May and falls of in early July. Fishery management information on run size and timing by species is limited until the salmon are distributed throughout the drainage and on the spawning grounds hundreds of miles from and weeks after the lower river fishery has been initiated.

Kuskokwim Bay salmon have similar run timing into the Kanektok, Goodnews, and Arolik rivers. These are small drainages in comparison to Kuskokwim River and although evaluation of run size and timing in Kuskokwim Bay rivers is not immediate, it is much timelier than that of the Kuskokwim River. Many of the factors that make Kuskokwim River fisheries management difficult are not present in Kuskokwim Bay fisheries.

Small numbers of Chinook salmon are harvested in salmon directed commercial fisheries during late June and July under a guideline harvest range of 0–50,000 fish. Directed Chinook salmon fisheries do occur in Districts 4 and 5 when abundance is adequate to allow for a commercial fishery. Little commercial harvest opportunity for Chinook salmon in the Kuskokwim River has been provided in recent years.

Because of poor Chinook salmon returns to the Kuskokwim River in recent years ADF&G has taken a number of preseason management actions including early season subsistence fishing closures, tributary closures, time and area restrictions, gillnet mesh size and length restrictions, and live release requirements to ensure escapement needs are met. These restrictions have had negative effects on subsistence users and subsistence Chinook salmon harvest has decreased by over 80% since the mid-2000s.

Chinook salmon escapements are evaluated through aerial surveys, by enumeration at weirs, and through mark and recapture at the mainstem tagging project near Upper Kalskag. Fourteen Kuskokwim Area Chinook salmon stocks are currently managed with escapement goals, all of which were met in 2017, with the exception of the Holitna River SEG of 970 to 2,100 Chinook salmon. The Kanektok River Chinook salmon return was not assessed in 2017. There are no stocks of concern in the Kuskokwim Management Area.

3.3.5.4.3 Yukon River

The Yukon Salmon Management Area encompasses the largest river in Alaska. The Yukon River and its tributaries drain an area of approximately 220,000 square miles within Alaska, while the Canadian portion of the river accounts for another 110,000 square miles. The river flows 2,300 miles from its origin in Canada, 30 miles from the GOA, to its terminus in the Bering Sea. Spawning populations of Chinook salmon occur throughout the Yukon River drainage in tributaries from as far downstream as the Archuelinuk River to as far upstream as the headwaters of the Yukon River in Canada.

Yukon River Chinook salmon stocks are managed with seven escapement goals and catches are reported by district and use (sport, commercial, personal use, and subsistence). The Yukon River Chinook salmon stocks have experienced a drastic decline in production since 1998, reaching an all-time low in 2013, and Yukon River Chinook salmon were designated a Stock of Yield Concern in 2000 (Hayes and Norris 2010).

The 2011 and 2013 Chinook salmon runs came in at the low end of the preseason outlook with the Anvik river goals not met between 2011 and 2013 and the Chena river escapement goals not met in 2013 (Munro and Volk 2017). Although below average, the 2014 through 2017 Chinook salmon runs came in above the upper end of the preseason outlook range and all escapement goals that could be assessed were either met or exceeded with the exception of Salcha River Chinook salmon in 2016 (Munro and Volk 2017). While most escapement goals were met during this time period they were done so under a regime of significant restrictions to the subsistence fishery including early season subsistence fishing closures, tributary closures, time and area restrictions, gillnet mesh size and length restrictions, and live release requirements.

3.3.5.4.4 Norton Sound

Norton Sound, Port Clarence, and Kotzebue Sound management areas include all waters from Point Romanof in southern Norton Sound to Point Hope at the northern edge of Kotzebue Sound, and St. Lawrence Island. There are few Chinook salmon in the Port Clarence District. In the Norton Sound District, only the eastern area has sizeable runs of Chinook salmon and the primary salmon producing rivers are the Shaktoolik and Unalakleet subdistricts. The Shaktoolik and Unalakleet Chinook salmon stock was classified as a stock of yield concern in 2004. Commercial fishing typically begins in June and targets Chinook salmon if sufficient run strength exists (Menard et al. 2010). Sport and subsistence fisheries for Chinook salmon also occur in the Norton Sound area.

Escapement goals were established for five stocks in the Norton Sound Area, all are SEGs: Fish River/ Boston Creek, Kwiniuk River, North River (Unalakleet River), Shaktoolik River, and Unalakleet/ Old Woman River. As of 2016, only two Chinook salmon escapement goals remained in the Norton Sound Area for Kwiniuk River and North River (Unalakleet River). The ADF&G review team recommended discontinuing other goals due to uncertainty of the relationship of the surveys to peak spawning time and the unreliability of counts for evaluating a goal on those systems (Conitz et al. 2015).

The forecast for 2017 was for a below average run of Chinook salmon and additional restrictions on subsistence fishing would be required to reach sufficient escapement. In consultation with residents of Shaktoolik and Unalakleet, a schedule was set for subsistence salmon fishing to close in all marine and fresh waters of both Shaktoolik and Unalakleet Subdistricts. One 36-hour fishing period with gillnets restricted to 6 inches or smaller mesh size was allowed each week in the marine waters during the remainder of June. In July subsistence fishing time in marine waters was increased to two 48-hour fishing periods a week with restricted mesh and beach seining was allowed in the rivers 7 days a week with all king salmon required to be released. The first in-river gillnet fishing period in both subdistricts was a 24-hour fishing period on July 7 with restricted mesh. On July 10 all fresh waters, except for the Unalakleet River were open to subsistence fishing and on July 13 all marine waters and the Unalakleet River were open to subsistence fishing for the remainder of the season.

3.3.5.5 British Columbia and U.S. West Coast

According to the information provided in Section 3.3.4, roughly 80% of the Chinook salmon taken as PSC in the GOA trawl fishery originate in British Columbia and U.S. West Coast rivers. Additional background information on the status and management of these stocks is provided in an addendum that is posted under Agenda Item C-6 to the NPFMC's April 2018 Agenda.[22]

3.3.5.5.1 British Columbia Stocks

Of the thousands of streams that support salmon in British Columbia, Chinook are found in a relatively small number of streams. Chinook production occurs mainly in major river systems, and particularly large stocks occur in the Skeena River in northern British Columbia and the Fraser River in Southern British Columbia. Of these, 26 are monitored annually by the Pacific Salmon Commission. In both systems with escapement goals, the Cowichan and Harrison rivers have only achieved their escapement goals once

[22] http://legistar2.granicus.com/npfmc/meetings/2018/4/977_A_North_Pacific_Council_18-04-02_Meeting_Agenda.pdf

since 2011 (CTC 2017). Some stocks without escapement goals, such as the Nass and the Skeena, have exhibited a declining trend in recent years (CTC 2017). Fisheries and Oceans Canada is currently undertaking several initiatives to assess the status of these stocks under Canada's Policy for Conservation of Wild Pacific Salmon.

3.3.5.5.2 Pacific Northwest Stocks

Chinook salmon stocks in the Pacific Northwest include over 200 stocks from Oregon, Idaho, and Washington State. The specific stocks are listed in 2010 BSAI Chinook salmon EIS (Chapter 3, NMFS 2009). A specific discussion of Chinook salmon stocks in the Pacific Northwest listed under the Endangered Species Act (ESA) is addressed in Section 3.3.5, and more information on non-ESA-listed species may be found on the NMFS Northwest Region website, http://www.westcoast.fisheries.noaa.gov/ or at the Pacific Salmon Commission website, www.psc.org.

3.3.6 ESA-listed Chinook Salmon Stocks in the Pacific Northwest

Of the nine Chinook salmon Evolutionarily Significant Units (ESUs) in the Pacific Northwest that are listed under the ESA, five are known to have been taken as PSC in the Alaska groundfish fisheries. The information currently available on Chinook salmon ESA-listed ESUs in the GOA is from CWTs. Chinook salmon from the Lower Columbia River, Snake River fall run, Snake River spring/summer run, Upper Columbia River, and Upper Willamette River Spring ESUs have been recovered in the GOA trawl fisheries (NMFS 2017a).

In January 2007, the NMFS Northwest Region completed a supplemental biological opinion to the November 30, 2000 biological opinion on the effects of the Alaska groundfish fisheries on ESA-listed salmon (NMFS 2007c). An incidental take statement was included in the 2000 and 2007 biological opinions, which established a threshold of 40,000 Chinook salmon caught as PSC in the GOA groundfish fisheries. The 2000 biological opinion concluded that the GOA groundfish fisheries are not likely to jeopardize the continued existence of ESA-listed Chinook salmon stocks. If, during the course of the fisheries, the specified level of take is exceeded, a reinitiation of consultation is required, along with a review of the reasonable and prudent measures identified in the 2007 supplemental biological opinion.

Because of the high number of Chinook salmon taken in the GOA groundfish fisheries in 2010, the NMFS Alaska Region reinitiated ESA section 7 formal consultation with NMFS Northwest region on the 2010 incidental take of Chinook salmon (Balsiger 2010). In 2012, the Northwest Region responded that, given the recently adopted Council actions to further reduce Chinook PSC and improve PSC estimation, monitoring, and sampling, the effect of the GOA groundfish fishery on listed Chinook salmon is likely to remain within the limits proscribed in the supplemental 2007 biological opinion (Stelle 2012). The incidental take of Chinook salmon in the 2017 GOA groundfish fisheries was 24,892 fish, compared to 54,576 fish in 2010 (NMFS Alaska Region Catch Accounting System February 10, 2011, January 2018). Detailed information on listed stocks is available in updated status reports of listed ESUs (Northwest Fisheries Science Center 2015), and in the ESA Recovery Plan for Lower Columbia River coho, Chinook, and chum salmon; and Lower Columbia River Steelhead (NMFS 2013).

In 2010, NMFS initiated a planned 5-year review of Pacific salmon and steelhead populations listed under the ESA to ensure the accuracy and classification of each listing. That review was completed in 2016 and found that no species warranted a change in status. More information on that 5-year review and on recovery activities is available at http://www.nwr.noaa.gov/Salmon-Recovery-Planning/index.cfm.

3.3.6.1 Occurrence of ESA-listed Chinook Salmon ESUs in the GOA

Recoveries of CWTs are important for documenting occurrence of ESA-listed ESUs in the GOA trawl fisheries. CWT Chinook salmon from ESA-listed ESUs have been recovered in GOA trawl fisheries (Table 34). Since 1981, CWT tagged Chinook salmon have been recovered in the GOA groundfish trawl fisheries from the Lower Columbia River, Snake River fall run, Snake River spring/summer run, Upper Columbia River spring run, and the Upper Willamette River ESUs. A total mark expansion factor was applied to observed recoveries to account for the wild, untagged component of each ESU.

Chinook salmon from the Lower Columbia River, Upper Willamette River, and Upper Columbia River Spring ESUs have been recovered in the GOA trawl fishery. Since 1981, CWTs have been recovered from 29 Lower Columbia River, 120 Upper Willamette River, 1 Upper Columbia River, 3 Snake River fall run, and 1 Snake River spring/summer run Chinook salmon in the GOA trawl fishery (Table 34). By applying mark expansion factors, the estimated numbers increase to 123.6 Lower Columbia River, 367.9 Upper Willamette River, 1 Upper Columbia River, 4 Snake River fall run, and 1.9 Snake River spring/summer run Chinook salmon in the GOA (Table 34). These numbers should be considered as very minimum estimates of the number of ESA-listed ESUs in the GOA groundfish fisheries. Until adequate numbers of CWTs are recovered from inside the observers' samples, where the total number of fish sampled is known, an estimate of total contribution of ESA-listed ESUs in the GOA fishery will remain indeterminable.

Table 34 Observed Number and Mark Expansion of ESA-listed CWT salmon by ESU captured in the prohibited species catch of the GOA trawl fisheries, summed over pre-listing and post-listing periods, 1981-2016

	GOA		
Chinook salmon ESU	Observed number	CWT Mark Expanded Number	Total mark expanded number
Lower Columbia River	29	123.6	138.4
Snake River fall run	3	4.0	5.4
Snake River spring/summer run	1	1.9	2.6
Upper Columbia River spring run	1	1.0	1.1
Upper Willamette River	120	367.9	448.7

Source: NMFS 2017a.

CWT Chinook salmon from ESA-listed ESUs have been recovered in salmon excluder device testing in the GOA and BSAI trawl fisheries and include Upper Willamette River and Snake River fall run in the GOA. In addition, U.S. trawl research directed at juvenile salmon has also documented the occurrence of Chinook salmon from ESA-listed ESUs in the GOA. Since 1996, trawl research in the GOA has recovered CWT Chinook salmon from the Lower Columbia River, Puget Sound, Snake River fall run, Snake River spring/summer run, Upper Columbia River, and Upper Willamette River ESUs.

The Council and NMFS contracted with Cramer Fish Sciences in 2010 to develop information to improve estimates of the potential impact of Chinook salmon PSC on ESA-listed ESUs from the Pacific Northwest. Since 2011, the database now includes all production (counted and estimated, tagged and untagged) of both wild and hatchery components of each ESU on an annual basis, dating back to when each ESU was first defined by NMFS.

3.3.7 Hatchery Releases

Around the Pacific Rim, most countries are releasing hatchery-produced salmon in varying amounts by species. The North Pacific Anadromous Fish Commission (NPAFC) summarizes information on hatchery releases by country and by area where available. Reports submitted to the NPAFC were used to summarize hatchery information by country and by U.S. state below (Table 35 and Table 36). For more information see the following: Russia (Akinicheva and Volobuev 2008; Anon. 2007; TINRO-centre 2006, 2005); Canada (Cook et al. 2008); United States (Volk and Josephson 2010, 2009; Josephson 2008, 2007; Eggers 2006, 2005; Bartlett 2007, 2006, 2005); all (Irvine et al. 2009).

Chinook salmon hatchery releases by country are shown below in Table 35. There are no hatchery releases of Chinook salmon in Japan and Korea and only a limited number in Russia.

Table 35 Hatchery releases of juvenile Chinook salmon in millions of fish

Year	Russia	Japan	Korea	Canada	USA	TOTAL
1999	0.6	-	-	54.4	208.1	263.1
2000	0.5	-	-	53.0	209.5	263.0
2001	0.5	-	-	45.5	212.1	258.1
2002	0.3	-	-	52.8	222.1	275.2
2003	0.7	-	-	50.2	210.6	261.5
2004	1.17	-	-	49.8	173.6	224.6
2005	0.84	-	-	43.5	184.0	228.3
2006	0.78	-	-	40.9	181.2	223.7
2007	0.78	-	-	44.6	182.2	227.6
2008	1	-	-	38	198.4	237.4
2009	0.78	-	-	41.6	201.0	243.4
2010	0.88	-	-	44.1	201.9	246.9
2011	0.82	-	-	38.6	197.8	237.2
2012	0.91	-	-	41.3	209.9	252.1
2013	0.91	-	-	39.2	200.29	240.4
2014	1	-	-	35.9	202.6	239.5
2015	0.89	-	-	35.5	187.86	224.3
2016	0.99	-	-	37.4	199.57	238.0

Source: North Pacific Anadromous Fish Commission

For Chinook salmon fry, the United States has the highest number of annual releases, followed by Canada. In Canada, enhancement projects have been on-going since 1977 with approximately 300 different projects for all salmon species (Cook and Irvine 2007). Maximum production for Chinook salmon releases was reached in 1991 with 66 million fish in that year (Cook and Irvine 2007). Releases of Chinook salmon in 2006 occurred in the following regions: Yukon, Transboundary Rivers, Skeena River, North Coast, Central Coast, West Coast and Vancouver Island, Johnstone Strait, Strait of Georgia, and the Lower and Upper Fraser River. Of these the highest numbers were released in the Strait of Georgia (20 million fish) followed by West Coast Vancouver Island area (12.4 million fish) and the Lower Fraser River (3.3 million fish) (Cook and Irvine 2007).

Of the releases from the United States, however, a breakout by area shows that the highest numbers are from the State of Washington, followed by California, and then Oregon (Table 36).

Table 36 United States west coast hatchery releases of juvenile Chinook salmon in millions of fish

Year	Alaska	Washington	Oregon	California	Idaho	WA/OR/CA/ID (combined)	TOTAL
1999	11.1	131.5	30.4	33.4	8.7	203.9	215.1
2000	16.2	128.0	24.2	28.6	7.0	187.8	204.1
2001	17.5	125.1	27.8	33.5	5.7	192.1	209.6
2002	15.3	132.9	31.0	29.4	12.1	205.4	220.7
2003	17.7	128.8	31.5	41.8	12.2	214.2	231.9
2004	15.0	120.6	32.5	36.3	11.9	201.3	216.2
2005	14.7	121.9	31.9	43.0	11.0	207.8	222.5
2006	19.8	116.6	29.8	42.4	12.2	201.0	220.8
2007	18.7	124.1	33.5	48.7	11.3	217.6	236.2
2008	22.4	118.2	27.7	47.7	11.1	204.7	227.2
2009	15.8	119.5	31.2	40.3	12.6	203.6	219.4
2010	15.6	118.1	33.4	41.5	14.5	207.4	223.0
2011	12.6	118.7	29.3	47.3	15.0	210.8	223.3
2012	12.9	117.6	31.9	48.4	14.4	212.3	225.2
2013	13.2	114.8	32.8	41.9	14.0	203.5	216.6
2014	13.1	114.5	31.1	43.3	15.9	204.9	217.9
2015	9.2	117.0	29.3	38.7	14.1	199.2	208.4
2016	10.5	105.5	28.9	45.6	14.1	195.0	205.6
2017	9.7	101.6	22.5	30.6	15.5	170.2	179.8

Source: Regional Mark Information System (RMIS) accessed February 23, 2018

Hatcheries in Alaska are located in southcentral and southeast Alaska. Altogether, a total of 27 production hatcheries and 1 research hatchery are currently operating in Alaska. Of these, private nonprofit corporations (PNPs) operate 24 of the hatcheries: 11 facilities owned by the state, and 13 owned by PNPs. ADF&G Division of Sport Fish operates 2 additional state-owned hatcheries in Anchorage and Fairbanks. The Metlakatla Indian Community on the federal Annette Islands Reserve south of Ketchikan operates Tamgas Creek Hatchery. NMFS operates a federal research hatchery in Little Port Walter in lower Chatham Strait (Stopha 2017).

The private nonprofit hatchery corporations produce salmon mainly for commercial harvest. They recoup their operational costs from a special harvest of returning adult fish, called a cost recovery harvest. All other returning adult fish are available for harvest in Alaska’s common property fisheries open to the public (sport, personal use, and subsistence). ADF&G’s two hatcheries primarily produce salmonid species intended for both salt and freshwater recreational fisheries at many locations along the coast and in numerous interior lakes.

The hatchery harvests alone in both 2013 and 2015 were greater than the entire statewide commercial salmon harvest in every year prior to statehood except for 7 years (1918, 1926, 1934, 1936, 1937, 1938 and 1941). The 2013 season was a record harvest overall, with the 283 million fish commercial salmon harvest composed of the second highest catch for wild stocks (176 million fish) and the highest catch for hatchery stocks (107 million fish) in Alaska’s history. The 2015 season was the second highest harvest, with the 263 million fish commercial harvest composed of the third highest catch for wild stocks (170 million fish) and the second highest catch for hatchery stocks (93 million fish). In 2016, Alaska hatcheries contributed an estimated 24 million fish to the commercial fishery. Hatchery fish made up 22% of the statewide commercial salmon harvest of 109 million fish (Stopha 2017).

Table 37 shows hatchery stocks that are covered by the ESA by evolutionarily significant unit (ESU), based on CWT recoveries from the last 10 years.

Table 37 Hatchery stocks covered by the ESA

ESU	Hatchery
Puget Sound	Wallace R. Hatchery
Upper Willamette River Spring	Clackamas Hatchery
	McKenzie Hatchery
	Willamette Hatchery
	Dexter Ponds Hatchery
	Marion Forks Hatchery
	Minto Ponds Hatchery (North Santiam River)
	South Santiam Hatchery
Upper Columbia Spring	Prosser Hatchery
Snake River Spring/Summer run	Nez Perce Tribal Hatchery
	Pahsimeroi Hatchery
Snake River Fall	Lyons Ferry Hatchery
	Irrigon Hatchery
Lower Columbia River	Cowlitz Salmon Hatchery
	Kalama Falls Hatchery
	Lewis River Hatchery
	Sandy Hatchery

Source: Alaska Department of Fish & Game staff

Relative magnitude of wild vs. hatchery stocks

The Chinook Technical Committee (CTC) has worked to improve the quality and consistency of wild Chinook escapement numbers. Success has varied regionally, with more wild Chinook indicator stocks in some regions than in others. For example, Southeast Alaska has relatively robust data on recent escapement numbers for a suite of rivers, but these stocks are less prominent in genetic and CWT samples from the Chinook PSC in the GOA trawl fisheries. Thus, while relative magnitudes between wild and hatchery stocks could be compared for some regions, they may not be sufficient for better resolution of Chinook PSC analyses.

Improvements in hatchery rearing and salmon survivability

An extensive literature search may reveal some record-keeping regarding changes in hatchery practices, but such documentation is unlikely to be available for many of the hatcheries with the greatest numbers of hatchery releases. A larger factor driving the number of Chinook migrating through the GOA areas is more likely to be the number of fish released by hatcheries. Increases in production numbers may greatly overshadow changes in hatchery rearing methods, especially for the larger and less experimental hatcheries.

Salmon as prey for whales

Washington state officials have recently proposed boosting hatchery production of Chinook as a way to supplement natural prey for the Pacific Northwest's critically endangered Southern Resident killer whales (SRKW). Salmon abundance has not been sufficient to support SRKW population growth over the last decade and new measures are needed to support both salmon and SRKW recovery. This increased production could happen in the next 1-2 years, however it is unlikely to affect salmon abundance in the GOA. While the priority Chinook stocks that would be increased through this action have not yet been identified, the focus would be on stocks that stay within the distribution of the SRKWs as opposed to more far-ranging stocks (personal communication with NOAA staff, Teresa Mongillo on 02/28/2018).

3.3.8 Effects of the Alternatives

The impact of the GOA groundfish fisheries on Chinook salmon was analyzed most recently in the Alaska Groundfish Fisheries Harvest Specifications Supplemental EIS (NMFS 2007a). Table 38 describes the criteria used to determine whether the impacts on Chinook salmon stocks are likely to be significant.

Table 38 Criteria used to estimate the significance of impacts on incidental catch of Chinook salmon

No impact	No incidental take of the prohibited species in question.
Adverse impact	There are incidental takes of the prohibited species in question
Beneficial impact	Natural at-sea mortality of the prohibited species in question would be reduced – perhaps by the harvest of a predator or by the harvest of a species that competes for prey.
Significantly adverse impact	An action that diminishes protections afforded to prohibited species in the groundfish fisheries would be a significantly adverse impact.
Significantly beneficial impact	No benchmarks are available for significantly beneficial impact of the groundfish fishery on the prohibited species, and significantly beneficial impacts are not defined for these species.
Unknown impact	Not applicable

The non-pollock trawl fisheries affect Chinook salmon through direct mortality due to PSC. Under the status quo, the annual hard cap PSC limit for the Western and Central GOA non-pollock trawl fishery is 7,500 Chinook salmon. Chinook salmon are a prohibited species, and it is incumbent upon fishermen to avoid catching Chinook salmon. The 2007 EIS also considered impacts of the fisheries on the genetic structure of the population, reproductive success, and habitat, concluding that it is unlikely that groundfish fishing has indirect impacts on these aspects of Chinook salmon sustainability. The GOA non-pollock trawl fisheries also incidentally catch salmon prey species including squid, capelin, eulachon, and herring. Catch of these prey species is small relative to their total populations. Thus, non-pollock trawl fishing activities are considered to have minimal and temporary effects on prey availability for salmon (NMFS 2005b). With respect to direct mortality, the 2007 EIS indicates that there is insufficient information available to directly link PSC in the groundfish fisheries to salmon stock biomass levels; therefore, there is an inability to discern small-scale impacts because data are not available at the individual stock level. The first priority of the State of Alaska in managing Chinook salmon is to meet spawning escapement goals in order to sustain salmon resources for future generations. Salmon surplus above escapement needs is made available for subsistence and other uses. The 2007 analysis concluded that minimum escapement were generally met in the preceding years, despite increasing levels of Chinook and chum salmon PSC in the Bering Sea pollock fishery.

Since 2007, there have been poor or below average Chinook salmon runs in western Alaska and, more recently, in southeastern Alaska. Implementation of strict fishery management actions has been necessary to meet escapement objectives, and many fisheries have been curtailed to protect Chinook salmon. These restrictions have resulted in forgone subsistence, personal use, sport, and commercial fishing opportunity resulting in hardship across coastal and interior Alaska. There are currently 66 stock-specific Chinook salmon escapement goals. In 2017, 49% of the Chinook salmon escapement goals were met or exceeded statewide. That figure represents a decrease from 54% of goals met in 2016 and is the second year of decline after an upward trend that ran from 2012 and 2015 (Figure 22).

As discussed in Section 3.3.3.3, relating Chinook salmon PSC with broader GOA Chinook abundance is complicated, although it appears the non-pollock trawl fisheries may catch more Chinook the year before the Pacific Salmon Commission estimates a high abundance index. It is understood that increasing PSC limits could increase the potential to impact salmon stocks in the aggregate. However, there is no evidence to indicate whether the groundfish fisheries' take of Chinook salmon is, or is not, causing escapement failures in Alaska rivers.

Information is available from CWT recoveries in GOA groundfish fisheries and research surveys (see Section 3.3.4.2). CWT recoveries provide reliable documentation of the presence of a specific salmon stock in the GOA trawl Chinook salmon PSC. Since 1995, however, CWTs of Chinook salmon recovered in the GOA groundfish fisheries have originated from British Columbia, Alaska, Oregon, Washington, and Idaho. However, due to sampling issues, CWT recoveries to date cannot be used to establish the relative representation of stocks in the PSC, nor to estimate the number harvested from any one stock as PSC. There are also likely to be Chinook salmon stocks that are taken in the GOA non-pollock trawl fisheries that originate in river systems with no tagging program.

Incidences of high annual Chinook salmon PSC do not translate directly into removals of sexually mature Chinook salmon that otherwise would have returned to spawn in their natal streams. As described in Section 3.3.3.1, the Chinook salmon caught as PSC in the GOA groundfish trawl fisheries had mean and median lengths of between 50 and 60 cm. While length and age are not perfectly correlated, observer data on size-at-capture indicates that the majority of Chinook PSC in the GOA trawl fishery are between three and five years of age. Some portion of the Chinook salmon taken as PSC would have experienced non-fishing sources of mortality before reaching sexual maturity; this document considers the best available science on how to discount trawl PSC in regards to the distribution of age-at-capture and assumed rates of Chinook salmon maturation and natural mortality.

Section 3.3.3.2 considers AEQ as a method for estimating fishing impacts on reproductive potential, recognizing that such models have been employed to estimate impacts on Chinook salmon stocks in the Bering Sea pollock trawl fishery and the Southeast Alaska troll fishery. While specific information on Chinook salmon age-at-capture and age-in-river is not available for this fishery, illustrative examples based on existing models suggests that the impact of PSC on any particular river system is less than 1:1 but likely greater than 1:0.5. While it is not possible to assess the impact of PSC on individual Chinook salmon stocks, it is nonetheless possible to develop general conclusions for the action that is being proposed. Increased amounts of PSC have a marginal negative effect on Chinook salmon stocks as well as on the harvesters and consumers of Chinook salmon, relative to the status quo. The analysts' ability to discern the specific impact on particular Chinook salmon stocks – beyond the regional level – is limited by the lack of stock of origin identification within the set of Chinook taken as trawl PSC.

There are currently prohibited species control measures in place for Chinook salmon in the GOA non-pollock trawl fisheries. In addition, regulations require that vessels engaged in directed fishing for groundfish in the GOA minimize their catch of prohibited species, including Chinook salmon. The Council's consideration of this action has emphasized the importance of Chinook salmon avoidance by the non-pollock trawl fleet. Under the PSC limit alternatives that are being considered, non-pollock trawl fleet may take active measures to avoid high PSC rates in order to preserve the opportunity to fully harvest the groundfish TACs – particularly if the attainment of the threshold appears to be imminent. Efforts to avoid Chinook PSC could take a variety of forms. At the outset of a given season, these efforts may have limited effect as participants need to gather information on the fishing grounds in order to detect and avoid the presence of a rare prohibited species such as Chinook salmon. As the fleet's information improves, participants may redirect effort to times and areas with lower Chinook catch rates, within the constraints of directed fishing seasons and market demands. Over time, effort may become more concentrated in areas that experience lower Chinook salmon PSC rates and decrease (or may be eliminated altogether) in areas of higher Chinook salmon catch rates. The extent of any effort redistribution is difficult to predict and will depend not only on the distribution of Chinook PSC rates on the fishing grounds and the participants' ability to accurately estimate Chinook salmon catch rates, but also participants' flexibility to alter their temporal and spatial fishing behavior. It is possible that shifting the spatial or temporal distribution of the non-pollock trawl fisheries could impact some particular Chinook salmon stocks more than others, but such impacts are not possible to assess with available information.

Under Alternatives 2 and 3, Chinook salmon PSC may increase slightly from the status quo. Any impact to the Chinook salmon stocks as a whole is likely to represent either no change from the status quo or to cause an impact that is not significant. None of the options considered under Alternatives 2 or 3 would have a significant adverse impact to Chinook salmon stocks.

Cumulative Effects on Chinook Salmon PSC

RFFAs that may affect prohibited species are shown in Table 10. Ecosystem management, rationalization, and traditional management tools are likely to improve the protection and management of target and prohibited species, including targets of the non-pollock trawl fleet and Chinook salmon, and are not likely to result in significant effects when combined with the direct and indirect effects of Alternatives 2 and 3. Ongoing research efforts are likely to improve our understanding of the interactions between the harvest of groundfish and salmon. NMFS is conducting or participating in several research projects to improve understanding of the ecosystems, fisheries interactions, and gear modifications to reduce salmon PSC. The State of Alaska manages the commercial salmon fisheries off Alaska. The State's first priority for management is to meet spawning escapement goals to sustain salmon resources for future generations. Subsistence use is the highest priority use under both State and federal law. Surplus fish beyond escapement needs and subsistence use are made available for other uses, such as commercial and sport harvests. The State carefully monitors the status of salmon stocks returning to Alaska streams and controls fishing pressure on these stocks. Other government actions and private actions may increase pressure on the sustainability of target and prohibited fish stocks either through extraction or changes in the habitat or may decrease the market through aquaculture competition, but it is not clear that these would result in significant cumulative effects.

Considering the direct and indirect impacts of the proposed alternatives when added to the impacts of past and present actions previously analyzed in other documents that are incorporated by reference and the impacts of the reasonably foreseeable future actions listed above, the cumulative impacts of the proposed alternatives are determined to be not significant.

3.4 Marine Mammals

3.4.1 Status

The GOA supports one of the richest assemblages of marine mammals in the world. Twenty-two species are present from the orders Pinnipedia (seals and sea lions), Carnivora (sea otters), and Cetacea (whales, dolphins, and porpoises). Some marine mammal species are resident throughout the year, while others migrate into or out of Alaska fisheries management areas. Marine mammals occur in diverse habitats, including deep oceanic waters, the continental slope, and the continental shelf (Lowry et al. 1982).

A number of concerns may be related to marine mammals and potential impacts of fishing. For individual species, these concerns include—

- listing as endangered or threatened under the Endangered Species Act (ESA);
- protection under the Marine Mammal Protection Act (MMPA);
- announcement as candidate or being considered as candidates for ESA listings;
- declining populations in a manner of concern to State or Federal agencies;

- experiencing large PSC or other mortality related to fishing activities;
- being vulnerable to direct or indirect adverse effects from some fishing activities;
- competition with fisheries for prey species;
- disturbance by fishing activities; or
- vulnerability to direct or indirect adverse effects from some fishing activities.

Marine mammals have been given various levels of protection under the current fishery management plans of the Council and are the subjects of continuing research and monitoring to further define the nature and extent of fishery impacts on these species. The most recent status information is available in the 2016 Marine Mammal Stock Assessment Reports (SARs) (Muto et al. 2016).

Marine mammals, including those currently listed as endangered or threatened under the ESA, that may be present in the action area are listed in Table 39. All of these species are managed by NMFS, with the exception of Pacific walrus, polar bears, and Northern sea otters, which are managed by USFWS. ESA section 7 consultations with respect to the actions of the Federal groundfish fisheries have been completed for all of the ESA-listed species, either individually or in groups. Of the species listed under the ESA and present in the action area, several species may be adversely affected by commercial groundfish fishing. These include Steller sea lions, humpback whales, fin whales, and sperm whales (NMFS 2006; NMFS 2010). In 2000, a Biological Opinion concluded that the FMPs, as then implemented, were likely to jeopardize the continued existence of the Western distinct population segment (DPS) of Steller sea lions and adversely modify its designated critical habitat (NMFS 2000). In 2001, a Biological Opinion was released that provided protection measures that did not jeopardize the continued existence of the Steller sea lion or adversely modify its designated critical habitat; that opinion was supplemented in 2003.

Table 39 Marine mammals likely to occur in the Gulf of Alaska

	Species	Stocks
NMFS Managed Species		
Pinnipeds	Steller sea lion	Western U.S* (west of 144° W long.) and Eastern U.S. (east of 144° W long.)
	Northern fur seal	Eastern Pacific**
	Harbor seal	Southeast Alaska, Gulf of Alaska
	Ribbon seal	Alaska
	Northern elephant seal	California
Whales and dolphins	Beluga Whale	Cook Inlet*
	Killer whale	Eastern North Pacific Northern Resident, Eastern North Pacific Alaska Resident, Eastern North Pacific GOA, Aleutian Islands, and Bering Sea transient, AT1 transient**, West Coast Transient
	Pacific White-sided dolphin	North Pacific
	Harbor porpoise	Southeast Alaska, Gulf of Alaska, and Bering Sea
	Dall's porpoise	Alaska
	Sperm whale	North Pacific*
	Baird's beaked whale	Alaska
	Cuvier's beaked whale	Alaska
	Stejneger's beaked whale	Alaska
	Gray whale	Eastern North Pacific
	Humpback whale	Hawaii, Mexico*, Central America*
	Fin whale	Northeast Pacific*
	Minke whale	Alaska
	North Pacific right whale	North Pacific*
	Blue whale	North Pacific*
	Sei whale	North Pacific*
USFWS Managed Species		
	Northern sea otter*[1]	Southeast Alaska, Southcentral Alaska, Southwest Alaska

Source: Muto et al., 2016.
*ESA-listed species; **Listed as depleted under the MMPA.
[1] Northern sea otters are under the jurisdiction of the USFWS

The 2010 Biological Opinion was challenged in the U.S. District Court, and although the court ruled that the conclusions of the Biological Opinion were valid, the court ruled that the Agency should have prepared an Environmental Impact Statement (EIS) rather than an Environmental Assessment (EA) to meet their National Environmental Policy Act (NEPA) requirements. The Agency completed a new review of the effects of recommended changes to the groundfish fisheries in the Aleutian Islands on the Western DPS of the Steller sea lion and, with new information available since the publication of the 2010 review, concluded that the recommended changes were not likely to jeopardize the continued existence of the Western DPS of the Steller sea lion or adversely modify its designated critical habitat (NMFS 2014). This decision was, subsequently, challenged in court, but the Agency's decision was upheld by by both the U.S. District Court for Alaska and the Ninth Circuit Court of Appeals.

The PSEIS (NMFS 2004a) provides descriptions of the range, habitat, diet, abundance, and population status for marine mammals. The most recent marine mammal stock assessment reports for the strategic GOA marine mammal stocks (Steller sea lions, northern fur seals, harbor porpoise, North Pacific right whales, humpback whales, sperm whales, and fin whales) were updated in the 2016 SARs (Muto et al., 2016). Northern sea otters were assessed in 2008. The information from the PSEIS and the SARs is incorporated by reference. The Alaska Groundfish Harvest Specifications EIS provides information on the effects of the groundfish fisheries on marine mammals (NMFS 2007) and has been updated with Supplemental Information Reports (SIRs) (NMFS 2017c). These documents are also incorporated by reference. Direct and indirect interactions between marine mammals and groundfish fishing vessels may occur due to overlap in the size and species of groundfish harvested in the fisheries that are also important marine mammal prey, and due to temporal and spatial overlap in marine mammal occurrence and commercial fishing activities.

This discussion focuses on marine mammals that may be affected by Chinook salmon PSC management measures for non-pollock trawl fisheries in the GOA. These species are listed in Table 40 and Table 41. Note that Table 41 includes Southern Resident killer whales. This stock does not occur in the GOA, but this analysis considers the potential effects of Chinook salmon PSC in the GOA non-pollock trawl fisheries on prey availability for this population of killer whales. The GOA non-pollock trawl fisheries take Chinook salmon from Pacific Northwest stocks, which are important prey for the Southern Resident killer whales.

Steller Sea Lion

The Steller sea lion inhabits many of the shoreline areas of the GOA, using these habitats as seasonal rookeries and year-round haulouts. The Steller sea lion has been listed as threatened under the ESA since 1990. In 1997, two distinct population segments, the Western and eastern (wDPS and eDPS) were recognized based on genetic and demographic dissimilarities. Because of a pattern of continued decline, the Western DPS was listed as endangered on May 5, 1997 (62 FR 30772), while the eastern DPS remained listed as threatened until 2013 when the eDPS was removed from the ESA list. The western DPS inhabits an area of Alaska approximately from Prince William Sound westward to the end of the Aleutian Island chain and into Russian waters (west of 144° W longitude).

Throughout the 1990s, particularly after critical habitat was designated, various fishing closures around rookeries, haulouts, and some offshore foraging areas were designated. These closures affect commercial harvests of pollock, Pacific cod, and Atka mackerel, which are important components of the western DPS diet. In 2001, a Biological Opinion was released that provided protection measures to prevent jeopardy to the continued existence of the Steller sea lion or adverse modification to its designated critical habitat; that opinion was supplemented in 2003 (NMFS 2001a, Appendix A, NMFS 2003). In 2006, NMFS reinitiated a FMP-level Section 7 consultation on the effects of the groundfish fisheries on Steller sea lions, humpback whales, and sperm whales to consider new information on these species and their interactions with the fisheries (NMFS 2006a). The Biological Opinion (NMFS 2010a) concluded that the groundfish fisheries may be likely to jeopardize the continued existence or adversely modify designated critical habitat (JAM) for the western Distinct Population Segment (DPS) of Steller sea lions. An Interim Final Rule (75 FR 77535, December 13, 2010, corrected 75 FR 81921, December 29, 2010) implemented a reasonable and prudent alternative (RPA) to remove the likelihood of JAM for Steller sea lions. The RPA did not change Steller sea lion protection measures in the GOA.

The 2010 Biological Opinion was challenged in the U.S. District Court, and although the court ruled that the conclusions of the Biological Opinion were valid, the court ruled that the Agency should have prepared an Environmental Impact Statement (EIS) rather than an Environmental Assessment (EA) to meet their National Environmental Policy Act (NEPA) requirements. The Agency completed a new review of the effects of recommended changes to the groundfish fisheries in the Aleutian Islands on the Western DPS of the Steller sea lion and, with new information available since the publication of the 2010 review, concluded that the recommended changes were not likely to jeopardize the continued existence of the Western DPS of the Steller sea lion or adversely modify its designated critical habitat (NMFS 2014). This decision was, subsequently, challenged in court, but the Agency's decision was upheld by by both the U.S. District Court for Alaska and the Ninth Circuit Court of Appeals.

In the GOA, extensive closures are in place for Steller sea lions including no transit zones and closures of critical habitat around rookeries and haulouts. Pollock is an important prey species for Steller sea lions (NMFS 2010a). The harvest of pollock in the GOA is temporally dispersed into 4 seasons (§ 679.23). Based on the most recent completed biological opinion, these harvest restrictions on the pollock fishery decrease the likelihood of disturbance, incidental take, and competition for prey to ensure the groundfish fisheries do not jeopardize the continued existence or adversely modify the designated critical habitat of Steller sea lions (NMFS 2000, NMFS 2001a, and NMFS 2010a).

A detailed discussion of Steller sea lion population trends in the GOA is included in the most recent Biological Opinion (NMFS 2014) and is summarized here. Based on non-pup counts of Steller sea lions on trend sites throughout the range of the western DPS in the GOA and Aleutian Islands, the overall population trend for the western DPS of Steller sea lions is increasing, but substantial variation exists between subregions of the western DPS' range. Non-pup counts have declined severely in the western Aleutian Islands, and less severely in the eastern Aleutian Islands (NMFS 2014). Pup and non-pup counts in the remainder of the western DPS range are either stable or increasing (NMFS 2014).

Northern Sea Otter

The southwest Alaska DPS of northern sea otter is listed as threatened under the ESA (70 FR 46366, August 9, 2005). This population segment ranges from the Western Aleutian Islands to the Central GOA. NMFS completed an informal consultation on Northern sea otters in 2006 and found that the Alaska fisheries were not likely to adversely affect Northern sea otters (Mecum 2006). The USFWS has determined that, based on available data, Northern sea otter abundance is not likely to be significantly affected by commercial fishery interaction at present (Allen and Angliss 2012), and commercial fishing is not likely a factor in the population decline (70 FR 46366, August 9, 2005). Otters feed primarily in the rocky near shore areas on invertebrates, while groundfish fisheries are conducted further offshore on groundfish species (Funk 2003). Critical habitat for sea otters has been designated and is located primarily in nearshore waters (74 FR 51988, October 8, 2009). The USFWS published a recovery plan for the southwest Alaska DPS of northern sea otters in 2013 (USFWS 2013).

Table 40 Status of Pinnipedia and Carnivora stocks potentially affected by the action

Pinnipedia and Carnivora species and stock	Status under the ESA	Status under the MMPA	Population trends	Distribution in action area
Steller sea lion – Western (W) and Eastern (E) Distinct Population Segment (DPS)	Endangered (W)	Depleted & a strategic stock (W)	For the WDPS, regional increases in counts in trend sites of some areas have been offset by decreased counts in other areas so that the overall population of the WDPS appears to be growing slowly (Sweeney et al. 2017). The EDPS is steadily increasing and was removed from the list of threatened or endangered species.	WDPS inhabits Alaska waters from Prince William Sound westward to the end of the Aleutian Island chain and into Russian waters. EDPS inhabit waters east of Prince William Sound to Dixon Entrance. Occur throughout AK waters, terrestrial haulouts and rookeries on Pribilof Islands, Aleutian Islands, St. Lawrence Island, and off the mainland. Use marine areas for foraging. Critical habitat designated around major rookeries, haulouts, and foraging areas.
Northern fur seal Eastern Pacific	None	Depleted & a strategic stock	Pup counts on St. Paul Island have declined 55% (-4.1% annually) since 1998. Pup production on St. George Island is approximately stable over the same time. Overall, 3.5% decline annually since 1998.	Fur seals occur throughout Alaska waters, but their main rookeries are located in the Bering Sea on Bogoslof Island and the Pribilof Islands. Approximately 45% of the worldwide abundance of fur seals is found on the Pribilof Islands.Forages in the pelagic area of the Bering Sea during summer breeding season, but most leave the Bering Sea in the fall to spend winter and spring in the N. Pacific.
Harbor seal – Gulf of Alaska	None	None	A moderate to large population decline has occurred in the GOA stock.	GOA stock found primarily in the coastal waters and may cross over into the Bering Sea coastal waters between islands.
Ribbon seal Alaska	None	None	Reliable data on population trends are unavailable.	Widely dispersed throughout the Bering Sea and Aleutian Islands in the summer and fall. Associated with ice in spring and winter and may be associated with ice in summer and fall. Occasional movement into the GOA (Boveng et al. 2008)
Northern sea otters – SW Alaska	Threatened*	Depleted & a strategic stock	The overall population trend for the southwest Alaska stock is believed to be declining, particularly in the Aleutian Islands.	Coastal waters from Central GOA to W Aleutians within the 40 m depth contour. Critical habitat designated in primarily nearshore waters with few locations into federal waters in the GOA.

Source: Muto et al. 2016; List of Fisheries for 2011 (75 FR 68468, November 8, 2010).
Northern fur seal pup data available from http://www.alaskafisheries.noaa.gov/newsreleases/2007/fursealpups020207.htm.
*Northern sea otter information from http://www.nmfs.noaa.gov/pr/pdfs/sars/seaotter2008_ak_sw.pdf and 74 FR 51988, October 8, 2009

Cook Inlet Beluga Whale

In 2008, the Cook Inlet DPS of beluga whales was listed as an endangered species under the ESA following a significant population decline. NMFS has identified more than one third of Cook Inlet as critical habitat. In 2014, NMFS estimated the Cook Inlet beluga whale population to be 340 individuals (Muto et al. 2016). The 2014 estimate remains within the 10-year annual trend, which shows an annual decline of 1.3% per year (Muto et al. 2016). Historical abundance is estimated at approximately 1,300 whales (NMFS 2008b). Cook Inlet belugas primarily occur in the northern portion of Cook Inlet. Beluga whales do not normally transit outside of Cook Inlet, and thus are unlikely to encounter vessels fishing in the federal groundfish fisheries. NMFS has determined that the only potential impact of the groundfish fisheries on Cook Inlet belugas is though competition for prey species (Brix 2010).

Southern Resident Killer Whale

The Southern Resident killer whale (SRKWs) Distinct Population Segment (DPS) was listed as endangered under the ESA on November 18, 2005 (70 FR 69903) following a 20 percent population decline from 1996 to 2001. The original listing identified three main threats to their survival: 1) scarcity of prey, 2) high levels of contaminants from pollution, and 3) disturbance from vessels and sound. The population declined from historical abundance estimates of 140 to 200 whales in the 1960s and 1970s to 77 whales in 2018. The entire population of SRKWs in 2018 consists of 77 animals in 3 pods, J-pod has 24 whales, K-pod has 18 whales, and L-pod has 35 whales.

A 5-year status review of Southern Resident killer whales was completed in 2016 (NMFS 2016b). The status review identifies a number of factors that likely continue to contribute to the decline, including a reduction in availability of preferred prey, small population size, vulnerability to oil spills, and other factors. Although the population of these whales has been studied for more than 40 years, it is not clear which threat is the most important to address in order to ensure recovery. The Recovery Plan (NMFS 2008), therefore, addresses each threat based on the best available science. An active research program is underway at the Northwest Fisheries Science Center (NWFSC) to gather more information about the biology of the whales, habitat use and distribution, how different threats are impacting the whales, and to monitor the population status.

SRKWs range from Haida Gwaii (formerly known as the Queen Charlotte Islands) to Central California. SRKWs forage selectively for Chinook salmon which are relatively large compared with other salmon species, have high lipid content, and are available year-round (Ford and Ellis 2006). In inland waters, the diet of SRKWs consists of 82% Chinook salmon during May through September (Hanson et al. 2010), primarily from the Fraser River, Puget Sound, and other Washington and Oregon stocks. Recent reports of SRKWs in poor body condition (Durban et al. 2009) and studies correlating a reduction in Chinook salmon and decreased survival of SRKWs (Ford et al. 2005) have prompted Washington State officials to conclude that salmon abundance has not been sufficient to support SRKW population growth over the last decade. They have proposed increasing hatchery production of Chinook salmon to supplement natural prey for SRKWs (NMFS, Pers. Comm.) in the next 1-2 years.

Table 41 Status of Cetacean stocks potentially affected by the action

Cetacean species and stock	Status under the ESA	Status under the MMPA	Population trends	Distribution in action area
Killer whale – AT1 Transient, E N Pacific transient, W Coast transient, Alaska resident, Southern resident	Southern resident endangered; remaining stocks none	AT1 depleted and a strategic stock, Southern Resident depleted. The rest of the stocks: None	Southern residents have declined by more than half since 1960s and 1970s. Unknown abundance for the Alaska resident; and Eastern North Pacific GOA, Aleutian Islands, and Bering Sea transient stocks. The minimum abundance estimate for the Eastern North Pacific Alaska Resident stock is likely underestimated because researchers continue to encounter new whales in the Alaskan waters.	Southern resident do not occur in GOA. Transient-type killer whales from the GOA, Aleutian Islands, and Bering Sea are considered to be part of a single population.
Dall's porpoise Alaska	None	None	Reliable data on population trends are unavailable.	Found in the offshore waters from coastal Western Alaska throughout the GOA.
Pacific white-sided dolphin	None	None	Reliable data on population trends are unavailable.	Found throughout the GOA.

Cetacean species and stock	Status under the ESA	Status under the MMPA	Population trends	Distribution in action area
Harbor porpoise GOA	None	Strategic	Reliable data on population trends are unavailable.	Primarily in coastal waters in the GOA, usually less than 100 m depth.
Humpback whale – Hawaii, Mexico, Central America	Mexico and Central America stocks are endangered	Depleted & a strategic stock	Increasing overall. The Structure of Populations, Levels of Abundance, and Status of Humpbacks (SPLASH) abundance estimate for the North Pacific represents an annual increase of 4.9% since 1991–1993. SPLASH abundance estimates for Hawaii show annual increases of 5.5% to 6.0% since 1991–1993 (Calambokidis et al. 2008).	Hawaii, Mexico, and Central America stocks occur in GOA waters and may mingle in the North Pacific feeding area.
North Pacific right whale Eastern North Pacific	Endangered	Depleted & a strategic stock	This stock is considered to represent only a small fraction of its precommercial whaling abundance and is arguably the most endangered stock of large whales in the world. A reliable estimate of trend in abundance is currently not available.	Before commercial whaling on right whales, concentrations were found in the GOA, eastern Aleutian Islands, south-Central Bering Sea, Sea of Okhotsk, and Sea of Japan (Braham and Rice 1984). During 1965–1999, following large illegal catches by the U.S.S.R., there were only 82 sightings of right whales in the entire eastern North Pacific, with the majority of these occurring in the Bering Sea and adjacent areas of the Aleutian Islands (Brownell et al. 2001). Critical habitat near Kodiak Island in the GOA
Fin whale Northeast Pacific	Endangered	Depleted & a strategic stock	Abundance may be increasing but surveys only provide abundance information for portions of the stock in the Central-eastern and southeastern Bering and coastal waters of the Aleutian Islands and the Alaska Peninsula. Much of the North Pacific range has not been surveyed.	Found in the GOA, Bering Sea and coastal waters of the Aleutian Islands.
Beluga whale- Cook Inlet	Endangered	Depleted & a strategic stock	2016 abundance estimate of 328. Population has declined by 0.4 percent annually since 1999.	Occurrence only in Cook Inlet.
Minke whale Alaska	None	None	There are no data on trends in Minke whale abundance in Alaska waters.	Common in the Bering and Chukchi Seas and in the inshore waters of the GOA. Not common in the Aleutian Islands.
Sperm whale North Pacific	Endangered	Depleted & a strategic stock	Abundance and population trends in Alaska waters are unknown.	Inhabit waters 600 m or more depth, south of 62°N lat. Widely distributed in North Pacific. Found year-round In GOA.
Baird's, Cuvier's, and Stejneger's beaked whale	None	None	Reliable data on population trends are unavailable.	Occur throughout the GOA.

Sources: Muto et al. 2016; List of Fisheries for 2011 (75 FR 68468, November 8, 2010); http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spermwhale.htm. North Pacific right whale included based on NMFS (2006a) and Salveson (2008). AT1 Killer Whales information based on 69 FR 31321, June 3, 2004. North Pacific Right Whale critical habitat information: 73 FR 19000, April 8, 2008. For beluga whales: 73 FR 62919, October 27, 2008.

3.4.2 Effects on Marine Mammals

3.4.2.1 Significance Criteria for Marine Mammals

Table 42 contains the significance criteria for analyzing the effects of the proposed alternatives on marine mammals. The Status Quo alternative is the non-pollock trawl fisheries as currently prosecuted in the GOA. These fisheries were evaluated under the GOA halibut PSC EA/RIR/IRFA (NMFS 2012) and were determined not to cause significant adverse impacts to marine mammals. As such, the Status Quo alternative is not considered to cause significant adverse impacts to marine mammals in this analysis. The other alternatives being considered constitute a change from status quo management, and impacts are assessed as a change from status quo.

Table 42 Criteria for determining significance of impacts to marine mammals

	Incidental take / Entanglement in marine debris	Prey availability	Disturbance
Adverse impact	Mammals are taken incidentally to fishing operations or become entangled in marine debris.	Fisheries reduce the availability of marine mammal prey.	Fishing operations disturb marine mammals.
Beneficial impact	There is no beneficial impact.	Generally, there is no beneficial impacts, with the possible exception for certain net or hook and line fisheries, of increased prey availability from removals from gear.	There is no beneficial impact.
Significantly adverse impact	Incidental take is more than PBR or is considered major in relation to estimated population when PBR is undefined.	Competition for key prey species likely to constrain foraging success of marine mammal species causing population decline.	Disturbance of mammal is such that population is likely to decrease.
Significantly beneficial impact	Not applicable	Not applicable	Not applicable
Unknown impact	Insufficient information available on take rates.	Insufficient information as to what constitutes a key area or important time of year.	Insufficient information as to what constitutes disturbance.

3.4.2.2 Incidental Take Effects

The GOA Halibut PSC EA/RIR/IRFA (NPFMC 2012) contains a detailed description of the incidental take effects of the groundfish fisheries on marine mammals and is incorporated by reference. Marine mammals can be taken in groundfish fisheries by entanglement in gear (e.g., trawl, longline, and pot) and, rarely, by ship strikes for some cetaceans. The List of Fisheries for 2018 reports that Steller sea lion and northern elephant seal were taken in the GOA non-pollock trawl fisheries. (83 FR 5349, February 7, 2018). Other marine mammals are assumed to be unlikely to be incidentally taken by any of the alternatives due to the absence of incidental take and entanglement records. No records exist of Alaska groundfish fisheries takes of North Pacific right whales.

Potential take in the GOA non-pollock trawl fisheries is well below the PBR for all marine mammals for which PBR has been determined. The GOA non-pollock trawl fisheries are Category III fisheries based on annual mortality and serious injury of a stock being less than or equal to 1% of the PBR level. Overall, very few marine mammals are reported taken in the GOA non-pollock trawl fisheries, and estimated mortality from federally managed fisheries has not been estimated. Considering the number of marine mammals taken incidentally in the fishery in relation to the PBR, it is unlikely that incidental takes would impact the subsistence harvest of marine mammals. While possible, the incidence of ship strikes and/or serious injury to whales from ships involved in the Alaska groundfish fisheries are likely to be minimal and not expected to result in an adverse population level effects.

Incidental Take Effects under Alternative 1: Status Quo

The effects of the status quo fisheries on incidental takes of marine mammals are detailed in the 2007 harvest specifications EIS (NMFS 2007a). The potential take of marine mammals in the GOA non-pollock trawl fisheries is well below the PBRs or a very small portion of the overall human caused mortality for those species for which a PBR has not been determined. No significantly adverse effects are expected.

Incidental Take Effects under Alternatives 2 and 3

The range of PSC limits under Alternatives 2 and 3 may result in different potential for incidental takes of marine mammals. A lower limit may result in the trawl fisheries closing early, before the TACs are reached, which would reduce the potential for incidental takes in areas where marine mammals may interact with trawl fishing vessels. If the fleet is able to identify hotspots with high Chinook salmon catch rates, and avoid fishing in these areas, the distribution of effort in the fishery may change to some extent. A higher PSC limit would allow for more groundfish fishing and more potential for interaction and incidental takes of marine mammals than a lower limit.

To the extent the redistribution of effort results in more vessel-days of effort, there could potentially be an increase in the likelihood of incidental takes of marine mammals compared to the status quo. However, the likely closures are relatively small compared to the capacity of the GOA groundfish trawl fleet, and seasons are likely to remain short. Under the status quo fisheries, the number of incidental takes is well below the PBRs and is a very small proportion of overall total human caused mortality. No substantial change in the number of incidental takes is expected under Alternatives 2 or 3, and the impacts of Alternatives 2 and 3 on incidental takes of marine mammals are likely to be insignificant.

3.4.2.3 Harvest of Prey Species

The Alaska Groundfish Harvest Specifications EIS contains a detailed description of the effects of the groundfish fisheries on prey species for marine mammals (NMFS 2007a) and is incorporated by reference. Harvests of marine mammal prey species in the GOA groundfish fisheries may limit foraging success through localized depletion, overall reduction in prey biomass, and dispersion of prey, making it more energetically costly for foraging marine mammals to obtain necessary prey. Overall reduction in prey biomass may be caused by removal of prey or disturbance of prey habitat. The timing and location of fisheries relative to foraging patterns of marine mammals and the abundance of prey species may be a more relevant management concern than total prey removals. The GOA non-pollock trawl fisheries may impact availability of key prey species of Steller sea lions, harbor seals, northern fur seals, ribbon seals; and fin, minke, humpback, beluga, and resident killer whales. Animals with varied diets may be less likely to be impacted than those with more restricted diets. Table 43 shows the GOA marine mammal species and their prey species that may be impacted by the GOA non-pollock trawl fisheries. Non-pollock groundfish targets and salmon prey are in **bold**.

Table 43 Prey species used by GOA marine mammals that may be impacted by the GOA non-pollock trawl fisheries

Species	Prey
Fin whale	Zooplankton, squid, fish (herring, **cod**, capelin, and pollock), and cephalopods
Humpback whale	Zooplankton, schooling fish (pollock, herring, capelin, saffron cod, sand lance, Arctic cod, and **salmon**)
Minke whale	Pelagic schooling fish (including herring and **pollock**)
Beluga whale	Wide variety of invertebrates and fish including **salmon** and pollock
Killer whale	Marine mammals (transients) and fish (residents) including herring, halibut, **salmon**, **and cod**.
Ribbon seal	**Cod**, pollock, capelin, eelpout, sculpin, flatfish, crustaceans, and cephalopods.
Northern fur seal	Pollock, squid, herring, **salmon**, capelin
Harbor seal	Crustaceans, squid, fish (including **salmon**), and mollusks
Steller sea lion	Pollock, Atka mackerel, Pacific herring, Capelin, Pacific sand lance, Pacific cod, and **salmon**

Sources: NOAA 1988; NMFS 2004a; NMFS 2007b; Nemoto 1959; Tomilin 1957; Lowry et al. 1980; Kawamura 1980; and http://www.adfg.state.ak.us/pubs/notebook/marine/orca.php

Chinook salmon PSC in the non-pollock trawl fisheries may remove salmon that would otherwise have been available as prey for marine mammals. CWT recoveries from Chinook salmon PSC in the GOA provide information on occurrence of specific salmon stocks in the GOA. Although CWT recoveries provide reliable documentation of the presence of a stock in the PSC, the recoveries to date can't be used to establish the relative abundance of stocks in the PSC, nor to estimate the number harvested from any one stock due to sampling issues. CWTs do not represent the true composition of all stocks of Chinook salmon in the PSC in the GOA groundfish fisheries (see Section 3.3.4.2). MARK expansions should be considered a minimum estimate of the actual PSC of specific Chinook salmon stocks. AEQ analysis on Chinook salmon PSC in the GOA is not available; however, most of the Chinook salmon represented by CWTs and harvested in the GOA originated from hatchery production. Chinook salmon recovered in the GOA are comprised of a variety of run types that are designated by the tagging agency (Masuda et al. 2017).

Several marine mammals in the GOA may be affected indirectly by impacts of non-pelagic trawl gear on benthic habitat. Table 44 lists marine mammals that may depend on benthic prey and known depths of diving. Sperm whales are not likely to be affected by any potential impacts on benthic habitat from non-pelagic trawling because they generally occur in deeper waters than where trawling occurs (Table 44). Benthic habitat for harbor seals and sea otters is also not likely to be affected by non-pelagic trawling because they occur primarily along the coast where trawling is not conducted. Cook Inlet beluga whales are not likely to be affected by non-pelagic trawling benthic impacts because they do not range outside of Cook Inlet and do not overlap spatially with the trawl fisheries.

Table 44 Benthic dependent GOA marine mammals, foraging locations, and diving depths

Species	**Depth of diving and location**
Ribbon seal	Mostly dive < 150 m on shelf, deeper off shore. Primarily in shelf and slope areas.
Harbor seal	Up to 183 m. Generally coastal.
Sperm whale	Up to 1,000 m, but generally in waters > 600 m.
Northern sea otter	Rocky nearshore < 75 m
Gray whale	Benthic invertebrates

Sources: Allen and Angliss 2012; Burns et al. 1981; http://www.adfg.state.ak.us/pubs/notebook/marine/rib-seal.php; http://www.afsc.noaa.gov/nmml/species/species_ribbon.php; http://www.adfg.state.ak.us/pubs/notebook/marine/harseal.php; http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spermwhale.htm

Prey Availability Effects under Status Quo: Alternative 1

The GOA Halibut PSC EA/RIR/IRFA concluded that competition for key prey species with the non-pollock trawl fisheries is not likely to constrain the foraging success of marine mammals in the GOA or cause population declines (NPFMC 2012). The introduction to this section reviewed the marine mammal species that depend on groundfish or salmon, and the potential impacts of the non-pollock trawl fisheries on benthic habitat that supports marine mammal prey. Below is additional information regarding potential effects of the GOA non-pollock trawl fisheries on prey availability for Steller sea lions, Cook Inlet belugas, and SRKW.

Steller sea lions

The following information on Steller sea lion diet is summarized from the 2010 Biological Opinion (NMFS 2010) and is incorporated by reference. Steller sea lions are generalist predators that eat a variety of fishes and cephalopods. Prey species can be grouped into those that tend to be consumed seasonally, when they become locally abundant or aggregated when spawning (e.g., herring, Pacific cod, eulachon, capelin, salmon and Irish lords), and those that are consumed and available to Steller sea lions more or less year-round (e.g., pollock, cephalopods, Atka mackerel, arrowtooth flounder, rock sole and sand lance.

Stomach content analysis from animals in Kodiak in the 1970s showed that walleye pollock was the most important prey in fall, winter, and spring, while in summer the most frequently eaten prey were small forage fishes (capelin, herring, and sand lance) (Merrick and Calkins 1996). Prey occurrence of pollock, Pacific cod, and herring were higher in the 1980s than in the 1950s through 1970s in stomach content samples for both eastern and Western Steller sea lion populations. In a recent study in the Kodiak Archipelago, the most frequent Steller sea lion prey were found to be Pacific sand lance, walleye pollock, arrowtooth flounder, Pacific cod, salmon, and Pacific herring (McKenzie and Wynne 2008). Other studies since 1990 have shown that pollock continue to be a dominant prey species in the GOA. Pacific cod is also an important prey species in winter in the GOA. Salmon was eaten most frequently during the summer months in the GOA.

The effects of the status quo GOA Pacific cod fishery and state-managed salmon fisheries on prey availability for Steller sea lions were evaluated in the recent Biological Opinion (NMFS 2010) and were not found to cause adverse population-levels effects on Steller sea lions. Steller sea lion protection measures in the GOA are sufficient to ensure that the groundfish fisheries are not likely to jeopardize the continued existence of Steller sea lions or adversely modify its designated critical habitat (NMFS 2010).

Killer Whales

Northern resident killer whales consume salmon that are migrating to spawning streams in nearshore waters in Alaska (NMFS 2004a). Recent studies have shown that SRKWs forage selectively for Chinook salmon which are relatively large compared with other salmon species, have high lipid content, and are available year-round (Ford and Ellis 2006). In inland waters of Washington and British Columbia, the diet of SRKWs consists of 82% Chinook salmon during May through September (Hanson et al. 2010). Stock of origin investigations have found that SRKWs forage on Chinook salmon from the Fraser River, Puget Sound runs, and other Washington and Oregon runs.

The non-pollock trawl fisheries may intercept salmon that would otherwise have been available as prey for Northern and Southern Resident killer whales. Any competition with the fisheries for Chinook salmon would depend on the extent to which the fishery intercepts salmon that would have otherwise been available to killer whales as prey. Data are not available to quantitatively evaluate the extent of this effect.

<u>Cook Inlet Beluga Whales</u>

The following information on Cook Inlet beluga diet is from the 2008 Recovery Plan (NMFS 2008b) and is incorporated by reference. Cook Inlet belugas feed on a wide variety of species, focusing on specific species when they are seasonally abundant. The groundfish fisheries directly harvest and incidentally catch several species that are important prey species for belugas, including pollock, Pacific cod, yellowfin sole, starry flounder, and staghorn sculpin. Because pollock is not likely to occur in large amounts in Cook Inlet and appears to be eaten only in spring and fall, it is not likely an important prey species for Cook Inlet beluga whales. The groundfish fisheries also catch eulachon and salmon, which are energetically rich food sources and important prey species in spring and summer, respectively.

Cook Inlet beluga whales are not likely to compete with the GOA non-pollock trawl fisheries because their occurrence does not overlap spatially with the fisheries. Any competition with the fisheries for Chinook salmon would depend on the extent to which the fishery intercepts salmon that would have otherwise been available to Cook Inlet belugas as prey. Data are not available to quantitatively evaluate the extent of this effect. Even though the GOA fisheries take Cook Inlet salmon as PSC, it is not likely that the number of salmon taken under status quo would have a measurable effect on Cook Inlet beluga whales. Of the Alaska Chinook salmon CWT recoveries, 9% are estimated to be Cook Inlet fish. Returns of Chinook salmon are in the thousands of fish based on the number of river systems in the inlet with Chinook salmon runs, and the effects of GOA PSC on the volume of Cook Inlet spawning runs is likely not substantial. NMFS completed an informal ESA Section 7 consultation on the effects of the groundfish fisheries on Cook Inlet beluga whales and determined that the incidental harvest of Chinook salmon in the groundfish fisheries was not likely to adversely affect Cook Inlet beluga whales (Salveson 2009 and Brix 2010).

<u>Other Marine Mammals</u>

Ribbon seals, northern fur seals, and minke, fin, and humpback whales potentially compete with the GOA non-pollock trawl fisheries because of the overlap of their occurrence with the location of this fishery. Ribbon seals, fin whales, and humpback whales have a more diverse diet than minke whales and northern fur seals and may therefore have less potential to be affected by any competition with the fisheries. There is no evidence that the harvest of groundfish in the GOA is likely to cause population level effects on these marine mammals.

Based on a review of marine mammal diets, and an evaluation of the status quo harvests of potential prey species in the GOA non-pollock trawl fishery, the effects of Alternative 1 on prey availability for marine mammals are not likely to cause population level effects and are therefore insignificant.

Prey Availability Effects under Alternatives 2 and 3

If a new PSC limit for Chinook salmon results in the fisheries closing before the TACs are reached, it could increase the availability of groundfish to marine mammals. If the PSC limit results in additional fishing effort in less productive groundfish areas with less salmon PSC, the shift in fishing location may result in additional groundfish being available in those areas where salmon is concentrated and would provide a benefit if these areas are also used by groundfish- and salmon-dependent marine mammals for foraging. A higher PSC limit would be less constraining on the fishery but could result in reduced prey availability. A lower PSC limit would be more constraining on the fishery, making more salmon available for prey; and may also increase availability of groundfish if the fishery is closed before the groundfish TACs is reached.

Consequently, Alternatives 2 and 3 may slightly increase the potential effects of the GOA non-pollock trawl fisheries on the availability of prey for marine mammals, except in years when the salmon cap is reached, and fishing may be constrained. It is not likely that the potential effects would be substantially different from status quo, and therefore the effects of Alternatives 2 and 3 are likely insignificant.

3.4.2.4 Disturbance

Disturbance Effects under Status Quo: Alternative 1

The GOA Halibut PSC EA/RIR/IRFA contains a detailed description of the disturbance of marine mammals by the non-pollock trawl fisheries (NPFMC 2012). The EA concluded that the status quo fishery does not cause significantly adverse impacts to marine mammals. Fishery closures limit the potential interaction between fishing vessels and marine mammals (e.g., 3-nm no groundfish fishing areas around Steller sea lion rookeries). Because disturbances to marine mammals under the status quo fishery are not likely to cause population level effects, the impacts of Alternative 1 are likely insignificant.

Disturbance Effects under Alternatives 2 and 3

The effects of the proposed PSC limits on disturbance would be similar to the effects on incidental takes. If the groundfish fishery closes early because the hard cap is reached, then less potential exists for disturbance of marine mammals. If the non-pollock trawl fisheries increase the duration of fishing in areas with lower concentrations of groundfish to avoid areas of high salmon PSC, there may be more potential for disturbance if this increased fishing activity overlaps with areas used by marine mammals.

None of the disturbance effects on other marine mammals under Alternatives 2 or 3 are expected to result in population level effects on marine mammals. Disturbance effects are likely to be localized and limited to a small portion of any particular marine mammal population. Because disturbances to marine mammals under Alternatives 2 and 3 are not likely to be substantially different from status quo, the impacts of Alternatives 2 and 3 are likely insignificant.

Cumulative Effects on Marine Mammal Species

See cumulative effects section for marine mammals and seabirds below.

3.5 Seabirds

3.5.1 Status

Alaska's waters support extremely large concentrations of seabirds. Over 80 million seabirds are estimated to occur in Alaska annually, including 40 million to 50 million individuals from the numerous species that breed in Alaska (Table 45; USFWS 2009). An additional 40 million to 50 million individuals do not breed in Alaska but spend part of their life cycle there. These include short-tailed and sooty shearwaters and three albatross species: the black-footed albatross, the Laysan albatross, and the endangered short-tailed albatross (Table 46; USFWS 2009).

More information on seabirds in Alaska's EEZ may be found in several NMFS, Council, and USFWS documents:

- The URL for the USFWS Migratory Bird Management program is at: http://alaska.fws.gov/mbsp/mbm/index.htm
- Section 3.7 of the PSEIS (NMFS 2004a) provides background on seabirds in the action area and their interactions with the fisheries. This may be accessed at http://www.alaskafisheries.noaa.gov/sustainablefisheries/seis/final062004/Chaps/chpt_3/chpt_3_7.pdf

- The annual Ecosystems Considerations chapter of the SAFE reports has a chapter on seabirds. Back issues of the Ecosystem SAFE reports may be accessed at http://www.afsc.noaa.gov/REFM/REEM/Assess/Default.htm.
- The Seabird Fishery Interaction Research webpage of the Alaska Fisheries Science Center: http://www.afsc.noaa.gov/refm/reem/Seabirds/Default.htm
- The NMFS Alaska Region's Seabird Incidental Take Reduction webpage: http://www.alaskafisheries.noaa.gov/protectedresources/seabirds.html
- The BSAI and GOA groundfish FMPs each contain an "Appendix I" dealing with marine mammal and seabird populations that interact with the fisheries. The FMPs may be accessed from the Council's home page at http://www.alaskafisheries.noaa.gov/npfmc/default.htm
- Washington Sea Grant has several publications on seabird takes, and technologies and practices for reducing them: http://www.wsg.washington.edu/publications/online/index.html
- The seabird component of the environment affected by the groundfish FMPs is described in detail in Section 3.7 of the PSEIS (NMFS 2004a).
- Seabirds and fishery impacts are also described in Chapter 9 of the Alaska Groundfish Harvest Specifications EIS (NMFS 2007a).
- Seabird Bycatch and Mitigation Efforts in Alaska Fisheries Summary Report: 2007 through 2015 (Eich et al. 2016).
- Seabird Bycatch Estimates for Alaska Groundfish Fisheries Annual Report: 2015 (Eich et al. 2017).

Table 45 Seabird species in Alaska

Type	Common name	Status	Type	Common name	Status
Albatrosses	Black-footed		Guillemots	Black	
	Short-tailed	Endangered		Pigeon	
	Laysan		Eiders	Common	
Fulmars	Northern fulmar			King	
Shearwaters	Short-tailed			Spectacled	Threatened
	Sooty			Steller's	Threatened
Storm petrels	Leach's		Murrelets	Marbled	
	Fork-tailed			Kittlitz's	
	Pelagic			Ancient	
	Red-faced		Kittiwakes	Black-legged	
	Double-crested			Red-legged	
Gulls	Glaucous-winged		Auklets	Cassin's	
	Glaucous			Parakeet	
	Herring			Least	
	Mew			Whiskered	
	Bonaparte's			Crested	
	Slaty-backed		Terns	Arctic	
Murres	Common		Puffins	Horned	
	Thick-billed			Tufted	
Jaegers	Long-tailed				
	Parasitic				
	Pomarine				

3.5.1.1 ESA-Listed Seabirds in the GOA

Two species of conservation concern occur in the GOA (Table 46). Short-tailed albatross is listed as endangered under the ESA, and Steller's eider is listed as threatened.

Table 46 ESA-listed and candidate seabird species that occur in the GOA

Common Name	Scientific Name	ESA Status
Short-tailed Albatross	*Phoebaotria albatrus*	Endangered
Steller's Eider	*Polysticta stelleri*	Threatened

Short-tailed Albatross

Short-tailed albatross (*Phoebaotria albatrus*) is listed as endangered under the ESA. Short-tailed albatross populations were decimated by feather hunters and volcanic activity at nesting sites in the early 1900s, and the species was reported to be extinct in 1949. In recent years, the population has recovered at a 7% to 8% annual rate. The world population of short-tailed albatross in 2014 was estimated at 4,354 birds. The majority of nesting occurs on Torishima Island in Japan, where an active volcano threatens the colony. No critical habitat has been designated for the short-tailed albatross in the United States, because the population growth rate does not appear to be limited by marine habitat loss (NMFS 2004). Short-tailed albatross feeding grounds are continental shelf breaks and areas of upwelling and high productivity. Short-tailed albatross are surface feeders, foraging on squid and forage fish.

Steller's Eider

Steller's eider (*Polysticta stelleri)* is listed as threatened under the ESA. While designated critical habitat for Steller's eiders does overlap with fishing grounds in the Bering Sea, there has never been an observed take of this species off Alaska (USFWS 2003a, 2003b; NMFS 2008), and no take estimates are produced by AFSC. Therefore, impacts to Steller's eider are not analyzed in this document.

3.5.1.2 Status of ESA Consultations on Seabirds

The USFWS has primary responsibility for managing seabirds and has evaluated effects of the BSAI and GOA FMPs and the harvest specifications process on currently listed species in two Biological Opinions (USFWS 2003a and 2003b). Both Biological Opinions concluded that the groundfish fisheries off Alaska are unlikely to jeopardize populations of listed species or adversely modify or destroy critical habitat for listed species. The current population status, life history, population biology, and foraging ecology of these species, as well as a history of ESA Section 7 consultations and NMFS actions carried out as a result of those consultations are described in detail in Section 3.5.2 of the GOA Halibut PSC EA/RIR/IRFA (NPFMC 2012).

3.5.1.3 Seabird Distribution in the Gulf of Alaska

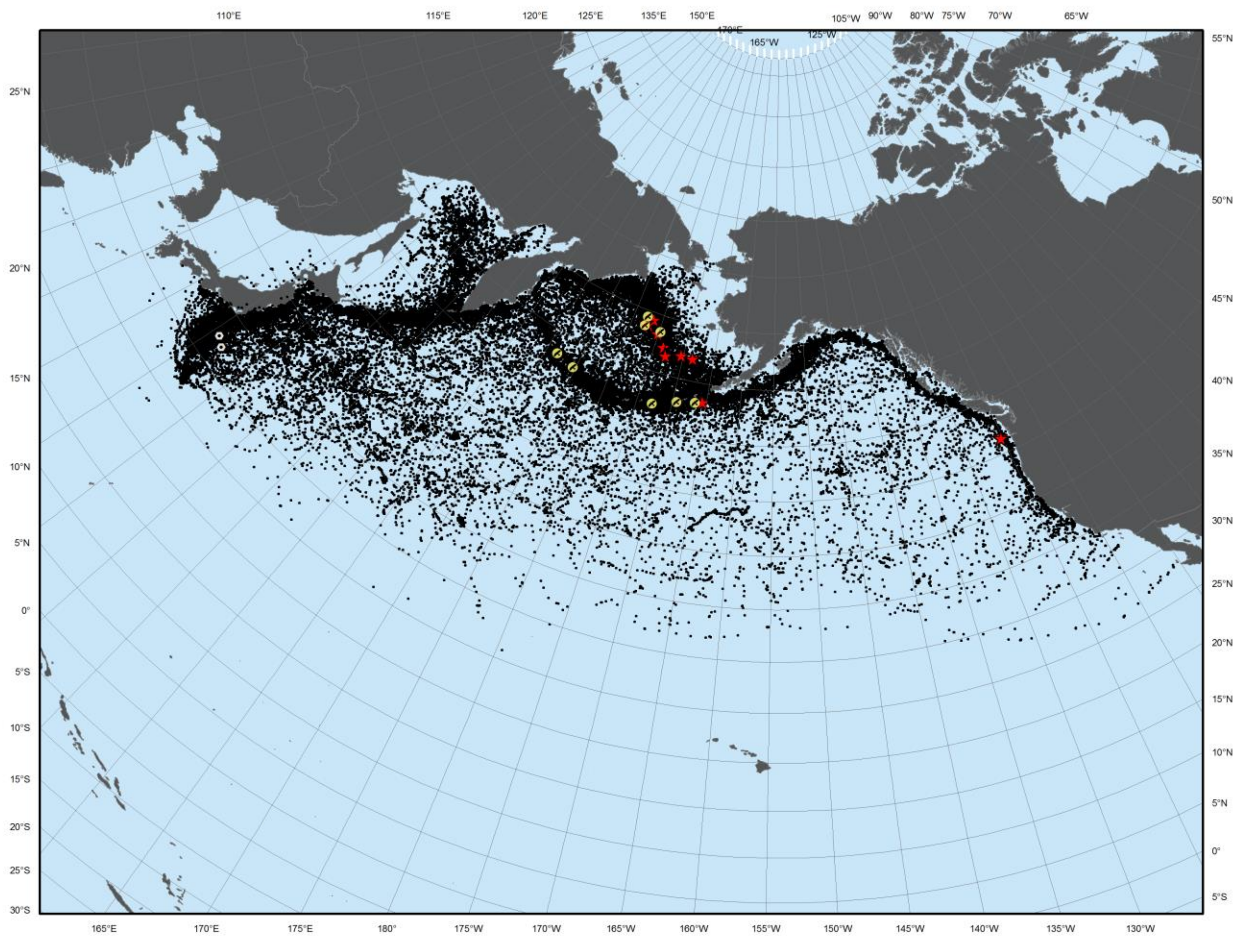
Figure 24 shows locations of short-tailed albatross seen on surveys through 2013. Eich et al. 2017 provides the most current and comprehensive data on seabird distribution patterns off Alaska.

Satellite Tracking of Short-tailed Albatross

USFWS and Oregon State University placed 52 satellite tags on Laysan, black-footed, and short-tailed albatrosses in the Central Aleutian Islands to study movement patterns of the birds in relation to commercial fishing activity and other environmental variables. From 2002 to 2006, 21 individual short-tailed albatrosses (representing about 1% of the entire population) were tagged, including adults, sub-adults, and hatch-year birds. During the non-breeding season, short-tailed albatross ranged along the Pacific Rim from southern Japan through Alaska and Russia to northern California, primarily along continental shelf margins (Suryan et al. 2006).

Sufficient data existed for 11 of the 14 to analyze movements within Alaska. Within Alaska, albatrosses spent varying amounts of time among NMFS reporting areas, with six of the areas (521, 524, 541, 542, 543, 610) being the most frequently used (Suryan et al. 2006). Non-breeding albatross concentrate foraging in oceanic areas characterized by gradients in topography and water column productivity. The primary hot spots for short-tailed albatrosses in the Northwest Pacific Ocean and Bering Sea occur where a variety of underlying physical processes enhance biological productivity or prey aggregations. The Aleutian Islands, in particular, were a primary foraging destination for short-tailed albatrosses.

Figure 24 Observations of short-tailed albatrosses



Black dots indicate location of short-tailed albatross (from multiple sources of sightings data) on the map; data from 2002, 2003, 2005 through 2006, and 2008 through 2013 (data provided by the Yamashina Institute for Ornithology, Oregon State University, U.S. Fish and Wildlife Service). Short-tailed albatross bycatch locations (excluding Russian fisheries) are depicted by red stars on the map. Short-tailed albatross hotspot locations (Piatt et al. 2006) are depicted by yellow circles on the map.
Source: Eich et al. 2016

Short-tailed Albatross Takes in Alaska Fisheries

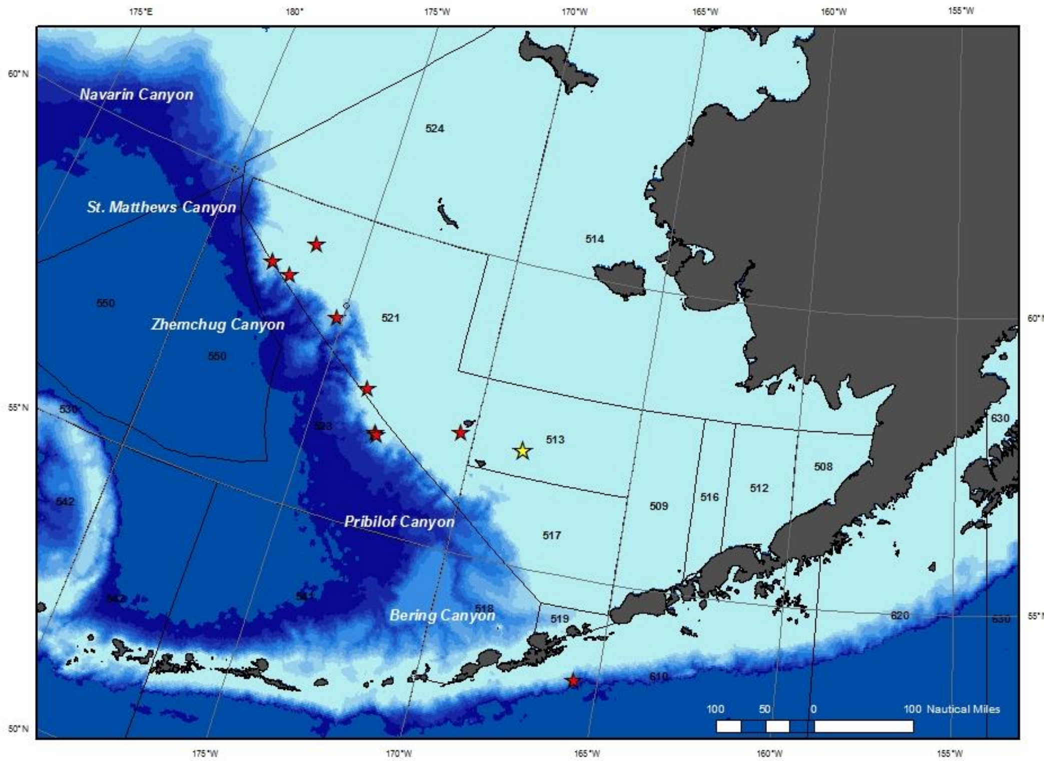
Table 47 lists the short-tailed albatrosses reported taken in Alaska fisheries since 1983. With the exception of one take in the Western GOA, all takes occurred along the shelf break in the Bering Sea. The Western GOA take was in the hook-and-line halibut fishery. No takes were reported from 1999 through 2009. No takes with trawl gear have been reported. The incidental take statement limits for short-tailed albatross have never been met or exceeded (Table 47 and Figure 25). NMFS is working closely with industry and the observer program to understand the specific circumstances of these incidents.

Table 47 Reported takes of short-tailed albatross in Alaska fisheries

Date	Fishery	Observer Program	In sample*	Bird age	Location	Source
7/15/1983	Net	No	n/a	4 months	Bering Sea	USFWS (2014)
10/1/1987	Halibut	No	n/a	6 months	GOA	USFWS (2014)
8/28/1995	IFQ sablefish	Yes	No	1 year	Aleutian Islands	USFWS (2014)
10/8/1995	IFQ sablefish	Yes	No	3 years	Bering Sea	USFWS (2014)
9/27/1996	Hook-and-line CP targeting Pacific cod	Yes	Yes	5 years	Bering Sea	USFWS (2014)
4/23/1998	Russian salmon drift net	n/a	n/a	Hatch-year	Bering Sea, Russia	USFWS (2014)
9/21/1998	Hook-and-line CP targeting Pacific cod	Yes	Yes	8 years	Bering Sea	USFWS (2014)
9/28/1998	Hook-and-line CP targeting Pacific cod	Yes	Yes	Sub-adult	Bering Sea	USFWS (2014)
7/11/2002	Russian**	n/a	n/a	3 months	Sea of Okhotsk, Russia	USFWS (2014)
8/29/2003	Russian demersal hook-and-line	n/a	n/a	3 years	Bering Sea, Russia	USFWS (2014)
8/31/2006	Russian**	n/a	n/a	1 year	Kuril Islands, Russia	USFWS (2014)
8/27/2010	Hook-and-line CP targeting Pacific cod	Yes	Yes	7 years	BSAI	USFWS (2014)
9/14/2010	Hook-and-line CP targeting Pacific cod	Yes	Yes	3 years	BSAI	USFWS (2014)
4/11/2011	Sablefish demersal hook-and-line	Yes	Yes	1 year	Pacific Ocean, Oregon	USFWS (2014)
10/25/2011	Hook-and-line CP targeting Pacific cod	Yes	Yes	1 year	Bering Sea	USFWS (2014)
5/24/2013	Hook-and-line, seabird bycatch mitigation research	No	n/a	1 year	Pacific Ocean, Japan	USFWS (2014)
9/7/2014***	Hook-and-line CP targeting Greenland turbot	Yes	No	5 years	Bering Sea	NOAA Fisheries (NMFS 2014b); S. Fitzgerald, pers. comm., NOAA Fisheries AFSC, June 2015
9/7/2014***	Hook-and-line CP targeting Greenland turbot	Yes	Yes	Sub-adult	Bering Sea	NOAA Fisheries (NMFS 2014a); S. Fitzgerald, pers. comm., NOAA Fisheries AFSC, June 2015
12/16/14***	Hook-and-line CP targeting Pacific cod	Yes	Yes	Immature	Bering Sea	NOAA Fisheries (NMFS 2015b); S. Fitzgerald, pers. comm., NOAA Fisheries AFSC, June 2015

CP = catcher/processor
* *In sample* refers to whether a specimen was in a sample of catch analyzed by a fisheries observer.
**Specifics regarding the type of fishery are unknown.
***These data were not included in USFWS (2014).

Figure 25 Observed locations of short-tailed albatross takes in Alaska groundfish fisheries since 1995 (red stars). Two takes, in September 2014, occurred in the same location and are represented by one star. Latest confirmed take on December 16, 2014, is shown by the yellow star. (NMFS Informational Bulletin 31 [2015])



3.5.2 Effects on Seabirds

The PSEIS identifies how the GOA groundfish fisheries activities may directly or indirectly affect seabird populations (NMFS 2015). Direct effects may include incidental take in fishing gear and vessel strikes. Indirect effects may include reductions in prey (forage fish) abundance and availability, disturbance to benthic habitat, discharge of processing waste and offal, contamination by oil spills, presence of nest predators in islands, and disposal of plastics, which may be ingested by seabirds.

3.5.2.1 Significance Criteria for Seabirds

Criteria for analyzing the potential impacts of these alternatives on seabirds are identified in Table 48. These criteria are adopted from the 2006-2007 groundfish harvest specifications EA/FRFA. The GOA Halibut PSC EA (NPFMC 2012) analyzed the GOA non-pollock trawl fisheries as currently prosecuted and concluded that the fisheries are not likely to result in significantly adverse impacts to seabirds. Alternative 1 is Status Quo, and under that alternative no changes are expected, and no significantly adverse impacts are expected for any seabirds. As with marine mammals, potential impacts from other alternatives are addressed as changes from status quo.

Table 48 Criteria used to determine significance of impacts on seabirds

	Incidental take	Prey availability	Benthic habitat
Insignificant	No substantive change in takes of seabirds during the operation of fishing gear.	No substantive change in forage available to seabird populations.	No substantive change in gear impact on benthic habitat used by seabirds for foraging.
Adverse impact	Non-zero take of seabirds by fishing gear.	Reduction in forage fish populations, or the availability of forage fish, to seabird populations.	Gear contact with benthic habitat used by benthic feeding seabirds reduces amount or availability of prey.
Beneficial impact	No beneficial impact can be identified.	Availability of offal from fishing operations or plants may provide additional, readily accessible, sources of food.	No beneficial impact can be identified.
Significantly adverse impact	Take levels increase substantially from the baseline level, or level of take is likely to have population level impact on seabirds.	Food availability decreased substantially from baseline such that seabird population level survival or reproduction success is likely to decrease.	Impact to benthic habitat decreases seabird prey base substantially from baseline such that seabird population level survival or reproductive success is likely to decrease. (ESA-listed eider impacts may be evaluated at the population level).
Significantly beneficial impact	No threshold can be identified.	Food availability increased substantially from baseline such that seabird population level survival or reproduction success is likely to increase.	No threshold can be identified.
Unknown impacts	Insufficient information available on take rates or population levels.	Insufficient information available on abundance of key prey species or the scope of fishery impacts on prey.	Insufficient information available on the scope or mechanism of benthic habitat impacts on food web.

3.5.2.2 Incidental Take of Seabirds in Trawl Fisheries

The impacts of the Alaska groundfish fisheries on seabirds were analyzed in the Alaska Harvest Specifications EIS (NMFS 2007), and the GOA halibut PSC EA evaluated these fisheries for their potential impacts to seabirds. Those documents are incorporated here by reference.

From 2007 to 2015, the estimated seabird bycatch for the Alaskan groundfish GOA fisheries, pelagic and non-pelagic gear combined, ranged from 0 in 2009 to 143 in 2013 (Eich et al. 2017). Northern fulmars and black-footed albatross were the only species of seabird reported in GOA trawl nets during those years.

Table 49 Estimated seabird bycatch for the Alaska groundfish Gulf of Alaska fishery management plan area, pelagic and non-pelagic trawl gear combined

Species/Species Group	2007	2008	2009	2010	2011	2012	2013	2014	2015
Black-footed Albatross	0	0	0	0	0	60	0	0	0
Northern Fulmar	91	39	0	121	27	0	143	20	0
Grand Total	91	39	0	121	27	60	143	20	0

Seabirds can interact with trawl fishing vessels in several ways including getting caught in the trawl net or vessel wires and striking the vessel infrastructure. Birds foraging at the water's surface or in the water column are sometimes caught in the trawl net as it is brought back on board. No short-tailed albatross

have been observed taken in trawl gear, but Laysan albatross mortalities have been observed. While trawl vessels do not offer any attraction from bait, they may produce a great amount of offal if the vessel is a CP. Birds are attracted to the net when it is being deployed and retrieved. Also, whole fish may be discarded as decks and equipment are washed or fish spill overboard when the codend is emptied.
The non-pelagic and pelagic trawl fisheries differ in the types and biomass of discards, which can play a role in the type of seabird attracted to vessels. The non-pelagic trawl fishery discards a greater biomass than does the pelagic trawl fishery even though it has a smaller amount of total catch than the pelagic trawl fishery. This is due in part to the ability of the larger pelagic trawl CPs to have a fish meal plant on board (Eich et al. 2016).

Overall seabird bycatch in recent years is nearly an order of magnitude less in the trawl fishery than in the hook-and-line fishery, based on the observer sample. However, sampling bias is known to exist with commercial trawl fisheries and is discussed below (Eich et al. 2016).

Seabird bycatch estimates derived from the observer species composition sample are biased low because observer sampling focuses on catch from the codend. However, on trawl vessels, seabirds can strike net monitoring equipment, such as paravanes or third wires, strike the trawl warp cables, or get caught in the net wings and thus not be brought on board with the fish so are not available to the observer during the species composition sampling period (Fitzgerald et al. in prep). Trawl-induced seabird mortality is difficult to quantify because birds that strike the cables may fall into the water and go unobserved (Dietrich and Melvin 2007; Zador and Fitzgerald 2008). Studies in the southern hemisphere also note these additional sources of mortality in trawl fisheries (Weimerskirch et al. 2000; Sullivan et al. 2006; Bull 2009). In the Alaska groundfish trawl fisheries, these additional mortalities were only noted on an ad-hoc basis by observers for many years (Labunski and Kuletz 2004; Fitzgerald et al. in prep).
The AFSC completed a multi-year observer special project in 2009 that compared observed seabird bycatch from the haul-level estimate, derived from the standard species composition sample, to seabird mortality from the supplemental sample of trawl gear (net wings, trawl warps, and third wires) (unpublished data in Fitzgerald et al. in prep). The study showed that there were 3.5 times as many birds in the supplemental sample than in the standard sample for the 9,395 hauls observed. The supplemental sample included six Laysan albatross while the standard sample did not have any, although the bycatch rate (0.0006 birds per haul) for the observed hauls was extremely low (Eich et al. 2016).

Based on this special project, in 2010 the Observer Program implemented standardized data recording measures for these additional sources of mortality, although the observer's ability to complete sampling for these data is constrained by matters of safety and other duties. While these data have been collected since 2010, the estimation procedures have not yet been developed so that they can be included in the annual bycatch report. However, work is underway to determine the best way to monitor and include these in annual estimates (Eich et al. 2016).

3.5.2.3 Prey Availability Disturbance of Benthic Habitat

As noted in Table 50, seabird prey species in the GOA are not usually fish that are targeted by non-pelagic commercial fishing gear. However, seabird species may be impacted indirectly by effects of the non-pelagic trawl gear on the benthic habitat of seabird prey, bottom fish, mollusks, and crustaceans. The essential fish habitat final environmental impact statement provides a description of the effects of trawling on bottom habitat in the appendix (NMFS 2005b), including the effects of the commercial fisheries on the GOA slope and shelf.

It is not known how much seabird species use benthic habitat directly. Thick-billed murres easily dive to 100 m, and have been documented diving to 200 m; common murres also dive to over 100 m. Since cephalopods and benthic fish compose some of their diet, murres could be foraging on or near the bottom (Kuletz, USFWS, personal communication, October 2008).

A description of the effects of prey abundance and availability on seabirds is found in the PSEIS (NMFS 2004a) and the Alaska Groundfish Harvest Specifications EIS (NMFS 2007a). Detailed conclusions or predictions cannot be made regarding the effects of forage fish bycatch on seabird populations or colonies. NMFS (2007a) found that the potential impact of the entire groundfish fisheries on seabird prey availability was limited due to little or no overlap between the fisheries and foraging seabirds based on either prey size, dispersed foraging locations, or different prey (NMFS 2007a). The majority of bird groups feed in vast areas of the oceans, are either plankton feeders or surface or mid-water fish feeders and are not likely to have their prey availability impacted by the non-pelagic trawl fisheries. There is no directed commercial fishery for those species that compose the forage fish management group, and seabirds typically target juvenile stages rather than adults for commercial target species. Most of the forage fish bycatch is smelt taken in the pollock fishery, which is not included in this action.

Table 50 Seabirds in the Gulf of Alaska: foraging habitats and common prey species

Species	Foraging habitats	Prey
Short-tailed albatross	Surface seize and scavenge	Squid, shrimp, fish, fish eggs
Black-footed albatross	Surface dip, scavenge	Fish eggs, fish, squid, crustaceans, fish waste
Laysan albatross	Surface dip	Fish, squid, fish eggs and waste
Spectacled eider	Diving	Mollusks and crustaceans
Steller's eider	Diving	Mollusks and crustaceans
Black-legged kittiwake	Dip, surface seize, plunge dive	Fish, marine invertebrates
Murrelet (Kittlitz's and marbled)	Surface dives	Fish, invertebrates, macroplankton
Shearwater spp.	Surface dives	Crustaceans, fish, squid
Northern fulmar	Surface fish feeder	Fish, squid, crustaceans
Murres spp.	Diving fish-feeders offshore	Fish, crustaceans, invertebrates
Cormorants spp.	Diving fish-feeders nearshore	Bottom fish, crab, shrimp
Gull spp.	Surface fish feeder	Fish, marine invertebrates, birds
Auklet spp.	Surface dives	Crustaceans, fish, jellyfish
Tern spp.	Plunge, dive	Fish, invertebrates, insects
Petrel spp.	Hover, surface dip	Zooplankton, crustaceans, fish
Jaeger spp.	Hover and pounce	Birds, eggs, fish
Puffin spp.	Surface dives	Fish, squid, other invertebrates

Source: USFWS 2006, Dragoo et al. 2010.

Seabirds that feed on benthic habitat, including Steller's eiders, scoters, cormorants, and guillemots, may feed in areas that could be directly impacted by non-pelagic trawl gear (NMFS 2004b). A 3-year otter trawling study in sandy bottom of the Grand Banks showed either no effect or increased abundance in mollusk species after trawling (Kenchington et al. 2001), but clam abundance in these studies was depressed for the first 3 years after trawling occurred. McConnaughey et al. (2000) studied trawling effects using the Bristol Bay area Crab and Halibut Protection Zone. They found more abundant infaunal bivalves (not including *Nuculana radiata*) in the highly fished area compared to the unfished area. In addition to abundance, clam size is important to these birds. Handling time is very important to birds foraging in the benthos, and their caloric needs could change if a stable large clam population is converted to a very dense population of small first year clams. Additional impacts from non-pelagic trawling may occur if sand lance habitat is adversely impacted. This would affect a wider array of piscivorous seabirds that feed on sand lance, particularly during the breeding season, when this forage fish is also used for feeding chicks.

Recovery of fauna after the use of non-pelagic trawl gear may also depend on the type of sediment. A study in the North Sea found biomass and production in sand and gravel sediments recovering faster (2 years) than in muddy sediments (4 years) (Hiddink et al. 2006). The recovery rate may be affected by the animal's ability to rebury itself after disturbance. Clams species may vary in their ability to rebury themselves based on grain size and whether they are substrate generalist, substrate specialist, or substrate sensitive species (Alexander et al.1993).

3.5.2.4 Alternative 1 Status Quo

Incidental Take

The effects of the status quo fisheries on incidental take of seabirds are described in seabirds is described in the GOA halibut PSC EA (NPFMC 2012), which concluded that these fisheries are not likely to result in significantly adverse impacts to seabirds. It is reasonable to conclude that incidental take of seabirds would not change under the Status Quo alternative.

Prey Availability and Benthic Habitat

The status quo groundfish fisheries do not harvest seabird prey species in an amount that would decrease food availability enough to impact survival rates or reproductive success, nor do they impact benthic habitat enough to decrease seabird prey base to a degree that would impact survival rates or reproductive success. Under the Status Quo alternative no substantive changes are expected, and impacts are expected to be negligible.

3.5.2.5 Alternatives 2 and 3

Incidental Take

The range of increased PSC limits under Alternatives 2 and 3 could potentially increase the number of incidental takes of seabirds in the GOA trawl fisheries. However, the lower PSC limit options may preclude trawl fishing in the non-pollock GOA fisheries at some point in the fishing season, which would reduce the potential for incidental takes in fishing areas that overlap with seabird distributions. If the fleet is able to identify hotspots with high Chinook salmon catch rates, and avoid fishing in these areas, the distribution of effort in the fishery may change to some extent, although likely within the existing footprint of the fishery. To the extent that the redistribution of effort results in more vessel-days of effort, there could potentially be an increase in the likelihood of incidental takes of seabirds, compared to the status quo. A higher PSC limit would allow for more fishing and potentially more incidental takes of seabirds than a lower cap. Overall effects on seabird takes are not likely to change substantially, and impacts are expected to be negligible.

Prey Availability and Benthic Habitat

Under higher PSC limits, the fishing season has the potential to be slightly longer than the status quo fishery in high Chinook salmon PSC years. Again, changes are not expected to be substantial, and any impacts are expected to be negligible.

3.5.2.6 Summary of Effects

Many seabird species use the marine habitat of the GOA. Several species of conservation concern and many other species could potentially interact with trawl cables. The AFSC estimates of incidental takes are small relative to total estimates of seabird populations. However, those estimates do not include cable-related trawl mortalities. Recent modeling suggests that even if there were to be a large increase in trawl cable incidental takes of short-tailed albatross (the only seabird listed as endangered under the ESA), it would have negligible effects on the recovery of the species. Table 51 summarizes the action alternatives' impacts to seabird populations.

Table 51 Summary of impacts to seabirds from alternatives in this analysis

Alternative	Impact on incidental take of seabirds in Alaska waters	Impact on prey density and benthic habitat
Alternative 1	Seabird takes and disruptions to benthic habitat and prey availability are at low levels and are mitigated (to some degree) by current spatial restrictions on the fisheries in the Gulf of Alaska. Insignificant effects.	Seabird takes and disruptions to benthic habitat and prey availability are at low levels and are mitigated (to some degree) by current spatial restrictions on the fisheries in the Gulf of Alaska. Insignificant effects.
Alternatives 2 and 3	Seabirds are taken by fisheries in minor amounts compared to population levels. Insignificant effects. Increased observer coverage would improve monitoring of incidental takes.	Overall prey availability is not affected by the groundfish fisheries at a level resulting in population level effects. Insignificant effects.

Cumulative Effects on Seabird Species and Marine Mammals

Reasonably foreseeable future actions for marine mammals and seabirds include ecosystem-sensitive management; rationalization; traditional management tools; actions by other federal, state, and international agencies; and private actions, as described in Sections 8.4 and 9.3 of the Harvest Specifications EIS (NMFS 2007a). Ecosystem-sensitive management, rationalization, and traditional management tools are likely to increase protection to marine mammals and seabirds by considering these species more in management decisions, and by improving the management of the non-pollock trawl fisheries through the restructured Observer Program, catch accounting, seabird avoidance measures, and vessel monitoring systems (VMS). Research into marine mammal and seabird interactions with the non-pollock trawl fisheries are likely to lead to an improved understanding leading to trawling methods that reduce adverse impacts of the fisheries. Changes in the status of species listed under the ESA, the addition of new listed species or critical habitat, and results of future Section 7 consultations may require modifications to groundfish fishing practices to reduce the impacts of these fisheries on listed species and critical habitat. Any change in protection measures for marine mammals likely would have insignificant effects because any changes would be unlikely to result in the PBR being exceeded and would not be likely to jeopardize the continued existence or adversely modify or destroy designated critical habitat. Additionally, since future TACs will be set with existing or enhanced protection measures, we expect that the effects of the fishery on the harvest of prey species and disturbance will not increase in future years.

Any action by other entities that may impact marine mammals and seabirds will likely be offset by additional protective measures for the federal fisheries to ensure ESA-listed mammals and seabirds are not likely to experience jeopardy or adverse modification of critical habitat. Direct mortality by subsistence harvest is likely to continue, but these harvests are tracked and considered in the assessment of marine mammals and seabirds. The cumulative effect of these impacts in combination with measures proposed under Alternatives 2 and 3 is not likely to be significant.

3.6 Habitat

3.6.1 Status

Fishing operations may change the abundance or availability of certain habitat features used by managed fish species to spawn, breed, feed, and grow to maturity. These changes may reduce or alter the abundance, distribution, or productivity of species. The effects of fishing on habitat depend on the intensity of fishing, the distribution of fishing with different gears across habitats, and the sensitivity and recovery rates of specific habitat features.

In 2005, NMFS and the Council completed the EIS for EFH Identification and Conservation in Alaska (NMFS 2005b). The EFH EIS evaluates the long-term effects of fishing on benthic habitat features, as well as the likely consequences of those habitat changes for each managed stock, based on the best available scientific information. The EFH EIS also describes the importance of benthic habitat to different groundfish species and the past and present effects of different types of fishing gear on EFH. Based on the best available scientific information, the EIS analysis concludes that despite persistent disturbance to certain habitats, the effects on EFH are minimal because the analysis finds no indication that continued fishing activities at the current rate and intensity would alter the capacity of EFH to support healthy populations of managed species over the long term. The EIS concludes that no Council managed fishing activities have more than minimal and temporary adverse effects on EFH for any FMP species, which is the regulatory standard requiring action to minimize adverse effects under the Magnuson-Stevens Act (50 CFR 600.815(a)(2)(ii)). Additionally, the analysis indicates that all fishing activities combined have minimal, but not necessarily temporary, effects on EFH.

The Council and NMFS have updated available habitat information, and their understanding of the impacts of fishing on habitat, in periodic 5-year reviews of the EFH components in the Council fishery management plans (NPFMC and NMFS 2010) and (Simpson et al. 2016). These 5-year reviews have not indicated findings different from those in the 2005 EFH EIS with respect to fishing effects on habitat, although new and more recent information has led to the refinement of EFH for a subset of Council-managed species. Maps and descriptions of EFH for groundfish species are available in the applicable fishery management plan.

3.6.2 Effects of the Alternatives

The effects of the GOA non-pollock trawl fisheries on benthic habitat and EFH were analyzed in the EFH EIS (NMFS 2005b), and that evaluation is incorporated by reference. Table 52 describes the criteria used to determine whether the impacts on EFH are likely to be significant. The GOA non-pollock trawl fisheries are prosecuted primarily with non-pelagic trawl gear, although pelagic gear is sometimes used in the rockfish target fishery. Year-round area closures protect sensitive benthic habitat. Appendix B to the EFH EIS describes how non-pelagic and pelagic trawl gear impacts habitat. The long-term effects index (LEI) estimates the proportion of habitat attributes that would be lost if recent fishing patterns continued. In the GOA, estimated reductions of epifaunal and infaunal prey due to fishing are less than 1% for all substrate types. For living structure, LEI impacts ranged between 3% and 9% depending on the substrate. Local areas with LEI values in excess of 50% occur to the east of Kodiak Island in Barnabus, Chiniak, and Marmot Gullies (NMFS 2005b.

In addition to impacting benthic habitat, the non-pollock trawl fisheries catch salmon prey species incidentally, for example, pollock. The catches of these prey species are very small relative to the overall populations of these species. Thus, fishing activities are considered to have minimal and temporary effects on prey availability for salmon.

Table 52 Criteria used to estimate the significance of impacts on essential fish habitat

No impact	Fishing activity has no impact on EFH.
Adverse impact	Fishing activity causes disruption or damage of EFH.
Beneficial impact	Beneficial impacts of this action cannot be identified.
Significantly adverse impact	Fishery induced disruption or damage of EFH that is more than minimal and not temporary.
Significantly beneficial impact	No threshold can be identified.
Unknown impact	No information is available regarding gear impact on EFH.

The analysis in the EFH EIS concludes that current fishing practices in the GOA non-pollock trawl fisheries have minimal or temporary effects on benthic habitat and essential fish habitat. These effects are likely to continue under Alternative 1 and are not considered to be significant.

Alternatives 2 and 3 would increase limits PSC of Chinook salmon in the GOA non-pollock trawl fisheries. A lower PSC limit may result in the non-pollock trawl fisheries closing before the TACs are reached, which may reduce impacts of this fishery on benthic habitat. If the fleet is able to identify hotspots with high Chinook salmon catch rates, and avoid fishing in these areas, the distribution of effort in the fishery may change to some extent, although it is likely to remain within the overall footprint of the current non-pollock trawl fisheries. A higher PSC limit would allow for more groundfish fishing, and impacts to benthic habitat may be similar to the status quo fishery.

Alternatives 2 and 3 may not change the potential adverse effects of fishing on benthic habitat compared to the status quo. To the extent that the redistribution of effort results in more vessel-days of effort, there could potentially be an increase in the habitat impacts compared to the status quo. However, regulatory constraints (e.g., seasonal allocations of TAC and halibut PSC) will continue to shape the temporal pattern of fishing, and the overall footprint of the fishery is unlikely to change. The potential effects on an area would be constrained by the amount of the groundfish TACs and by the existing habitat conservation and protection measures. To the extent that Alternatives 2 and reduce effort in the GOA non-pollock trawl fisheries, these alternatives would reduce impacts on habitat relative to the status quo. Because Alternatives 2 and 3 are not likely to result in significantly adverse effects to habitat, the impacts of Alternatives 2 and 3 are likely insignificant.

Currently, non-pelagic and pelagic trawl gear is subject to a number of area closures in the GOA to protect habitat and marine species. If new information emerges to indicate that the GOA non-pollock trawl fisheries are having more than a minimal impact on EFH, the Council may consider additional habitat conservation measures. The Council conducts a review of EFH for all managed species every five years.

Cumulative Effects on Habitat

Reasonably foreseeable future actions for habitat and the ecosystem include ecosystem-sensitive management; rationalization; traditional management tools; actions by other federal, state, and international agencies; and private actions, as detailed in Sections 10.3 and 11.3 of the Harvest Specifications EIS (NMFS 2007a). These actions include but are not limited to the implementation of Amendment 89 Area closures for *Chinoecetes Bairdi* Crab Protection in the Gulf of Alaska Groundfish Fisheries (NPFMC 2010b), and Amendment 95 Revise GOA Halibut PSC Limits. Ecosystem-sensitive management, rationalization, and traditional management tools are likely to increase protection to ecosystems and habitat by considering ecosystems and habitat more in management decisions and by improving the management of the fisheries through the Observer Program, catch accounting, seabird and marine mammal protection, gear restrictions, and VMS. Continued fishing under the harvest specifications is likely the most important cumulative effect on EFH but the EFH EIS (NMFS 2005b) has determined that this effect is minimal. The Council is also considering improving the management of non-specified species incidental takes in the fisheries to provide more protection to this component of the ecosystem. Any shift of fishing activities from federal waters into state waters would likely result in a reduction in potential impacts to EFH because state regulations prohibit the use of trawl gear in much of state waters. Nearshore impacts of coastal development and the management of the Alaska Water Quality Standards may have an impact on EFH, depending on the nature of the action and the level of protection the standards may afford. Development in the coastal zone is likely to continue, but Alaska overall is lightly developed compared to coastal areas elsewhere and therefore overall impact to EFH are not likely to be great. Many of the GOA non-pollock trawl fisheries have been independently certified to the Marine Stewardship Council environmental standard for sustainable fishing. Overall, the cumulative effects on habitat and ecosystems under Alternatives 2 and 3 are not likely to be significant.

There is no new information available that suggests the effects of climate change combined with the effects of this action will have effects beyond those already discussed in the Alaska Groundfish Final Programmatic Supplemental EIS (NMFS 2004), the Harvest Specifications EIS (NMFS 2007a), and the Bering Sea Chinook salmon bycatch EIS (NMFS 2009b). Commercial fishing has not been largely implicated in the GOA ecosystem changes; however, studies of other ecosystems with much larger fishing pressures indicate that fishing, in combination with climate change, can alter ecosystem species composition and productivity (NMFS 2004). Many efforts are underway to assess the relationship between oceanographic conditions, ocean mortality of salmon, and their maturation timing to their respective rivers of origin for spawning. It is unclear whether the observed changes in salmon bycatch in recent years is due to fluctuations in salmon abundance, or whether there is a greater degree of co-occurrence between salmon and groundfish stocks as a result of changing oceanographic conditions. Specific ocean temperature preferences for salmon species are poorly understood. Regime shifts and consequent changes in climate patterns in the North Pacific Ocean has been shown to correspond with changes in salmon production (Mantua et al. 1997). A study linking temperature and salmon bycatch rates in the pollock fishery was conducted in the Bering Sea and preliminary evidence indicates a relationship, even when factoring for month and area; Chinook bycatch appeared to be also related to conditions for a given year, season, and location (Ianelli et al. 2010).

Compelling evidence from studies of changes in Bering Sea and Arctic climate, ocean conditions, sea ice cover, permafrost, and vegetation indicate that over the long-term, the area is experiencing warming trends in ocean temperatures and major declines in seasonal sea ice (IPCC, 2007; ACIA, 2005). Some evidence exists for a contraction of ocean habitats for salmon species under global warming scenarios (Welch et al. 1998). Studies in the Pacific Northwest have found that juvenile survival is reduced when in-stream temperatures increase (Marine and Cech 2004, Crozier and Zabel 2006). A correlation between sea surface temperature and juvenile salmon survival rates in their early marine life has also been proposed (Mueter et al. 2002). The variability of salmon responses to climate changes is highly variable at small spatial scales, and among individual populations (Schindler et al. 2008). This diversity among salmon populations means that the uncertainty in predicting biological responses of salmon to climate change remains large, and the specific impacts of changing climate on salmon cannot be assessed. It is not expected that the effects of this action will have effects beyond those already discussed in the Alaska Groundfish Final Programmatic Supplemental EIS (NMFS 2004), the Harvest Specifications EIS (NMFS 2007a), and the Bering Sea Chinook salmon bycatch EIS (NMFS 2009b).

Considering the direct and indirect impacts of the proposed action when added to the impacts of past and present actions previously analyzed in other documents that are incorporated by reference and the impacts of the reasonably foreseeable future actions listed above, the cumulative impacts of the proposed action are determined to be not significant.

3.7 Ecosystem

3.7.1 Status

Ecosystems consist of communities of organisms interacting with their physical environment. Within marine ecosystems, competition, predation, and environmental disturbance cause natural variation in recruitment, survivorship, and growth of fish stocks. Human activities, including commercial fishing, can also influence the structure and function of marine ecosystems. Fishing may change predator-prey relationships and community structure, introduce foreign species, affect trophic diversity, alter genetic diversity, alter habitat, and damage benthic habitats.

The GOA non-pollock trawl fisheries potentially impact the GOA ecosystem by relieving predation pressure on shared prey species (i.e., species that are prey for both target groundfish and other species), reducing prey availability for predators of the target groundfish, altering habitat, imposing PSC and bycatch mortality, or by ghost fishing caused by lost fishing gear. Ecosystem considerations for the GOA groundfish fisheries are summarized annually in the Stock Assessment and Fishery Evaluation report (NPFMC 2017b). These considerations are summarized according to the ecosystem effects on the groundfish fisheries, as well as the potential fishery effects on the ecosystem.

3.7.2 Effects of the Alternatives

An evaluation of the effects of the GOA groundfish fisheries on the ecosystem is discussed annually in the Ecosystem Considerations sections of each chapter of the SAFE report (NPFMC 2017b) and was evaluated in the Harvest Specifications EIS (NMFS 2007). The significance criteria used in that analysis are incorporated here by reference. The analysis concluded that the current GOA non-pollock trawl fisheries do not produce population-level impacts to marine species or change ecosystem-level attributes beyond the range of natural variation. Consequently, Alternative 1 is not expected to have a significant impact on the ecosystem.

Alternatives 2 and 3 will likely maintain the overall level of groundfish harvest from the status quo. The level of fishing effort by non-pollock trawl vessels is not expected to change, except in years where the fisheries are closed early due to the attainment of the Chinook salmon PSC cap. While the location and timing of fishing activities may show some localized changes, overall the fleets are constrained by regulatory measures (e.g., seasonal allocations of TAC and halibut PSC) in the location and timing of the fisheries. As a result, Alternatives 2 and 3 are not likely to have a significant impact on the ecosystem.

Cumulative Effects on the Ecosystem

See section on cumulative effects on habitat above.

3.8 NEPA Summary

One of the purposes of an environmental assessment is to provide the evidence and analysis necessary to decide whether an agency must prepare an environmental impact statement (EIS). The Finding of No Significant Impact (FONSI) is the decision maker's determination that the action will not result in significant impacts to the human environment, and therefore, further analysis in an EIS is not needed. The Council on Environmental Quality regulations at 40 CFR 1508.27 state that the significance of an action should be analyzed both in terms of “context” and “intensity.” An action must be evaluated at different spatial scales and settings to determine the context of the action. Intensity is evaluated with respect to the nature of impacts and the resources or environmental components affected by the action. These factors form the basis of the analysis presented in this EA/RIR. The subsequent public review draft of this analysis will include responses to the 16 questions that must be considered in order to determine the intensity of impacts (FONSI or no FONSI)

4 Regulatory Impact Review

This Regulatory Impact Review (RIR) examines the benefits and costs of a proposed regulatory amendment to increase the existing Chinook salmon PSC limits for Central and Western GOA non-pollock trawl CVs and CVs fishing under the authority of a Central GOA Rockfish Program cooperative quota permit. Trawl fishing in the GOA is limited by Chinook salmon PSC; directed fishing with trawl gear is closed if that limit is met.

The preparation of an RIR is required under Presidential Executive Order (E.O.) 12866 (58 FR 51735, October 4, 1993). The requirements for all regulatory actions specified in E.O. 12866 are summarized in the following Statement from the E.O.:

> *In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and Benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nonetheless essential to consider. Further, in choosing among alternative regulatory approaches agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.*

E.O. 12866 requires that the Office of Management and Budget review proposed regulatory programs that are considered to be “significant.” A “significant regulatory action” is one that is likely to:

- Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, local or tribal governments or communities;
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, the President’s priorities, or the principles set forth in this Executive Order.

4.1 Statutory Authority

Under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) (16 U.S.C. 1801, *et seq*.), the United States has exclusive fishery management authority over all marine fishery resources found within the exclusive economic zone (EEZ). The management of these marine resources is vested in the Secretary of Commerce (Secretary) and in the regional fishery management councils. In the Alaska Region, the Council has the responsibility for preparing fishery management plans (FMPs) and FMP amendments for the marine fisheries that require conservation and management, and for submitting its recommendations to the Secretary. Upon approval by the Secretary, NMFS is charged with carrying out the Federal mandates of the Department of Commerce with regard to marine and anadromous fish.

The trawl fishery for non-pollock groundfish species in the EEZ off Alaska is managed under the FMP for Groundfish of the GOA. The proposed action under consideration would amend this FMP and Federal regulations at 50 CFR 679.21(h). Actions taken to amend FMPs or implement other regulations governing these fisheries must meet the requirements of Federal law and regulations.

4.2 Purpose and Need for Action

The Council adopted the following purpose and need statement at its February 2018 meeting:

The Magnuson-Stevens Act (MSA) National Standards require, among other factors, that the Council to balance the objectives of achieving optimum yield, minimizing bycatch, and minimizing adverse impacts on fishery-dependent communities. Chinook salmon PSC taken in GOA trawl fisheries is a resource concern, and the Council has taken action to set hard cap PSC limits that are below the incidental take amount that would trigger reconsultation under the Endangered Species Act (ESA). Attainment of a PSC hard cap closes the trawl fishery. Since the 2015 implementation of Chinook salmon PSC limits for the GOA non-pollock groundfish trawl CV sector, the fishery has continued to display variable levels and unpredictable timing of salmon encounter. Potential closures and PSC encounter rates that vary from year-to-year or even week-to-week create uncertainty for fishery participants, which in turn can make business planning more difficult or directly lead to forgone harvest opportunities. Those outcomes adversely affect trawl harvesters, crew, processors, and GOA coastal communities.

Relative to what was available when the Council established the PSC limits, new information about the resource and the fishery's rate of salmon encounter has been gathered from salmon genetic identification studies and the expansion of observer sampling onto smaller trawl vessels. Meanwhile, the non-Rockfish Program GOA trawl fisheries continue to operate under a limited access management structure where harvesters must compete for a share of the available catch without formalized cooperative tools to best minimize and utilize PSC.

The proposed action would consider increasing Chinook salmon PSC limits and establishing an annual rollover of unused Chinook salmon PSC for the GOA non-pollock non-Rockfish Program trawl CV sector and/or the Central GOA Rockfish Program CV sector. Alternatives to increase PSC limits or provide more flexibility under the existing PSC limits are offered in light of new information and multiple years of experience fishing under constraining hard caps for these fisheries with variable and unpredictable PSC rates. The action would not modify PSC rollovers from the Rockfish Program CV sector to the limited access CV sector, and NMFS's ability to make in-season Chinook salmon PSC limit reapportionments between certain trawl sectors. The action seeks to find the most appropriate PSC limits or flexibility within the existing PSC limits for these fisheries by providing a margin that accommodates expected high variability, while remaining within previously established outer bounds for annual GOA-wide PSC levels that are not expected to jeopardize the Chinook salmon resource.

4.3 Alternatives

The Council adopted the following alternatives for analysis in February 2018.

Alternative 1: No action

Alternative 2: Modify the Chinook salmon PSC limit for the GOA non-pollock non-Rockfish Program CV sector by:

- Option 1: 1,000 fish
- Option 2: 2,000 fish
- Option 3: 3,000 fish
- Option 4: Replace the performance standard/incentive buffer with an annual rollover of any unused Chinook salmon PSC in this sector. NMFS will

determine the amount of unused Chinook salmon PSC based on the amount used in the sector relative to the base limit of 2,700 fish. The maximum amount of Chinook salmon PSC that may be rolled over cannot exceed:

Suboption 1: 675 fish (25% of the limit of 2,700 fish)
Suboption 2: 1,350 fish (50% of the limit of 2,700 fish)
Suboption 3: 2,025 fish (75% of the limit of 2,700 fish)

Under Option 4, in any year the total amount of Chinook salmon PSC available cannot exceed the base limit plus the amount in the suboption selected.

Alternative 3: Modify the Chinook salmon PSC limit for the Central GOA Rockfish Program CV sector by:

Option 1: 300 fish
Option 2: 600 fish
Option 3: 900 fish
Option 4: Allow an annual rollover of any unused Chinook salmon PSC in this sector. NMFS will determine the amount of unused Chinook salmon PSC based on the amount used in the sector relative to the base limit of 1,200 fish. The maximum amount of Chinook salmon PSC that may be rolled over cannot exceed:

Suboption 1: 300 fish (25% of the limit of 1,200 fish)
Suboption 2: 600 fish (50% of the limit of 1,200 fish)
Suboption 3: 900 fish (75% of the limit of 1,200 fish)

Under Option 4, in any year the total amount of Chinook salmon PSC available cannot exceed the base limit plus the amount in the suboption selected.

The Council may select either Alternative 2 or 3 or may select both in combination. If an action alternative is not selected, that CV sector’s Chinook salmon PSC limit will remain at the status quo level described in Section 2.1.

4.4 Methodology for Analysis of Impacts

The evaluation of impacts in this analysis is designed to meet the requirement of E.O. 12866, which dictates that an RIR evaluate the costs and benefits of the alternatives, to include both quantifiable and qualitative considerations. Additionally, the analysis should provide information for decisionmakers “to maximize net benefits (including potential economic, environment, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.” The costs and benefits of this action with respect to these attributes are described in the sections that follow, comparing the No Action Alternative 1 with the action alternatives. The analyst then provides a qualitative assessment of the net benefit to the Nation of each alternative, with “no action” as a baseline.

This analysis was prepared using data from the NMFS catch accounting system, which is the best available data to estimate total catch and PSC in the groundfish fisheries off Alaska. Total catch estimates are generated from information provided through a variety of required industry reports of harvest and at-sea discard, and data collected through an extensive fishery observer program. In 2003, NMFS changed the methodologies used to determine catch estimates from the NMFS blend database (1995 through 2002) to the catch accounting system (2003 through present). The catch accounting system was implemented to better meet the increasing information needs of fisheries scientists and managers. Currently, the catch accounting system relies on data derived from a mixture of production and observer reports as the basis of the total catch estimates. The 2003 modifications in catch estimation included providing more frequent data summaries at finer spatial and fleet resolution, and the increased use of observer data. Redesigned observer program data collections were implemented in 2008 and include recording sample-specific information in lieu of pooled information, increased use of systematic sampling over simple random and opportunistic sampling, and decreased reliance on observer computations. As a result of these modifications, NMFS is unable to recreate blend database estimates for total catch and retained catch after 2002. Therefore, NMFS is not able to reliably compare historical data from the blend database to the current catch accounting system. This analysis relies solely on total catch and PSC estimates during years more recent than 2003. In particular, this analysis focuses on data beginning in 2007, which coincides with the implementation of the Central GOA Rockfish Pilot Program. The Rockfish Program would be directly regulated by Alternative 3; moreover, the implementation of the Rockfish Program broadly affected the annual patterns of effort and business strategies in multiple key non-pollock trawl fisheries that are at the core of this action.

The analysis of potential impacts provided in Section 4.7 draws heavily on the analysis that was provided for the Council's previous consideration of alternatives when establishing GOA Groundfish FMP Amendment 97 (NPFMC 2014). That analysis considered a range of alternatives that could have set the Chinook salmon PSC limit for GOA non-pollock trawl fisheries as high as 12,500 fish per year, making the overall GOA trawl Chinook salmon PSC limit 37,500 fish per year (25,000 PSC limit for pollock trawl fisheries and 12,500 for non-pollock). The Council ultimately selected a non-pollock trawl limit of 7,500 Chinook PSC, which is apportioned between the CV and CP non-pollock sectors (3,900 and 3,600 Chinook, respectively). The highest possible average annual amount of GOA trawl Chinook salmon PSC that could be taken as a result of this action would be 36,400 salmon (refer to Section 2 of this document). That amount would represent selecting both Alternative 2, Option 3 and Alternative 3, Option 3 – adding 3,900 Chinook PSC to the status quo overall GOA trawl Chinook PSC limit of 32,500 per year. In summary, the Council has previously considered the cumulative impacts of removing 36,400 Chinook salmon PSC on the environment, groundfish stakeholders, non-trawl users of Chinook salmon, and net benefits to the nation.

4.5 Description of GOA Non-Pollock Trawl Fisheries

The groundfish trawl fisheries in the Central and Western regulatory areas of the GOA are comprised of directed fisheries for pollock, Pacific cod, flatfish, and rockfish species. GOA trawl fisheries open on January 20 and close on December 31, unless NMFS intercedes with a closure to prevent the exceeding of annual TAC or established PSC limits for Pacific halibut or Chinook salmon. Regulations prescribe seasons for pollock, Pacific cod, and rockfish within the fishing year (50 C.F.R. 679.23). In the absence of management closures, directed pollock fishing is permitted in A and B seasons from January 20 to May 31, and in C and D seasons from August 25 to November 1. Likewise, directed Pacific cod fishing is permitted in the A season from January 20 to June 10 and the B season from September 1 to November 1. The seasonal apportionment of pollock and Pacific cod harvest is considered necessary to ensure that groundfish fisheries are not likely to cause jeopardy of extinction or adverse modification of critical habitat for Steller sea lions. In the Central GOA, directed rockfish fishing with trawl gear is permitted from May 1 to December 31. CVs that participate in the Central GOA Rockfish Program are permitted to fish cooperative quota from May 1 to November 15. In the Western GOA, directed rockfish fishing is permitted beginning on July 1 (CVs do not historically target rockfish with trawl gear in the Western GOA). Directed flatfish fishing is permitted in either regulatory area from January 20 to December 31.

While these regulatory fishing seasons define beginning- and end-points for GOA trawl activity, the pattern of fishing behavior in a given year is complex and largely driven by participants' ability to be active in multiple fisheries – including trawl and fixed-gear, state and federal, and GOA and BSAI fisheries. Beyond regulatory-established season dates, the factors that influence annual business plans include the relative value of various target species in local processing markets, interacting directed fishing closures due to species TAC limits or PSC limits, and seasonal fish stock abundance. The timing of fish aggregations (particularly in the Pacific cod fishery) might affect decisions about when to prosecute those fisheries, as increased aggregation often results in cost savings from increased catch per unit of effort and decreased PSC. Roe conditions also influence the timing of fishing activity (especially in the pollock fishery). While this analysis focuses on GOA non-pollock trawl fisheries, it is important to note that many participants also trawl for GOA pollock (Table 58).

As of January 1, 2000, an LLP license is required for vessels participating in directed fishing for “License Limitation” groundfish species in Federal waters in the GOA or BSAI. License Limitation groundfish in the GOA means "target species and the 'other species' category, specified annually pursuant to 679.20(a)(2). A vessel must be named on an original LLP license that is onboard the vessel. The LLP is authorized in Federal regulations at 50 CFR 679.4(k), definitions relevant to the program are at 679.2, and prohibitions are at 679.7.”

The set of vessels that participates in the fisheries that could be affected by this action is diverse. Some operators depend on the GOA groundfish trawl fishery for the majority of their annual business, while others are substantially engaged in BSAI trawl fishing, fixed-gear fisheries, and state-managed fisheries for non-FMP species such as salmon. Non-groundfish revenues for trawl vessels may also include work as tender vessels. Vessel dependency information is provided in Section 4.5.2.4 of this document. Only a subset of the trawl CVs that would be affected by this action participate in the Central GOA Rockfish Program, though all Rockfish Program CVs also participate in the GOA limited access trawl fishery.

This section also describes the diversity in the processing sector (Section 4.5.4) and communities (4.5.5) that participate in the GOA non-pollock trawl fishery, and their relative dependence on non-pollock trawl fishing relative to other activity. Community descriptions draw heavily on previously provided documents, including Social Impact Assessments prepared for the Council’s consideration of a GOA Trawl Bycatch Management Program[23] and the MSA-mandated review of the Central GOA Rockfish Program.[24] Finally, management and harvest of Chinook salmon in the state-managed commercial fishery, the state-managed sport/personal use fishery and state/federal subsistence fisheries is described in Section 4.6.

4.5.1 Management

4.5.1.1 Catch and PSC Monitoring and Estimation

NMFS estimates total groundfish catch and Chinook salmon PSC for the GOA trawl fisheries based on Observer Program data and mandatory fishing industry reports. A brief overview of the North Pacific Observer Program is available on the NMFS Alaska Region website.[25] NMFS uses at-sea samples on observed trips to create Chinook PSC rates that are applied to unobserved vessels based on varying levels of aggregation. This section provides a summary of the observer sampling and salmon PSC estimation methods used in GOA trawl fisheries. NMFS’s catch, bycatch, and PSC estimation methods – including levels of aggregation for estimation of unobserved fishing – are described in more detail in Cahalan et al. (2014).

Vessels with FFPs that fish in the Federal groundfish fisheries in the GOA are placed in either the full observer coverage or partial coverage categories, as defined in regulation at Section 679.51(a)(2). CVs that are fishing Central GOA Rockfish Program cooperative quota operate within the full coverage category. All non-Rockfish Program GOA trawl CVs are in the partial coverage category. Each year NMFS develops (1) an Annual Deployment Plan (ADP) that describes how observers will be deployed on

[23] http://npfmc.legistar.com/gateway.aspx?M=F&ID=e3852a81-a379-4676-a27a-ef2d3938b3e1.pdf
[24] http://npfmc.legistar.com/gateway.aspx?M=F&ID=1c813c58-b346-4cef-aa74-44dbe2a24b42.pdf
[25] https://alaskafisheries.noaa.gov/sites/default/files/observer-prog-summary.pdf, updated January 3, 2018.

vessels in the partial coverage category in the upcoming year; and (2) an annual report that evaluates the performance of the prior year's ADP implementation. Vessel owners or operators are required to log each fishing trip into the Observer Declare and Deploy System (ODDS) and each trip has a probability of being selected for observer coverage. The selection rate for partial coverage trawl CVs has evolved through each subsequent ADP since the restructured Observer Program was implemented in 2013. The deployment strategy for the current year is detailed in the final ADP for 2018 (NMFS 2017b)[26] and the most recent overview and review of observer deployment is available in the 2016 Annual Report (AFSC 2017a).[27]

Prior to 2013, the observer coverage level for vessels in the partial coverage category was based on length overall (LOA). Groundfish trawl vessels of less than 60' LOA were not required to carry observers; trawl vessels of 60' to 125' LOA were required to carry observers for 30% of their total fishing time; and trawl vessels of 125' LOA or greater were required to carry observers 100% of the time. During the period from 1990 to 2012, NMFS provided operational oversight, observer certification training, definitions of observer sampling duties and methods, observer debriefing, and data management, but vessels (and processors) were responsible for contracting and paying direct observer deployment costs and vessel chose when to take observers on their boats. The data biases that were inherent to that program design provided the impetus for the restructuring that was implemented in 2013. During that period – including the years of historical Chinook salmon PSC information that were used in the analysis of GOA Groundfish FMP Amendment 97 – total catch and PSC estimates for trawl fisheries that were primarily prosecuted by vessels with no coverage requirements were derived using sampled rates from vessels that carried observers. Such was the case for a significant portion of the Western GOA non-pollock trawl fishery. Under that system, Chinook PSC estimates for trawl vessels of less than 60' LOA fishing in the Western GOA were derived from larger vessels fishing at the same time in the Western GOA, or from vessels fishing in the Central GOA.

Since 2013, partial coverage GOA trawl CVs of any size (LOA) have all been subject to the same annual observer selection rate, and observer coverage for trawl activity has been randomly assigned on a trip-by-trip basis. This sampling method has reduced the coverage gap that previously existed in the Western GOA where roughly three-quarters of vessels were less than 60' LOA.[28] Table 53 summarizes the target observer selection rates for partial coverage trawl CVs that were established in each year's final ADP. Beginning in 2017, the ADP includes a separate selection stratum of trawl vessels that deliver to tenders as a further effort to generate representative, unbiased data that reflects the diversity in fishing operations. For reference, the final ADPs for 2017 and 2018 forecast the total number of trawl trips that were expected to carry an observer given the designated selection probability for that year; tender trips were expected to account for 5.3% of observed trawl activity in 2017 (24 out of 457 trips) and 2.2% of observed trawl activity in 2018 (15 out of 685 trips).

Table 54 illustrates the change in effective observer coverage levels before and after the 2013 implementation of restructuring. The table shows the proportion of groundfish harvest that occurred on trips that carried an observer, broken out by trips that were classified in the Catch Accounting System (CAS) as having either a pollock or a non-pollock target. Percentages are used in order to accommodate confidentiality rules for harvest volume data that represent fewer than three individual entities. Prior to the 2013 restructuring, observer coverage levels on trawl vessels of less than 60' LOA were at zero or very low. Since 2013, coverage levels for non-pollock trips on smaller vessels in the Western GOA have increased from near-zero to an annual range of 3% to 14%. On balance, a greater percentage of overall

[26] https://alaskafisheries.noaa.gov/sites/default/files/final_2018_adp.pdf
[27] https://www.afsc.noaa.gov/Publications/ProcRpt/PR2017-07.pdf
[28] In 2013 and 2014, the ADP stratified selection rates for fixed-gear vessels based on length overall, but partial coverage trawl CVs were all placed in the same selection stratum with a uniform probability of trip selection in ODDS.

pollock harvest occurs on observed trips because the pollock fishery accounts for a larger proportion of total GOA trawl trips, and selection is not based on target species as designated in CAS. For larger vessels, which had to meet observer coverage requirements prior to the 2013 restructure, the proportion of their total catch that occurs on observed trips has decreased because observer-days are spread out over a larger set of vessels that includes those less than 60' LOA. While observer coverage rates on larger vessels since 2013 may be lower, confidence in the accuracy of those data is improved because they are derived from a scientifically designed sampling plan, as described in the ADPs.

Table 53 Observer selection rate for partial coverage GOA trawl CVs

Year	ADP Selection Probability
2013	15%
2014	16%
2015	24%
2016	28%
2017	18% shoreside 14% tender
2018	20% shoreside 17% tender

Table 54 Percentage of GOA non-Rockfish Program trawl CV harvest by observed/unobserved trips, 2007 through 2017

Central GOA		% Harvest Observed			
Vessel Size	Year	Non-Pollock	Vessel Count	Pollock	Vessel Count
< 60'	2007	0.0%	2	0.0%	1
	2008	0.0%	2	0.0%	2
	2009	0.0%	1	0.0%	1
	2010	0.0%	3	0.0%	4
	2011	0.0%	3	0.0%	7
	2012	7.3%	10	0.0%	15
	2013	4.6%	15	13.0%	7
	2014	3.5%	19	16.6%	7
	2015	8.8%	7	22.0%	12
	2016	3.2%	4	29.4%	11
	2017	0.0%	5	26.3%	7
Total		3.7%		16.5%	
60'-125'	2007	23.3%	35	31.4%	37
	2008	24.8%	39	34.0%	42
	2009	22.9%	33	47.1%	39
	2010	26.4%	35	31.5%	37
	2011	25.8%	39	35.1%	40
	2012	28.4%	38	39.3%	45
	2013	15.0%	34	16.9%	42
	2014	9.1%	29	16.0%	42
	2015	14.9%	27	25.5%	42
	2016	11.8%	31	31.7%	43
	2017	8.8%	25	21.5%	40
Total		20.2%		26.8%	

Western GOA		% Harvest Observed			
Vessel Size	Year	Non-Pollock	Vessel Count	Pollock	Vessel Count
< 60'	2007	0.0%	24	0.0%	16
	2008	1.0%	23	0.0%	16
	2009	0.0%	25	0.0%	17
	2010	0.0%	13	0.0%	20
	2011	0.0%	10	0.2%	19
	2012	0.0%	20	0.0%	21
	2013	3.3%	21	11.6%	17
	2014	4.2%	23	11.6%	21
	2015	5.8%	22	21.4%	17
	2016	13.7%	22	23.8%	21
	2017	9.4%	22	17.3%	22
Total		4.8%		10.8%	
60'-125'	2007	68.0%	4	30.0%	9
	2008	-	-	50.4%	3
	2009	-	-	74.1%	5
	2010	43.9%	2	37.0%	6
	2011	59.1%	2	29.1%	4
	2012	87.7%	3	33.0%	8
	2013	0.0%	2	17.6%	7
	2014	31.0%	1	30.4%	4
	2015	39.4%	1	22.7%	3
	2016	-	-	24.6%	8
	2017	26.8%	6	19.2%	7
Total		37.7%		27.0%	

Note: Vessel counts across pollock and non-pollock categories are not additive; GOA vessels that target non-pollock species also target pollock.

4.5.1.1.1 Observer Sampling and PSC Estimation

Observers are responsible for assessing fishing activities and determining how to sample the unsorted catch for species composition and biological information using methodologies described in the Observer Program Sampling Manual (AFSC 2017b). In the GOA trawl fisheries, observers are expected to sample every haul for composition and biological data.[29] For each sampled haul, observers are instructed to collect a random species composition sample of the total catch. Observers are trained and encouraged to use a systematic sample whenever it is logistically feasible, and they strive to take multiple, equal-sized samples from throughout the haul to obtain the largest possible sample size. However, even with large sample sizes that reduce detectability issues, Chinook salmon is a relatively uncommon species and is characterized by an over-dispersed data distribution. This distribution is characterized by many small and zero counts (i.e., right skewed distribution) with occasional large counts. There is a relationship between the homogeneity of a species in a haul and between hauls, sample size, and the level of precision in the resulting estimate of species catch from sampling. In general, it is possible to have high precision in the catch estimate for common (target species) with very small samples of the haul. Conversely, even extremely large samples of a haul provide relatively imprecise estimates of catch for rare and clustered species, such as Chinook salmon.

Gear handling methods, vessel layout, and the associated safety concerns can restrict an observer's access to unsorted catch at sea. Therefore, catch sampling and PSC estimation procedures differ among the GOA trawl fisheries.

PSC estimation on non-Rockfish Program CVs

CVs using trawl gear to fish for non-pollock groundfish species sort their catch extensively at sea. Sorting at sea is a critical attribute associated with the fishery due to a larger amount of unmarketable bycatch. Vessels frequently have conveyor systems on deck to facilitate sorting of uneconomical species and non-salmon PSC that must be discarded at sea. If vessels do not have a sorting conveyor then they often sort directly from the trawl alley. Observers collect species composition samples prior to any sorting of catch by the fishing crew. Because a large amount of sorting occurs at sea and the observers are unable to monitor this sorting while engaged in other sampling duties, it is impossible to verify that no salmon PSC have been discarded at sea. Because of the extensive sorting for bycatch at sea, there is a high likelihood that salmon PSC has been sorted from the catch prior to delivery, be it intentional or unintentional. Relying on offload counts (often referred to as "census") of salmon for PSC estimation is not reliable in these fisheries because of the amount of sorting that occurs at sea. As a result, unlike CVs targeting pollock, PSC estimates from GOA non-pollock trawl CVs are all derived from at-sea samples.

Chinook estimates on observed trips are specific to the observed vessels' data, while unobserved vessels receive Chinook PSC rates that may be averaged across multiple vessels and trips. Therefore, salmon PSC information from multiple observed vessels is averaged into the PSC rates that are applied to unobserved fishing activity. From a NMFS inseason management perspective, the Chinook PSC rates for unobserved vessels are continually revised on a rolling basis as additional observer information is obtained. The temporal variation in Chinook salmon PSC estimates contributes to management uncertainty. This uncertainty complicates management of salmon PSC limits because rates can change from day-to-day as new observer information is used for estimation. The catch estimation methods are designed to provide an estimate of catch, bycatch, and PSC as quickly as possible so that inseason managers have information to make decisions. However, this estimation method results in Chinook PSC estimates that are imprecise relative to catch limits at a given point in time. For GOA trawl CVs, it may take anywhere from a few days to over a week for NMFS to receive preliminary observer data. After deployment in the field,

[29] In some cases, an observer is unable to sample all the hauls during a trip and is instructed to use a random break table. This could be a result of observer illness or injury, or rough weather preventing the observer from completing his or her duties.

observers review their data with FMA Division staff and ensure that data were collected following NMFS protocols. It is normal for data modifications to occur during this debriefing and quality control process. For those reasons, Chinook PSC estimates can change after the fishery is closed as the observer data are finalized in late February to early March of the year following the fishery.

PSC estimation on Rockfish Program CVs

The observer sampling protocol aboard CVs in the Central GOA Rockfish Program is the same as in other non-pollock trawl CV fisheries. However, 100% observer coverage is required so that the vessels in a rockfish cooperative obtain a vessel-specific halibut PSC rate to support transferable halibut PSC allocations. Observers collect species composition samples at sea prior to any sorting of the catch by the vessel's crew. Since the majority of species caught in the Rockfish Program fishery are allocated and full retention of allocated species is required, sorting at sea is limited to the species that must be discarded. Those species include non-salmon PSC and other prohibited species (e.g., lingcod during certain times of the year).

PSC estimates from Rockfish Program CVs are derived from at-sea samples. On observed vessels, the estimates of the Chinook PSC are specific to the observed vessel's data. The observer samples are extrapolated to the haul and the amount of Chinook PSC in the sampled hauls is used to calculate a vessel-specific PSC rate for the trip. Therefore, within the Rockfish Program, extrapolation of observers' PSC estimates occurs only within hauls on a trip, and not from one Rockfish Program vessel to another. Shoreside processors in the Central GOA that receive catch from Rockfish Program vessels are required to operate under a Catch Monitoring and Control Plan (CMCP) that details how the processing plant will ensure that all delivered catch is sorted and weighed within view of a CMCP specialist. The CMCP specialist is a NMFS employee who monitors portions of the offload. The role of the CMCP specialist is not to conduct observer sampling. The CMCP specialist ensures that the processor is following their CMCP and provides feedback to the processors to improve sorting, weighing, and reporting of delivered species.

PSC Sampling and Estimation Summary

The observer sampling and PSC estimation procedures that are currently in place for the GOA non-pollock trawl CV fisheries represent the best available information on Chinook salmon encounters. These procedures have been developed through the iterative process of program restructuring and annual ADPs. Nevertheless, challenges remain when estimating bycatch of a rare species such as Chinook salmon in fisheries where offload counts are not feasible and not every haul (Rockfish Program) or trip (non-Rockfish Program) is sampled. A fundamental point to understanding the PSC estimation strategy is that the extrapolation from "sampled Chinook" to "estimated PSC" represents contemporaneous activity that is occurring on unsampled hauls or unobserved trips. For example, estimation for a fleet with only one active vessel (observed) would not require extrapolation beyond the sample to the haul (if not censused) to capture unobserved activity. By comparison, a fleet with one observed vessel and many unobserved vessels active requires rate-based extrapolation of sampled PSC from the observed vessel to the other vessels. The amount of "extrapolated Chinook" depends on both the number of active unobserved vessels and the prevailing PSC rate at the time. If the fleet is operating in an environment of high observed PSC rates, expansion will result in a higher estimated PSC total. When a few Chinook salmon in an observer's sample result in dozens of estimated PSC, it is likely the case that other vessels of a similar type and in a similar area are fishing without observer coverage. If the rate that is used to estimate total PSC is revised downward as new representative observer data become available, the CAS retroactively adjusts the total PSC estimate.

As with any sampling and estimation strategy, PSC estimation becomes more precise when more samples are available in the time and space that reflects the activity of unobserved vessels. The amount of observer data can increase with time as more observed trips occur. While the number of available observer-days (i.e. funding) is an external constraint, the CAS and inseason managers utilize additional information by continually revising the applied PSC rate as more debriefed observer data become available. In short, the PSC estimation strategy is, by necessity, designed in a way that provides robust estimates, – but can display high variability when there are few samples and/or high heterogeneity in chinook catch within and between observed trips. This reality creates a management challenge in the context of PSC hard caps that have immediate effect.

It is important to distinguish between volatility in PSC estimates that occurs within a year and the variability in annual PSC that is evident in Table 74. The imprecision of PSC estimates over the shortest of in-season time scales is an artifact of methodology; that imprecision is expected to attenuate as more observer data are collected, resulting in improved estimates of total annual PSC. The seasonal or annual PSC estimates rely on the probability theory called the “law of large numbers,” where the results obtained from a number of “trials” (trip-level estimates) grow closer to the expected true value as more trials are performed. The variation in total annual PSC from one year to the next reflects yearly estimates of chinook that are more robust estimates of Chinook salmon encountered by the fleet when compared with inseason information. The signal associated with annual differences has less noise than the inseason estimates and are more likely to show differences in environmental factors including, but not limited to, Chinook salmon abundance in the times and areas that the GOA trawl fleet operates; and/or changes in fleet dynamics (e.g., amount of groundfish harvested). This document includes the best available information on Chinook salmon abundance and correlation to annual PSC levels in Section 3.3.3.3.

4.5.1.2 In-Season Management

The GOA non-pollock non-Rockfish Program trawl fisheries can be high-pulse fisheries; this is particularly true of the Pacific cod fishery, which has limited seasonal allocations. The competitive nature of limited access fisheries can induce the fleet to fish at a concentrated time if seasonal or annual TAC and PSC allocations are constraining. NMFS generally makes inseason management decisions about whether to open or close fisheries based on weekly catch reports and available observer data. Prior to a fishery opening, NMFS contacts processors that have historically participated in the fishery to calculate expected effort. NMFS then queries historical catch rates based on that effort and projects a range of possible catch rates. To account for uncertainty and to be conservative, estimated catch is calculated using historical maximum catch rates and the most recent information. NMFS then projects a closure date and makes a decision whether to announce a closure prior to the opening of the season or to manage inseason. Managing inseason is defined as allowing the fishery to open with no closure date announced, collecting information while the fishery is ongoing, and using that information to project a closure date.

The decision to manage inseason is made if the allocation of groundfish or remaining PSC is large enough to allow NMFS the time to assess the catch rates and close the fishery before the allocation is exceeded. The weekday that the fishery opens must also be taken into account. To close a fishery, NMFS processes the required paperwork at least one working day before the closure. A closure notice is required to be published in the *Federal Register,* which is open Monday through Friday; therefore, closures for Friday, Saturday, or Sunday must be decided before Friday.

When projecting a closure date, there is a risk that the fleet will not harvest the entire directed fishing allowance in which case the fishery may need to reopen. To reopen the fishery, NMFS has to ensure that all catch information has been reported and that there is enough remaining directed fishing allowance to reopen the fishery. NMFS usually has enough information to make a decision approximately three to five days after the closure. NMFS will then calculate catch rates, determine why the allocation was not fully harvested, and examine other factors (such as weather, participation) before determining if a fishery needs to reopen. If a fishery reopens then NMFS must then go through the same protocol and associated timeline discussed above for issuing a closure. To ensure the fleet has prior notice and is available to participate, NMFS will typically reopen a fishery about four days after the day it is announced. There is usually about a week between the closure and the subsequent reopening.

In general, the degree to which a seasonal or annual allocation requires inseason management is inversely related to the size of the allocation. Smaller the catch limits or lower PSC limits require more intensive management to ensure that a limit is not exceeded. The timeliness of getting observer data to manage a partially observed fleet from week-to-week or day-to-day is challenging. That factor, coupled with high variance in the estimates of rare PSC species such as Chinook salmon, sometimes means that inseason managers must take a conservative approach.

GOA Groundfish FMP Amendment 103, implemented in 2017, provided inseason managers with additional flexibility to keep fisheries open when a sector is constrained by a low remaining Chinook PSC limit and effort or PSC rates display variance or uncertainty. Amendment 103 allows managers to reapportion Chinook salmon PSC limits between GOA trawl sectors based on need and availability, helping the Agency to maximize benefits from the fishery. As noted in Section 1.2, NMFS has used this tool one time since its implementation, moving 404 Chinook PSC from the Central GOA pollock trawl sector to the Western GOA pollock trawl sector on November 15, 2017. NMFS works closely with each sector before issuing reapportionments to understand the need for PSC during the period remaining in the year. Before making an inseason reapportionment, NMFS goes through the following steps:

1. NMFS determines that a sector's PSC limit has been reached or is projected to be reached;
2. If sufficient PSC is not available for reapportionment from another sector, close the sector;
3. If PSC limit is available from another sector, proceed with reapportionment (Step #4);
4. Review current effort (# of vessels, rate of PSC, amount of groundfish in the sector that reached its PSC limit ("limited sector");
5. Project future effort in the limited sector based on and on discussions with the fleet;
6. Review current effort (# of vessels, rate of PSC, amount of groundfish TAC remaining in the sector with projected excess PSC ("reapportion sector");
7. Project future effort in the reapportion sector based on both historical effort and discussions with the fleet;
8. Issue a reapportionment by writing and processing an Inseason Action.

While the Amendment 103 reapportionment action provides NMFS with an important tool to respond to variability within the fishery and the environment, the agency notes that PSC management within the GOA trawl CV sector can be particularly complicated for the following reasons:

- Chinook PSC is highly variable by fisheries and year, and it is thus difficult to project future PSC rates based on rates in the current or prior year;
- The GOA trawl CV sector encompasses various fisheries with many different rates (nine non-pelagic trawl gear target fisheries and six pelagic trawl gear target fisheries);
- Trawl CVs vary in their dependence upon different target fisheries, and may not uniformly favor reapportionments;
- TAC levels may increase or decrease from year to year, which can change the amount of PSC that may be necessary to permit harvest of the available TAC;
- The GOA limited access trawl fleet may have difficulty organizing to avoid or limit Chinook salmon PSC after a reapportionment has occurred, thus, limiting NMFS's confidence in PSC rate projections for a reopening under a low remaining limit.

When the Council was first considering non-pollock trawl Chinook salmon PSC limits under Amendment 97, NMFS advised that—given the timeliness of fishery data and the high variance in Chinook PSC rates—hard caps that are lower than the highest historical weekly PSC amount are a proxy for what is difficult to manage inseason. Section 5.2.1.1 of the Amendment 97 analysis placed that number at roughly 1,500 Chinook salmon for the Central GOA non-pollock trawl CV sector, and 100 Chinook salmon for the Western GOA. Those figures represent the historical period from 2003 through 2011. The data available for the Western GOA critically do not reflect the direct observer coverage of the segment of that area's trawl CV fleet that is smaller than 60' LOA—roughly 75% of the typical fleet.

During the time period from 2007 through 2017, there were 444 weeks during which the Catch Accounting System recorded Chinook salmon PSC in the GOA non-pollock non-Rockfish Program CV trawl fishery. In the Central GOA, the largest amount of Chinook PSC estimated for a week was 1,302 fish. Of those 444 weeks, 100 or fewer Chinook salmon were estimated during 281 weeks. Estimates of 500 or more Chinook salmon occurred in only 15 weeks. Those high-Chinook events were concentrated in April and October. Most of these PSC pulses occurred in flatfish target fisheries, though three were recorded during the Pacific cod B season (October). The largest amount of Chinook PSC estimated during one week in the Western GOA was 920 fish. However, only eight weeks recorded more than 100 estimated Chinook PSC and only three weeks were greater than 200. Each of these high-Chinook events occurred during the Pacific cod A season.

Catch share programs that apportion Chinook PSC limits to entities, such as the Rockfish Program cooperatives (in aggregate), give participants more specific control over their fisheries. Rockfish Program cooperatives have a greater ability to manage the effort of their fleet, and incentives to change fishing behavior to minimize Chinook PSC in real-time do not come at an individual cost to a vessel operator. As a result, the management approach required for a catch share program does not have to be as conservative because inseason managers can consult with the fleet to make effort projections with greater precision.

Since 2007, Chinook salmon PSC has been recorded within the Rockfish Program during 262 weeks. Fewer than 100 Chinook salmon were estimated during 196 of those weeks, and fewer than 200 were estimated during 233 of those weeks. The highest estimated PSC in a given week was 899 Chinook. Only four weeks had an estimated PSC of 500 or more Chinook.

4.5.1.2.1 Voluntary Cooperative Fleet Management

Industry and NMFS have worked together to meet management challenges within the limited access CV trawl fisheries, particularly in regards to fishing under constraining PSC limits. In some cases, the fleet has developed short-term voluntary catch sharing agreements so that inseason managers can open or reopen a fishery with a reduces risk of exceeding catch or bycatch limits. These agreements tend to occur within a management area (Central GOA or Western GOA) and have been more common in the Central GOA where fleet managers can sometimes leverage relationships that exist through other cooperative structures, such as the Rockfish Program. Even in the Central GOA, however, voluntary agreements can be tenuous, and are costly to transact under the best of circumstances. Central GOA fleet managers report that developing an agreement for a single pollock season has taken as many as nine pre-season meetings. In some cases, an agreement is not reached at all; in other cases, special considerations are necessary to accommodate hold-outs.

Voluntary catch sharing agreements have been most widely used in the Central GOA trawl pollock fishery. Table 55 shows the voluntary catch share plans for Areas 620 and 630, by season, for the years 2010 through 2016. "CSP" denotes 100% agreement by the trawl fleet to manage effort and the timing of fishing by internally allocating the pollock TAC. "Race" denotes the lack of an agreement, and a competitive open access style fishery among LLP holders with Central GOA trawl endorsements. Some CSPs were developed by the fleet amidst concern about Chinook PSC closing the fishery, which is of greatest concern during the fall seasons (C and D seasons) when salmon bycatch rates are the highest. Moreover, annual PSC hard caps close a fishery after a cumulative limit is reached; that event is obviously more likely later in the year after more cumulative fishing time has occurred. Annual GOA pollock TACs have been high in recent years (2014 through 2017) relative to the preceding decade, so there are more fish to catch under a static Chinook PSC limit.[30] Moreover, in recent years the seasonal apportionment of the GOA pollock TAC has shifted more pollock into the fall seasons, reflecting the best scientific estimates of seasonal biomass distribution. In some years the fleet agreed to a CSP during the A/B seasons in order to bank salmon PSC for the fall when it is most needed. CSPs have also been developed during times when the remaining pollock TAC is small, and NMFS would otherwise be unable to open the fishery because the 24-hour harvesting capacity of the fleet exceeds the remaining available quota; that type of agreement typically occurs in the A/B season in Area 630. Finally, Central GOA pollock CSPs also develop due to market factors, sometimes allowing the fleet to work with processors to manage plant capacity at the end of the summer when the commercial salmon fishery overlaps the pollock C season or allowing plants and vessels to harmonize delivery schedules and catch composition (all pollock, or a mix of pollock and other groundfish) to increase the profitability of trips by producing higher-value product forms. In some cases, vessels agree to take fewer trips if they can receive a higher dock price.

Organizing voluntary agreements requires trust within the fleet, between the fleet and NMFS, and in AGDB who monitors compliance with the agreements to the extent possible; individuals do not always comply fully with the fleet's voluntary agreement. The four biggest hurdles for developing voluntary CSPs are: (1) how to allocate the fish; (2) how to develop a closed class of participants for the fishery when "new" vessels with latent LLPs can enter the fishery; (3) how to set and meet bycatch objectives; and (4) how to get 100% consensus from the participants. Building structure around each of these provisions creates opportunities for gaming the system.

Voluntary agreements, when executed have used the following tools to minimize Chinook PSC: individual vessel allocations of Chinook PSC based on internal pollock allocations; individual vessel accountability measures for poor bycatch performance; mandatory stand-downs for other vessels within the voluntary cooperative when internal PSC limits are exceeded; trip-level self-monitoring using processors' fish ticket information; and Chinook hot spot reporting based on self-reported PSC rates. Fleet managers have noted that not all vessels file timely hot spot reports, and there is no consequence for non-reporting or authority to prevent other vessels from fishing in ad hoc hot spots.

[30] GOA groundfish TAC summary, 1986 through 2018:
https://alaskafisheries.noaa.gov/sites/default/files/GOA_harvest%20specs_1986-2018.pdf

Table 55 Voluntary catch sharing agreements (CSP) in the Central GOA pollock trawl fishery, 2010 through 2016

Year	Regulatory Area 630			
Season	A	B	C	D
2016	Race	Race	CSP	CSP
2015	CSP	CSP	CSP	CSP
2014	CSP	CSP	CSP	CSP
2013	CSP	CSP	CSP	Race/CSP
2012	CSP	CSP	CSP	CSP
2011	CSP	CSP	CSP	CSP
2010	Race/CSP	CSP	Race	Race/CSP

Year	Regulatory Area 620			
Season	A	B	C	D
2016	Race	Race	CSP	Race
2015	CSP	CSP	CSP	CSP
2014	CSP	CSP	CSP	CSP
2013	Race	Race	CSP	Race/CSP
2012	Race	Race	CSP	CSP
2011	Race	Race	CSP	CSP
2010	Race	Race	Race	Race

Source: Alaska Groundfish Data Bank (personal communication, 2016)

Voluntary catch sharing agreements have occasionally been attempted during the Central GOA Pacific cod trawl B season when bycatch rates tend to be higher compared to the A season, and cod are less aggregated (the Western GOA CV sector does not prosecute a directed Pacific cod fishery during the B season). Low catch per unit effort—sometimes coinciding with low TACs—increases the chance that bycatch caps will be reached and makes it more difficult for NMFS to keep the fishery open. From 2006 through 2012, the Central GOA fleet coordinated “pulse” openings that were sometimes as short as 12 hours due to halibut bycatch constraints. Since 2013, vessels have reported their real-time halibut and Chinook salmon PSC rates to a fleet manager who shares that information with other vessels and, coordinates with NMFS inseason managers. The Central GOA Pacific cod trawl CV fleet executed voluntary CSPs in the 2010, 2011, and 2012 B seasons, but have not done so since. The 2010 agreement was developed in response to a low seasonal TAC, and the 2011 and 2012 agreements were necessitated by low halibut PSC availability after September 1. In some cases, the fleet voluntarily separated itself into subsets of vessels that took turns fishing so that projected effort and expected halibut PSC would not exceed the level at which NMFS could open the fishery.

No voluntary CSPs or fleet management measures have been implemented in GOA flatfish fisheries. However, observed vessel PSC rates are posted on the NMFS website and circulated among the fleets by their trade group representatives and processors in the form of weekly updates.

4.5.2 Participation and Harvest

4.5.2.1 LLP Licenses and Vessel Counts

Table 56 summarizes the GOA LLP licenses that have a trawl endorsement. While not all eligible LLPs are active in the GOA trawl fishery, this table establishes the limit of how many vessels could potentially participate in the fisheries affected by this action. There are 152 GOA groundfish LLP licenses with a trawl endorsement; most of those licenses (124) have a CV endorsement. The table further breaks down the licenses by whether the trawl endorsement is for the Central GOA, Western GOA, or both. The table also show whether the license is endorsed for trawl gear only or both trawl and non-trawl gear.

Table 56 CV and CP LLP licenses issued with a GOA trawl endorsement

License	Area	Trawl only	Trawl and non/trawl	Total
CV	CG & WG	17	34	51
	CG only	14	32	46
	WG only	7	20	27
	Total	**38**	**86**	**124**
CP	CG & WG	11	2	13
	CG only	6	2	8
	WG only	7	0	7
	Total	**24**	**4**	**28**
All	CG & WG	28	36	64
	CG only	20	34	54
	WG only	14	20	34
	Total	**62**	**90**	**152**

Source: NMFS RAM division

Table 57 is a matrix of the endorsements associated with the 124 GOA CV trawl licenses. This table shows the broader suite of endorsements associated with the CV licenses. For example, the table shows that the 97 licenses with a CG trawl endorsement also contain 37 Bering Sea trawl endorsements and four Aleutian Islands trawl endorsements. Six of those 97 licenses also have a CG Pacific cod pot endorsement and 17 are endorsed to fish Pacific cod with pot gear in the WG. Similar information is provided for the Pacific cod endorsed license for other areas and gear types.

Forty-six CV LLP license are allocated quota for the primary species in the Central GOA Rockfish Program. Those LLPs are associated with 43 unique vessels, which fish in seven different cooperatives. Cooperate membership ranges in size from 2 vessels (2 LLPs) to a cooperative with 11 vessels (12 LLPs). Of the 43 vessels that are associated with Rockfish Program LLPs, typically between 25 and 28 vessels actively harvest cooperative quota in a given year. CVs that actively participate in the Rockfish Program generally tend to fish in the GOA non-Rockfish Program trawl fisheries during the latter months of the year, when Chinook salmon PSC limits are most likely to constrain the fishery. On average, 87% of active RP CVs in a given year participate in non-pollock non-Rockfish Program GOA trawl fisheries after October 1, which is the date on which NMFS is able to reallocate a portion of unused Chinook salmon PSC from the Rockfish Program to other GOA trawl fisheries. Those vessels tend to focus on Pacific cod and shallow water flatfish during the latter months of the fishing year, as fits the general pattern of effort in the fishery (see Section 4.5.2). The significance of this percentage is that Rockfish Program CVs as a group have a stake in ensuring that Chinook salmon PSC is available throughout the year for the non-Rockfish Program fishery, and thus have an incentive to conserve PSC throughout the year. No vessels harvest GOA groundfish *only* after October 1.

Table 57 Endorsements associated with the 124 GOA CV trawl endorsed LLPs

	AI_TRW	BS_TRW	CG_TRW	WG_TRW	AI_CV_PCOD_HAL	AI_CV_PCOD_POT	BS_CV_PCOD_HAL	BS_CV_PCOD_POT	CG_CV_PCOD_HAL	CG_CV_PCOD_POT	CG_CV_PCOD_JIG	WG_CV_PCOD_HAL	WG_CV_PCOD_POT	WG_CV_PCOD_JIG
AI_TRW	8	7	4	5	1	0	0	0	1	0	0	0	0	0
BS_TRW	7	47	37	31	0	0	0	0	0	1	0	0	2	0
CG_TRW	4	37	97	51	0	0	0	0	0	6	0	0	17	0
WG_TRW	5	31	51	78	1	0	0	1	2	3	0	0	30	1
AI_CV_PCOD_HAL	1	0	0	1	1	0	0	0	1	0	0	0	0	0
AI_CV_PCOD_POT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BS_CV_PCOD_HAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BS_CV_PCOD_POT	0	0	0	1	0	0	0	1	0	0	0	0	1	0
CG_CV_PCOD_HAL	1	0	0	2	1	0	0	0	2	0	0	0	1	0
CG_CV_PCOD_POT	0	1	6	3	0	0	0	0	0	7	0	0	1	0
CG_CV_PCOD_JIG	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WG_CV_PCOD_HAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WG_CV_PCOD_POT	0	2	17	30	0	0	0	1	1	1	0	0	31	1
WG_CV_PCOD_JIG	0	0	0	1	0	0	0	0	0	0	0	0	1	1

Source: NMFS RAM division

From 2007 through 2017, a total of 91 unique trawl CVs harvested non-pollock groundfish in the GOA limited access fishery. One hundred trawl CVs participated in the fishery during the 2003 through 2011 period that was analyzed for Amendment 97, reflecting a modest contraction in the overall size of the fleet. Seventy vessels trawled for non-pollock species in the Central GOA from 2007 through 2017, and 45 vessels trawled in the Western GOA during that period. Twenty-four CVs were active in both GOA areas for which there are Chinook salmon PSC limits. Table 58 provides a total vessel count for the 2007 through 2017 GOA non-pollock trawl CV fleet, broken out by area fished and participation in the Rockfish Program, the GOA pollock fishery, and groundfish trawl fisheries in the BSAI FMP area. Total fleet size has trended downwards but appears stable, noting that as many as 71 CVs were active in the fishery in 2003. Active participation in the Central GOA Rockfish Program has remained fairly stable as cooperatives have been able to allocate their available quota among an efficient number of harvesters. For the years shown in Table 58, an average of 24 CVs have remained active in the fishery after October 1. The number of active vessels during the latter portion of the fishing year peaked at 33 CVs in 2011, but was as low as 14 and 15, respectively, in 2013 and 2016. That subset of the fleet reflects the vessels that would be most impacted by fishery closures that occur as a result of volatility around the existing Chinook salmon PSC limits and the amount and time-distribution of PSC that the fleet accumulates in a typical year. Information about the time distribution of Chinook salmon PSC is provided in Section 4.5.3.3.

Table 58 Active trawl CVs in the GOA non-pollock trawl fishery, 2007 through 2017

	GOA Non-Pollock					
Year	Total	CGOA	WGOA	CGOA RP	GOA Pollock	BSAI Trawl
2007	**63**	37	28	27	50	28
2008	**65**	41	24	27	53	26
2009	**59**	34	25	26	50	22
2010	**52**	38	15	27	48	23
2011	**53**	42	12	25	47	27
2012	**61**	48	23	28	59	28
2013	**58**	49	23	29	53	21
2014	**58**	51	24	28	57	17
2015	**57**	39	23	28	51	16
2016	**56**	36	22	27	54	16
2017	**56**	36	28	25	53	22

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT and AFSC Gross Revenue Procedure compiled by AKFIN

4.5.2.2 TAC Allocation and Utilization

Annual catch limits (TAC) for GOA groundfish and Rockfish Program species are published on the NMFS Alaska Region website, at https://alaskafisheries.noaa.gov/harvest-specifications. An annually updated summary table that provides GOA groundfish OFLs, ABCs, and TACs from 1986 through 2018 is available at https://alaskafisheries.noaa.gov/sites/default/files/GOA_harvest%20specs_1986-2018.pdf. Table 59 excerpts ABC and TAC levels from recent years for species that are targeted in the GOA non-pollock trawl CV fishery and primary or key secondary Rockfish Program species.

Table 60 illustrates the trend in GOA groundfish TAC levels from 2012 through 2018. In that table, 100% represents the 2012 GOA-wide TAC level; values greater than 100% represent an increase and values less than 100% represent a decrease. The most notable trend is the recent and projected decline in GOA Pacific cod TAC levels. The GOA Pacific cod TAC is reduced by 80% in 2018 compared to 2017; the reduction for the Central and Western GOA trawl CV sectors is 82% and 77%, respectively. According to a notice published on the NPFMC website in December 2017, the most likely cause of the decrease in Pacific cod biomass is a warm water mass in the Pacific Ocean that persisted from 2014 through 2016, increasing fish metabolism and reducing available food; low Pacific cod TACs are expected to persist for at least the near-term future.[31] Sablefish ABC and TAC are slightly lower in 2018 relative to 2012 levels, but the most current Groundfish SAFE report projects a significant 41% uptick in ABC from 2018 to 2019, from 11,505 mt to 16,194 mt.[32] While Table 60 shows that arrowtooth flounder TAC decreased in 2018 relative to 2012, it should be noted that the 2012 TAC was a large step up from previous levels; GOA arrowtooth TAC was less than 50,000 mt from 2003 through 2011. The 2012 increase in arrowtooth TAC reflected the development of a viable target market for arrowtooth and the possibility of exceeding a quota that had been set much lower than ABC due to a previous lack of market interest and as a means to slow a fishery that can have high rates of halibut PSC. Less than 50% of the arrowtooth TAC—and more often on the order of 25%—was taken during the time from 2012 through 2017 when Central GOA arrowtooth TAC was set at 75,000 mt.

Though not directly affected by this action, it is worth noting that GOA pollock TACs had been on a steady and marked increase from a low of 49,900 mt in 2009 to a peak of 257,872 mt in 2016. GOA pollock TAC decreased to 208,595 mt in 2017 and again to 166,228 mt in 2018; pollock TAC is expected to fall further in the GOA SAFE TAC projections for 2019. The pollock fishery is connected to this action

[31] http://npfmc.legistar.com/gateway.aspx?M=F&ID=8ed82d4e-449c-468d-9e3a-22e5bd706a83.pdf
[32] Sablefish SAFE chapter, p.332: https://www.afsc.noaa.gov/REFM/Docs/2017/GOAsablefish.pdf

as GOA non-pollock trawl CV harvesters and processors also rely on pollock as a significant source of revenue (Table 69). Moreover, the 25,000 Chinook salmon PSC that are apportioned to the GOA pollock trawl fishery can be reallocated to non-pollock fisheries by inseason managers if there is a need and the PSC is not projected to be used in the pollock fishery. Even at high TAC levels, pollock has a fairly high utilization rate, particularly in Areas 630 and 610 (90% or above in recent years). Lower TAC does not necessarily correspond to lower Chinook PSC; however, if the GOA pollock fishery is able to harvest a lower TAC quickly and efficiently, it could provide a source of Chinook PSC that can be reallocated in-season during years of need in the non-pollock CV sector.

Table 59 ABC and TAC for selected GOA non-pollock groundfish species, 2012 through 2018

Species		2012		2013		2014		2015		2016		2017		2018	
	Area	ABC	TAC	ABC	TAC	ABC	TAC	ABC	TAC	ABC	TAC	ABC	TAC	ABC	TAC
Pacific Cod	WG	28,032	21,024	28,280	21,210	32,745	22,922	38,702	27,091	40,503	28,352	36,291	25,404	8,082	5,657
	CG	56,940	42,705	49,288	36,966	53,100	39,825	61,320	45,990	49,312	36,984	44,180	33,135	8,118	6,089
	EG	2,628	1,971	3,232	2,424	2,655	1,991	2,828	2,121	8,785	6,589	7,871	5,903	1,800	1,350
	Total	**87,600**	**65,700**	**80,800**	**60,600**	**88,500**	**64,738**	**102,850**	**75,202**	**98,600**	**71,925**	**88,342**	**64,442**	**18,000**	**13,096**
Arrowtooth Flounder	WG	27,495	14,500	27,181	14,500	31,142	14,500	30,752	14,500	28,183	14,500	28,100	14,500	37,253	14,500
	CG	143,162	75,000	141,527	75,000	115,612	75,000	114,170	75,000	107,981	75,000	107,934	75,000	73,480	48,000
	EG	42,225	13,800	41,743	13,800	48,604	13,800	47,999	13,800	50,024	13,800	50,059	13,800	40,212	13,800
	Total	**212,882**	**103,300**	**210,451**	**103,300**	**195,358**	**103,300**	**192,921**	**103,300**	**186,188**	**103,300**	**186,093**	**103,300**	**150,945**	**76,300**
SWF	WG	21,994	13,250	19,489	13,250	20,376	13,250	22,074	13,250	20,851	13,250	20,921	13,250	25,206	13,250
	CG	22,910	18,000	20,168	18,000	17,813	17,813	19,297	19,297	19,242	19,242	19,306	19,306	25,315	25,315
	EG	5,779	5,779	5,827	5,827	2,616	2,616	2,834	2,834	4,271	4,271	4,287	4,287	4,167	4,167
	Total	**50,683**	**37,029**	**45,484**	**37,077**	**40,805**	**33,679**	**44,205**	**35,381**	**44,364**	**36,763**	**44,514**	**36,843**	**54,688**	**42,732**
DWF	WG	176	176	176	176	302	302	301	301	186	186	256	256	413	413
	CG	2,308	2,308	2,308	2,308	3,727	3,727	3,689	3,689	3,495	3,495	3,454	3,454	3,400	3,400
	EG	2,642	2,642	2,642	2,642	9,443	9,443	9,344	9,344	5,545	5,545	5,582	5,582	5,571	5,571
	Total	**5,126**	**5,126**	**5,126**	**5,126**	**13,472**	**13,472**	**13,334**	**13,334**	**9,226**	**9,226**	**9,292**	**9,292**	**9,384**	**9,384**
Rex Sole	WG	1,307	1,307	1,300	1,300	1,270	1,270	1,258	1,258	1,315	1,315	1,459	1,459	3,086	3,086
	CG	6,412	6,412	6,376	6,376	6,231	6,231	5,816	5,816	4,445	4,445	4,930	4,930	8,739	8,739
	EG	1,893	1,893	1,884	1,884	1,840	1,840	2,076	2,076	1,733	1,733	1,922	1,922	3,548	3,548
	Total	**9,612**	**9,612**	**9,560**	**9,560**	**9,341**	**9,341**	**9,150**	**9,150**	**7,493**	**7,493**	**8,311**	**8,311**	**15,373**	**15,373**
Flathead Sole	WG	15,300	8,650	15,729	8,650	12,730	8,650	12,767	8,650	11,027	8,650	11,098	8,650	12,690	8,650
	CG	25,838	15,400	26,563	15,400	24,805	15,400	24,876	15,400	20,211	15,400	20,339	15,400	20,238	15,400
	EG	6,269	6,269	6,446	6,446	3,696	3,696	3,706	3,706	3,782	3,782	3,806	3,806	2,338	2,338
	Total	**47,407**	**30,319**	**48,738**	**30,496**	**41,231**	**27,746**	**41,349**	**27,756**	**35,020**	**27,832**	**35,243**	**27,856**	**35,266**	**26,388**
Sablefish	WG	1,780	1,780	1,750	1,750	1,480	1,480	1,474	1,474	1,272	1,272	1,349	1,349	1,544	1,544
	CG	5,760	5,760	5,540	5,540	4,681	4,681	4,658	4,658	4,023	4,023	4,514	4,514	5,158	5,158
	EG	5,420	5,420	5,220	5,220	4,411	4,411	4,390	4,390	3,792	3,792	4,211	4,211	4,803	4,803
	Total	**12,960**	**12,960**	**12,510**	**12,510**	**10,572**	**10,572**	**10,522**	**10,522**	**9,087**	**9,087**	**10,074**	**10,074**	**11,505**	**11,505**
POP	WG	2,102	2,102	2,040	2,040	2,399	2,399	2,302	2,302	2,737	2,737	2,679	2,679	3,312	3,312
	CG	11,263	11,263	10,926	10,926	12,855	12,855	15,873	15,873	17,033	17,033	16,671	16,671	20,112	20,112
	EG	3,553	3,553	3,446	3,446	4,055	4,055	2,837	2,837	4,667	4,667	4,568	4,568	5,812	5,812
	Total	**16,918**	**16,918**	**16,412**	**16,412**	**19,309**	**19,309**	**21,012**	**21,012**	**24,437**	**24,437**	**23,918**	**23,918**	**29,236**	**29,236**
Northern Rockfish	WG	2,156	2,156	2,008	2,008	1,305	1,305	1,226	1,226	457	457	432	432	420	420
	CG	3,351	3,351	3,122	3,122	4,017	4,017	3,772	3,772	3,547	3,547	3,354	3,354	3,261	3,261
	EG	0	0	0	0	0	0	0	0	4	0	4	0	4	0
	Total	**5,507**	**5,507**	**5,130**	**5,130**	**5,322**	**5,322**	**4,998**	**4,998**	**4,004**	**4,004**	**3,790**	**3,786**	**3,685**	**3,681**
Dusky Rockfish	WG	409	409	377	377	317	317	296	296	173	173	158	158	146	146
	CG	3,849	3,849	3,533	3,533	3,584	3,584	3,336	3,336	4,147	4,147	3,786	3,786	3,502	3,502
	EG	860	860	790	790	1,585	1,585	1,477	1,477	366	366	334	334	309	309
	Total	**5,118**	**5,118**	**4,700**	**4,700**	**5,486**	**5,486**	**5,109**	**5,109**	**4,686**	**4,686**	**4,278**	**4,278**	**3,957**	**3,957**
Thornyhead Rockfish	WG	150	150	150	150	235	235	235	235	291	291	291	291	344	344
	CG	766	766	766	766	875	875	875	875	988	988	988	988	921	921
	EG	749	749	749	749	731	731	731	731	682	682	682	682	773	773
	Total	**1,665**	**1,665**	**1,665**	**1,665**	**1,841**	**1,841**	**1,841**	**1,841**	**1,961**	**1,961**	**1,961**	**1,961**	**2,038**	**2,038**

Source: https://alaskafisheries.noaa.gov/sites/default/files/GOA_harvest%20specs_1986-2018.pdf

EG = Eastern GOA (West Yakutat + Southeast Outside); SWF = Shallow-Water Flatfish; DWF = Deep-Water Flatfish; POP = Pacific Ocean Perch.

Table 60 Trend in GOA TAC, relative to 2012 level

Species	2012	2013	2014	2015	2016	2017	2018
Pacific Cod	100%	92%	99%	114%	109%	98%	20%
Northern Rock.	100%	93%	97%	91%	73%	69%	67%
Arrowtooth	100%	100%	100%	100%	100%	100%	74%
Dusky Rock.	100%	92%	107%	100%	92%	84%	77%
Flathead Sole	100%	101%	92%	92%	92%	92%	87%
Sablefish	100%	97%	82%	81%	70%	78%	89%
SWF	100%	100%	91%	96%	99%	99%	115%
Thornyhead Rock.	100%	100%	111%	111%	118%	118%	122%
Rex Sole	100%	99%	97%	95%	78%	86%	160%
POP	100%	97%	114%	124%	144%	141%	173%
DWF	100%	100%	263%	260%	180%	181%	183%

SWF = Shallow-Water Flatfish; DWF = Deep-Water Flatfish; POP = Pacific Ocean Perch.

The primary rockfish species in the Rockfish Program are Pacific ocean perch, northern rockfish, and dusky rockfish. Rockfish Program primary and secondary species allocations to cooperatives are publicly available in .csv format on the NMFS website.[33] ABC and TAC is specified for each species, which is apportioned to the GOA management areas (Western, Central, and Eastern) based on the distribution of survey biomass. The primary species TACs are further allocated in the Central GOA area to Rockfish Program CV and CP cooperatives. The Central GOA is apportioned 69.7% of the overall GOA ABC and TAC for Pacific ocean perch. The GOA TAC for 2018 is 29,236 mt, which is a 22% increase over 2017 and a 73% increase relative to 2012. Trawl vessels in the Rockfish Program typically target Pacific ocean perch first and then switch to northern and dusky rockfish. Pacific ocean perch has a higher value and substantially higher TAC relative to other rockfish species. Northern rockfish are targeted almost exclusively by trawl gear, and most of the Central GOA TAC is allocated to Rockfish Program cooperatives. The majority of the GOA harvest for northern rockfish occurs near Kodiak Island, with 88.5% of the ABC allocated to the Central GOA area. The GOA-wide northern rockfish stock has been stable or slightly declining since 2004. The TAC for 2018 is 3,681 mt in the GOA, a 2.8% decrease from 2017 and a 33% decrease relative to 2012. Trawl vessels in the Rockfish Program target dusky rockfish near Kodiak Island around the same time they target northern rockfish. Dusky rockfish is generally a bycatch species in hauls targeting northern rockfish. A large amount of the dusky rockfish TAC is unharvested due to fishery closures triggered by other species such as Pacific ocean perch. The GOA-wide dusky rockfish stock has been stable, with only a recent slight decline that began in 2015. The Central GOA receives 88.5% of the GOA ABC. The GOA-wide TAC for 2018 is 3,957 mt, which is a 7.5% decrease from 2017 and a 23% decrease relative to 2012.

The Rockfish Program secondary species include Pacific cod, sablefish, thornyhead rockfish, rougheye rockfish, and shortraker rockfish (shortraker and rougheye rockfish are allocated to Rockfish Program CP cooperatives, but not to CV cooperatives). Pacific cod are allocated by gear type in the GOA. Sablefish are primarily targeted by longline IFQ vessels in the GOA with a proportion of the overall TAC allocated to the Rockfish Program. The remaining three rockfish species are targeted by vessels using trawl gear. NMFS allocates Pacific cod TAC between gear type, operation type, and vessel length and the Rockfish Program is allocated 3.81% of the GOA TAC for the trawl sector. Sablefish is the most valuable species per pound in the Rockfish Program. NMFS allocates 80% of the Central GOA sablefish TAC to the fixed gear sector which is managed under an IFQ system. The remaining 20% of the TAC is allocated to the

[33] 2017 allocations can be found at https://alaskafisheries.noaa.gov/sites/default/files/reports/17rpallocations.xls

trawl sector. The Rockfish Program CV cooperatives are allocated 6.78% and the catcher/processor cooperatives are allocated 3.51% of the Central GOA sablefish TAC. The Central GOA is apportioned 50% of the GOA ABC for thornyhead rockfish. Rockfish Program CV and CP cooperatives receive 7.84% and 26.5% of the Central GOA TAC, respectively. The thornyhead rockfish biomass estimates have recently been stable in the GOA; the TAC for 2018 was 2,038 mt in the GOA, which is a 3.9% increase over 2017 and a 22% increase relative to 2012.

The final Rockfish Program harvest specifications table for 2018 is not yet officially available, but GOA and Central GOA TACs are shown in Table 59. The 2017 allocations were published in the Federal Register on February 27, 2017. Table 61 shows the quota allocations for CV cooperatives in 2017. In 2018, Rockfish Program CV quota is set to increase for Pacific ocean perch, sablefish, and thornyhead rockfish. Rockfish Program CV quota will decrease for Pacific cod, northern rockfish, and dusky rockfish.

Table 61 Rockfish Program 2017 catcher vessel allocations

Species		RP CV Quota	CGOA TAC
Primary	Pacific Ocean Perch	8,917	16,671
	Northern Rockfish	1,827	3,354
	Dusky Rockfish	2,171	3,786
Secondary	Pacific Cod	1,262	33,135
	Sablefish	306	4,514
	Thoryhead Rockfish	77	988

Table 62 shows total TAC utilization for the key targeted GOA groundfish species from 2012 through 2017. These data are taken from NMFS's annual catch reports, and thus are aggregating across multiple gear and operational types.[34] Sablefish is shown for trawl-only, which includes Rockfish Program catch and incidentally caught sablefish that are retained in the limited access trawl fisheries up to the maximum retainable amount (for most groundfish basis species, the maximum retainable amount for sablefish is 20% of the total fish onboard the vessels).[35] The GOA Pacific cod TAC is apportioned among gear and operational type sectors within each regulatory area, and then apportioned into A and B seasons such that 60% of total removals in each area occur during the A season (January through June 10) and 40% occur during the B season (September 1 through November 1 for trawl, and through December 31 for fixed-gear). Table 63 shows Pacific cod TAC utilization that is specific to each area and season that is affected by this action; Central GOA data does not include Pacific cod that is allocated to the Rockfish Program in the Central GOA. Rockfish Program TAC utilization is summarized in Table 64; those data are also derived from NMFS catch reports, which do not disaggregate CV and CP Rockfish Program cooperatives. Historical data on actual Rockfish Program CV catch is reported in Table 65. Table 64 reflects that Pacific ocean perch, which makes up the bulk of the allocation, and sablefish, which is the most valuable secondary species, are near fully harvested. Pacific cod is allocated to Rockfish Program cooperatives for incidental catch, and utilization of that TAC is variable but typically less than 50%.

[34] https://alaskafisheries.noaa.gov/fisheries-catch-landings
[35] Maximum retainable amounts for secondary species are defined in regulation at Table 10 to Part 679, available at https://alaskafisheries.noaa.gov/sites/default/files/tab10.pdf.

Table 62 TAC utilization of GOA groundfish species (all gear), 2012 through 2017

	2012		2013		2014		2015		2016		2017	
	CG	WG	CG	WG	CG	WG	CG	WG	CG	WG	CG	WG
Pacific Cod	87%	91%	87%	91%	101%	95%	79%	70%	65%	65%	51%	72%
Arrowtooth	28%	6%	28%	6%	46%	13%	25%	4%	25%	7%	35%	2%
SWF	30%	1%	30%	1%	25%	2%	16%	2%	19%	1%	12%	2%
DWF	9%	11%	9%	11%	7%	22%	5%	18%	6%	2%	7%	8%
Sablefish (TRW)	60%	4%	60%	4%	80%	21%	86%	15%	103%	18%	132%	24%
Flathead Sole	14%	7%	14%	7%	15%	3%	12%	2%	14%	3%	13%	1%
Rex Sole	57%	8%	57%	8%	55%	10%	32%	6%	35%	13%	29%	3%
POP	103%	22%	103%	22%	107%	87%	93%	89%	104%	97%	111%	100%
Northern Rock.	87%	108%	87%	108%	85%	65%	79%	80%	93%	26%	48%	54%
Dusky Rock.	83%	57%	83%	57%	79%	44%	78%	62%	78%	55%	65%	79%
Thornyhead Rock.	71%	203%	71%	203%	76%	104%	67%	99%	70%	71%	62%	53%

TRW = trawl. SWF = Shallow-Water Flatfish; DWF = Deep-Water Flatfish; POP = Pacific Ocean Perch.

Table 63 GOA Pacific cod trawl CV sector TAC utilization by season, 2012 through 2017

	Central GOA			Western GOA		
	A	B	Total	A	B	Total
2012	103%	32%	85%	100%	70%	99%
2013	107%	52%	92%	12%	73%	101%
2014	111%	42%	93%	106%	53%	98%
2015	84%	77%	82%	97%	8%	72%
2016	69%	28%	55%	96%	1%	70%
2017	69%	16%	43%	109%	1%	79%

Table 64 Central GOA Rockfish Program TAC utilization (CV plus CP), 2012 through 2017

	2012	2013	2014	2015	2016	2017
POP	99%	98%	100%	99%	100%	95%
Northern Rock.	96%	80%	83%	75%	95%	47%
Dusky Rock.	91%	80%	79%	76%	76%	62%
Pacific Cod	49%	35%	90%	45%	14%	4%
Sablefish	96%	95%	100%	95%	96%	92%
Thornyhead Rock.	32%	50%	63%	68%	87%	81%

TAC utilization for the period from 2003 through 2011 is detailed in Section 4.4.7 of the RIR that was prepared to analyze GOA Groundfish FMP Amendment 97. During that time period, the CV trawl TAC for Pacific cod ranged from 20,000 to 42,000 mt in the Central GOA, and from 14,000 to 23,000 mt in the Western GOA. At least 75% of the TAC was caught in each area and year, including TAC closures in five of the nine years from 2003 through 2011. As noted above, arrowtooth flounder TACs were met or exceeded when they were set at low levels, but TAC utilization dropped to below 50% when the TAC was increased in 2012. Shallow water flatfish TAC was typically harvested at less than 50% in the Central GOA, and utilization did not exceed 17% in the Western GOA. Utilization of flathead sole TAC was similarly low across the GOA. Central GOA flathead sole harvest did not exceed 70% of the TAC, and no more than 41% of the Western GOA TAC was taken in any single year. Rex sole fisheries did not exceed 70% of the available TAC in either regulatory area of the GOA and were typically below 50% of the allowed harvest. Directed and secondary rockfish species that are targeted in the Rockfish Program were generally well utilized during the period spanning the 2008 implementation of the pilot program to 2011. The Central GOA Pacific ocean perch harvest level was never less than 94% of the available TAC and northern rockfish harvest ranged from 74% to 89%, while pelagic shelf rockfish was less fully utilized but topped 75% harvest during two of the years under the pilot program.

In general, GOA non-pollock groundfish TACs are not fully harvested. The amount of groundfish harvested is most often constrained by PSC limits for halibut or, in some cases, Chinook salmon. Low utilization of flatfish TACs is also a function of market demand, as some vessels and processors find it uneconomical to stay active in a lower-value fishery outside of the focal seasons of A season cod, A/B season pollock, summer salmon seining, B season cod, and C/D season pollock. Pacific cod TACs might not be fully harvested if fish aggregation does not align with the timing of the fishery. Low aggregation and undeveloped markets for Pacific cod in the Western GOA B season result in most of that TAC going unharvested or reallocated to other gear sectors in-season.

4.5.2.3 Historical Catch and Value

Table 65 and Table 66 report GOA trawl CV harvest and ex-vessel revenue of non-pollock groundfish species. Catch data is reported from 2007 through 2017; at the time of this report's preparation, revenue data for 2017 is not yet available.

The Central GOA non-pollock non-Rockfish Program CV fishery recorded an average annual harvest of roughly 28,000 mt, with an ex-vessel value around $13 million; catch and nominal value levels have displayed a decline relative to the period average since 2015. Thirty-five percent of the sector's non-pollock harvest and 51% of its ex-vessel value was derived from trips targeting Pacific cod, which portends a decrease in expected revenues beginning in 2018 as the GOA Pacific cod TAC has been reduced by roughly 80% relative to 2017 (Table 59). Roughly 70% of Pacific cod revenues for the Central GOA non-Rockfish Program fleet occur in the A season, and 30% occur in the B season. The non-pollock fishery makes up a smaller portion of total GOA trawl groundfish catch, relative to pollock. From 2007 through 2017, pollock harvest accounted for 73% of total weight landed (and 63% of ex-vessel revenues through 2016)

Rockfish Program CVs harvested an average of roughly 11,000 mt within the program, with a nominal average ex-vessel value around $6 million. Harvest and nominal value for the sector have remained fairly stable and higher than the period average since 2014, largely due to an increase in biomass and TAC for Central GOA Pacific ocean perch. The average monthly distribution of that harvest and revenue activity is shown in Table 68, below.

The Western GOA non-pollock trawl CV fishery is essentially a Pacific cod fishery that is prosecuted in the A season (typically January 20 through March), leaving the sector relatively exposed to projected near-term declines in Pacific cod TAC. In recent years, the Western GOA sector has harvested around 7,000 mt of non-pollock groundfish, worth a nominal ex-vessel value of $3 million to $4 million dollars. Similar to the Central GOA non-Rockfish Program CV sector, non-pollock harvest is small relative to the pollock fishery. The pollock fishery accounted for 84% of total trawl groundfish landed from 2007 through 2017 (and 69% of ex-vessel revenues through 2016).

Table 65 Harvest of non-pollock groundfish (mt) by GOA trawl CVs, 2007 through 2017

	CGOA CV			WGOA CV	GOA Total
Year	Non-RP	RP	CG Total		
2007	28,916	9,261	38,177	4,316	42,493
2008	37,731	8,797	46,528	4,685	51,213
2009	31,583	8,697	40,280	1,804	42,085
2010	34,587	10,108	44,694	1,833	46,528
2011	31,916	8,772	40,688	2,099	42,787
2012	24,684	11,966	36,651	5,662	42,313
2013	29,314	10,324	39,639	5,688	45,327
2014	28,714	12,595	41,309	6,803	48,112
2015	21,952	12,558	34,509	6,843	41,352
2016	23,852	14,388	38,240	7,206	45,446
2017	18,538	10,359	28,898	7,484	36,381
Total	311,788	117,825	429,613	54,422	484,035
Average	28,344	10,711	39,056	4,947	44,003
Median	28,916	10,324	39,639	5,662	42,787

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA

Table 66 Nominal Ex-vessel revenues ($) for GOA non-pollock trawl CVs, 2007 through 2017

	CGOA CV			WGOA CV	GOA Total
Year	Non-RP	RP	CG Total		
2007	14,583,755	5,046,227	19,629,982	4,330,563	23,960,544
2008	20,524,484	5,258,773	25,783,256	5,480,939	31,264,195
2009	10,443,875	3,700,011	14,143,886	939,083	15,082,968
2010	12,977,697	4,953,010	17,930,706	702,364	18,633,070
2011	14,143,213	6,143,459	20,286,672	1,168,603	21,455,275
2012	12,531,760	9,193,828	21,725,588	3,771,095	25,496,682
2013	11,651,813	6,257,234	17,909,047	3,147,889	21,056,936
2014	12,842,047	7,037,035	19,879,081	3,424,887	23,303,968
2015	9,351,624	6,628,812	15,980,435	3,555,314	19,535,750
2016	9,512,961	7,440,794	16,953,755	3,995,214	20,948,969
2017	-	-	-	-	-
Total	128,563,226	61,659,182	190,222,408	30,515,951	220,738,359
Average	12,856,323	6,165,918	19,022,241	3,051,595	22,073,836
Median	12,686,903	6,200,347	18,780,344	3,490,101	21,256,106

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA

Table 67 shows how harvest volume and ex-vessel value is distributed throughout the year in GOA non-pollock non-Rockfish CV trawl fisheries. The Central GOA data breaks out trips that targeted Pacific cod which, as noted above, accounts for 35% of harvest volume and 51% of ex-vessel value. The overall value generated from the fishery tends toward the earlier months of the year, driven by the fact that CVs prosecute the Pacific cod A season in both GOA regulatory areas. Non-pollock CV participation during the latter months of the year, when a constraining PSC hard cap is most likely to curtail fishing opportunities, occurs exclusively in the Central GOA. Considering all Central GOA non-pollock trawl target species, roughly 27% of harvest and 30% of ex-vessel revenues are generated from September through December. Figure 26 illustrates the accumulation of non-pollock non-Rockfish Program ex-vessel revenues over the calendar year. The figure reflects that the Western GOA CV sector completes its non-pollock activity by the end of March. By contrast, the Central GOA non-Rockfish Program CVs have generally only accumulated 40% of average annual ex-vessel revenues by the end of March, reaching around 70% by the end of August, and 96% by the end of October.

Table 67 GOA non-pollock non-Rockfish Program groundfish harvest (mt; 2007–2017) and ex-vessel value ($; 2007–2016), by month

	Central GOA						Western GOA		GOA Non-RP Total	
	Pacific Cod		Flatfish		Subtotal		Pacific Cod		All Species	
Month	Harvest	Ex-Vessel	Harvest	Ex-Vessel	Harvest	Ex-Vessel	Harvest	Ex-Vessel	Harvest	Ex-Vessel
JAN	21%	22%	1%	1%	8%	12%	8%	7%	8%	11%
FEB	15%	17%	8%	7%	11%	13%	66%	68%	19%	23%
MAR	25%	24%	7%	6%	13%	15%	26%	25%	15%	17%
APR	6%	4%	31%	26%	23%	15%			19%	12%
MAY	1%	< 1%	11%	10%	7%	5%			6%	4%
JUN			4%	4%	3%	2%			2%	1%
JUL			5%	8%	3%	4%			3%	3%
AUG	< 1%	< 1%	9%	10%	6%	5%			5%	4%
SEP	21%	21%	7%	7%	12%	14%			10%	12%
OCT	10%	11%	11%	13%	11%	12%			9%	10%
NOV	< 1%	< 1%	5%	6%	3%	3%			3%	2%
DEC			1%	1%	1%	1%			1%	1%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA

Figure 26 Cumulative percent of GOA trawl CV annual average non-pollock non-Rockfish Program ex-vessel revenues, by month, 2007 through 2017

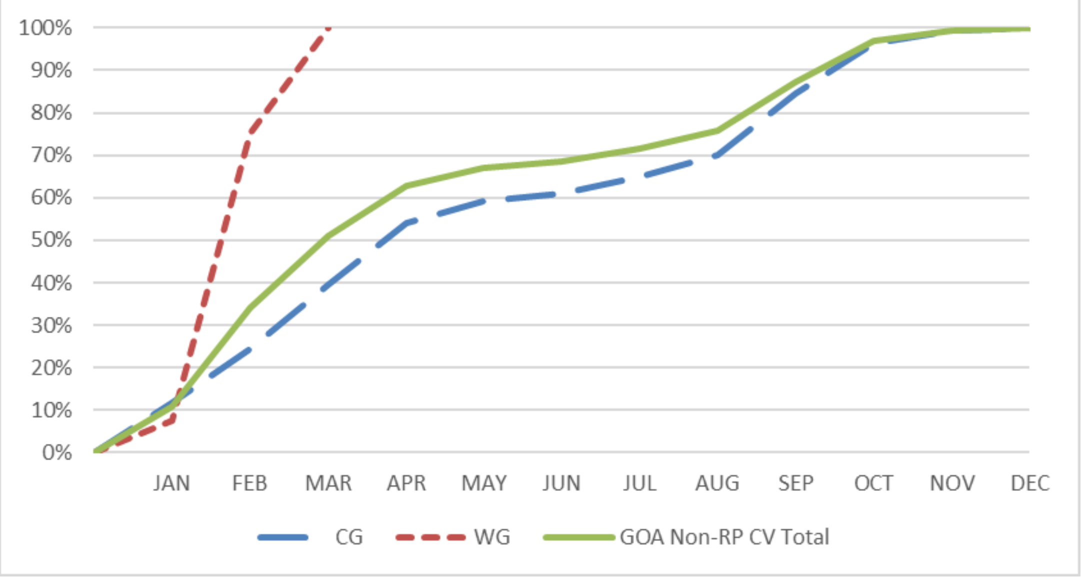


Table 68 Monthly distribution of Rockfish Program CV harvest (mt; 2007–2017) and ex-vessel value ($; 2007–2016)

Month	Harvest	Ex-Vessel
MAY	40%	39%
JUN	26%	24%
JUL	10%	14%
AUG	5%	6%
SEP	7%	8%
OCT	5%	3%
NOV	7%	5%

4.5.2.4 Vessel Dependency

Table 69 and Table 70 are diversification tables provided by AKFIN that reflect the dependency of GOA non-pollock trawl CVs on that fishery, relative to other sources of gross revenue. Table 69 includes all activity by the 88 unique trawl CVs that landed GOA non-pollock groundfish from 2007 through 2016 (revenue information is not yet available for 2017). Note that the vessel counts and value data reflect the activity in each year of *all* CVs that landed GOA non-pollock groundfish in *any* year during the period; refer to Table 58 for a count of vessels that harvested GOA non-pollock groundfish in each year. “Other” revenues include non-trawl activity in both Federal and state waters, including fixed-gear Pacific cod fisheries and salmon seining. Revenues from the Central GOA Rockfish Program are included in the column for GOA non-pollock trawl activity. The downward trend in dependency on non-pollock trawl revenues is mainly a reflection of a significant increase in pollock TACs over the period covered in the tables. (Note that 2018 GOA pollock TAC is down 20% from 2017, year-on-year, and down 36% from a historical peak in 2016; GOA pollock TAC is projected to decline further in 2019.) Though not included in the tables, the vessels that landed GOA non-pollock trawl groundfish during the analyzed period accumulated a total of $63.8 million in gross ex-vessel revenue from fishing activity in Washington, Oregon, and California.

The set of vessels represented in Table 70 is restricted to the 43 unique trawl CVs that landed GOA non-pollock groundfish since 2007 but did not trawl for groundfish in the BSAI. This set of vessels is not exclusive to smaller trawl CVs but is a better reflection of their pattern of participation. These vessels are likely to earn more of their gross revenues from non-trawl fisheries such as Pacific cod pots and salmon seining.

Table 69 Combined nominal ex-vessel revenues ($million) for all CVs that harvested GOA non-pollock groundfish with trawl gear, 2007 through 2016

							GOA Non-Pollock Trawl Revenue as...		
Year	Vessels	GOA Non-Pollock TRW	GOA Pollock TRW	BSAI TRW	Other Revenue	Total Revenue	% GOA Trawl	% AK Trawl	% Total
2007	72	25.3	12.0	30.5	23.3	91.1	68%	37%	28%
2008	75	31.7	17.9	35.8	26.0	111.4	64%	37%	28%
2009	73	15.2	13.7	24.0	18.0	70.9	53%	29%	21%
2010	68	19.1	25.1	23.0	18.9	86.2	43%	28%	22%
2011	69	22.1	27.4	35.3	33.5	118.3	45%	26%	19%
2012	71	26.4	35.5	45.2	21.2	128.3	43%	25%	21%
2013	71	21.5	31.8	39.7	26.0	119.0	40%	23%	18%
2014	72	22.7	38.4	40.4	18.2	119.8	37%	22%	19%
2015	72	20.0	38.6	33.6	22.0	114.1	34%	22%	17%
2016	72	20.3	30.9	33.9	16.8	101.9	40%	24%	20%
Total	88	224.2	271.3	341.4	224.0	1,061.0	45%	27%	21%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT and AFSC Gross Revenue Procedure compiled by AKFIN

Table 70 Combined nominal ex-vessel revenues ($million) for CVs that harvested GOA non-pollock groundfish with trawl gear but did not fish BSAI groundfish, 2007 through 2016

					GOA Non-Pol TRW as...	
Year	Vessels	GOA Non-Pollock TRW	GOA Pollock TRW	Total Revenue	% GOA Trawl	% Total
2007	36	13.4	4.7	34.1	74%	39%
2008	35	15.3	7.3	41.2	68%	37%
2009	35	7.0	6.4	26.1	52%	27%
2010	35	7.5	10.5	31.1	42%	24%
2011	37	8.5	10.8	42.1	44%	20%
2012	37	12.8	14.4	42.2	47%	30%
2013	38	10.3	12.6	40.6	45%	25%
2014	38	10.8	14.8	38.3	42%	28%
2015	37	10.1	15.2	40.6	40%	25%
2016	36	10.9	11.0	33.8	50%	32%
Total	43	106.5	107.7	370.2	50%	29%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT and AFSC Gross Revenue Procedure compiled by AKFIN

Table 71 provides additional depth to the GOA non-pollock trawl CV fleetwide average ex-vessel revenue data for the 2007 through 2016 period. Note that GOA Non-Pollock TRW and GOA Pollock TRW sum to create GOA TRW Total. Total Revenue is the sum of GOA TRW Total, BSAI TRW, Directed Salmon, and Other Fishing. Directed Salmon includes Fish Ticket sales of all salmon species; Other Fishing includes fixed-gear fisheries in both Federal and state-managed fisheries. The table breaks out the set of 88 CVs that landed GOA non-pollock groundfish with trawl gear during the period into five quintiles, where Quintile 1 represents the bottom 20% of GOA non-pollock trawl CV revenue earners, and Quintile 5 represents the to 20%.[36] The data in Table 71 only capture the activity of vessels that landed GOA non-pollock trawl groundfish from 2007 through 2016. Other revenues earned by persons crewing on, or otherwise affiliated with, GOA trawl CVs are not reflected. For example, the table does not include individual earnings from work on other vessels or from salmon fishing on gillnetters or at setnet sites.

Vessels in the Quintile 1 generated the highest aggregate revenues and proportion of total revenues from BSAI trawl fisheries, indicating that roughly one fifth of the 88 vessels had only a marginal interest in GOA groundfish. Vessels in Quintiles 2 and 3 generated 28% and 41% of their total fishing revenues from GOA groundfish trawl fisheries, respectively; Salmon plus fixed-gear fishing accounted for 32% and 48% of those vessel groups' total fishing revenues. Quintiles 2 and 3 typify the revenue distribution of the smaller trawl vessels that fish in the Western GOA, though vessels in that subset of the fleet can be found across Quintiles 1 through 4. Quintiles 4 and 5 depended on GOA groundfish trawl fisheries for 58% and 79% of their total gross revenue, respectively. As would be expected, the vessels in Quintile 5 relied most heavily on GOA non-pollock trawl fisheries (43% of total gross fishing revenue).

Of the $89.2 million that these vessels earned from directed salmon fishing, only $566,000 was from commercial catch of Chinook salmon. This reflects the fact that trawl vessels typically only fish for salmon with seine gear where the primary species are sockeye or pink salmon, and Chinook salmon are taken in relatively small numbers as an incidental marketable species. Chinook salmon revenues, by quintile, varied in proportion to total Directed Salmon revenues. Of the 88 vessels that are included in Table 71, between 20 and 31 landed commercially caught salmon in any given year.

[36] Per-vessel and annual revenues are not shown due to confidentiality constraints. Average per-vessel and per-annum estimates for each value in the table can be obtained by dividing any value by the number of vessels in the quintile, or dividing by 10 (per-annum).

Table 71 Total nominal ex-vessel revenues ($million) for GOA non-pollock trawl CVs, by fishery and by quintile of GOA non-pollock trawl revenue, 2007 through 2016

Quintile	# Vessels	GOA Non-Pollock TRW	GOA Pollock TRW	GOA TRW Total	BSAI TRW	Directed Salmon	Other Fishing	Total Revenue
1	18	2.0	4.7	6.6	149.7	14.4	38.0	208.7
2	18	10.8	24.9	35.7	49.1	19.8	20.7	125.3
3	18	26.4	47.4	73.8	21.6	42.1	44.5	182.0
4	17	53.0	82.6	135.9	69.4	12.9	17.9	236.1
5	17	132.1	111.8	244.3	51.7	0.0	13.0	309.0
Total	88	224.2	271.3	496.2	341.4	89.2	134.1	1,061.0

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT and AFSC Gross Revenue Procedure compiled by AKFIN

4.5.2.5 Catcher Vessel Crew

The best available information on CV crew participation in the GOA groundfish trawl fisheries (including pollock) is available in Section 5.4 of the Preliminary Social Impact Assessment that was prepared for the Council's consideration of the GOA Trawl Bycatch Management Program in December 2016.[37] Table 74 in that section provides a 2015 snapshot of licensed crew members by their reported community of residence cross-tabulated with the community of ownership for the vessel they crewed on. That table reports that 387 licensed crew worked on GOA trawl CVs in 2015.

Among Alaska communities, for Sand Point, King Cove, and Petersburg resident-owned vessels, 2015 EDR data show a close correspondence between community of crew residence and the vessels they work on. Roughly 80% of crew members from Sand Point work on Sand Point-owned vessels (and 70.8% of the crew positions on Sand Point-owned vessels are filled by Sand Point residents); 88.9% of crew members from King Cove work on King Cove-owned vessels (and 61.5% of the crew positions on King Cove-owned vessels are filled by King Cove residents); and 75.0% of crew members from Petersburg work on Petersburg-owned vessels (and 37.5% of the crew positions on Petersburg-owned vessels are filled by Petersburg residents). By comparison, 56.0% of crew members from Kodiak work on Kodiak-owned vessels (and 54.7% of the crew positions on Kodiak-owned vessels are filled by Kodiak residents).

Patterns of employment vary considerably for crew who are residents of Washington and Oregon communities. Roughly 91% of crew members from the Seattle municipal area work on Seattle-owned vessels (17.2% of the crew positions on Seattle MSA-owned vessels are filled by Seattle MSA residents); 34.1% of crew members from other Washington communities work on vessels owned by residents of Washington communities other than the Seattle area (and 36.8% of the crew positions on vessels owned by residents of Washington communities other than the Seattle are filled by residents of Washington communities other than the Seattle area). For Oregon, 21.7% of crew members from Newport work on Newport-owned vessels (and 17.2% of the crew positions on Newport-owned vessels are filled by Newport residents); 31.7% of crew members from other Oregon communities work on vessels owned by residents of Oregon communities other than Newport (and 48.7% of the crew positions on vessels owned by residents of Oregon communities other than Newport are filled by residents of Oregon communities other than Newport).

[37] http://npfmc.legistar.com/gateway.aspx?M=F&ID=e3852a81-a379-4676-a27a-ef2d3938b3e1.pdf

Table 72 GOA trawl CV crew participants by community of residence, 2015

Crew Residence	# Crew	Crew Residence	# Crew
Kodiak	84	Anchor Point	2
Other OR	60	Chiniak	2
Sand Point	43	Cantwell	1
Other WA	41	Gustavus	1
Newport OR	23	Juneau	1
Seattle MSA	22	Old Harbor	1
Other States	21	Salcha	1
King Cove	9	Soldotna	1
Anchorage	8	Unalakleet	1
Petersburg	4	Wasilla	1
Palmer	4	Unknown	56
		TOTAL	**387**

Source: NMFS 2016.

4.5.3 Chinook Salmon Prohibited Species Catch

4.5.3.1 ESA Origins of the GOA Chinook Salmon PSC Limit

In recent years, the Council has amended the GOA Groundfish FMP to limit the amount of Chinook salmon PSC that can be taken in trawl fisheries. Those efforts culminated in limits for the directed pollock trawl fishery (Amendment 93), and the non-pollock trawl fisheries including the Central GOA Rockfish Program (Amendment 97). Amendment 93 set a limit of 25,000 Chinook salmon, and Amendment 97 set a limit of 7,500 Chinook salmon. NMFS has conducted Endangered Species Act (ESA) Section 7 consultations to ensure that the GOA groundfish fisheries the Alaska Region determination that the GOA groundfish fisheries, as modified with changes under Amendment 93, were not likely to adversely affect the Southern Resident Killer whale population or its designated critical habitat. These determinations were reached prior to the additional limits on Chinook salmon PSC implemented under Amendment 97. NMFS determined that Amendment 97 was unlikely to change the basic conduct of the GOA trawl fisheries that were analyzed in the previous Section 7 consultations. Thus, NMFS determined that the GOA groundfish fisheries as modified by Amendment 97 were not likely to affect Southern Resident killer whales in a manner not previously considered in an ESA consult.

An action to increase flexibility to reapportion Chinook salmon PSC among sectors but that does not change the total Chinook salmon PSC limit, would not affect listed species in a manner not considered in previous ESA consultations.

In January 2007, the NMFS Northwest Region completed a supplemental biological opinion to the November 30, 2000 biological opinion on the effects of the Alaska groundfish fisheries on ESA-listed salmon (NMFS 2007b). An incidental take statement was included in the 2000 and 2007 biological opinions, which established a threshold of 40,000 Chinook salmon caught as PSC in the GOA groundfish fisheries. The 2000 biological opinion concluded that the GOA groundfish fisheries are not likely to jeopardize the continued existence of ESA-listed Chinook salmon stocks. If, during the course of the fisheries, the specified level of take is exceeded, a re-initiation of consultation is required, along with a review of the reasonable and prudent measures identified in the 2007 supplemental biological opinion.

Since 1994, Chinook salmon PSC in the GOA groundfish trawl fisheries has generally remained below its incidental take limit of 40,000, except in 2007 (40,540) and 2010 (54,559). The high Chinook salmon

PSC in 2010 prompted the most recent ESA reconsultation in 2012 (Stelle 2012). The 2012 reconsultation concluded that exceeding the Chinook salmon incidental take limit in the GOA fishery was not a chronic situation and retained the provisions in the incidental take statement in the 2007 Biological Opinion (NMFS 2007b), which included an overall incidental take limit of 40,000 Chinook salmon.

The 40,000 Chinook salmon GOA limit in the incidental take statement originates from a 1994 Biological Opinion (NMFS 1994) on the impacts of the BSAI and GOA groundfish fisheries on ESA listed Snake River sockeye, spring/summer Chinook, and fall Chinook salmon. In that Biological Opinion, NMFS assumed that the annual PSC of Chinook salmon in 1994, and "for the foreseeable future," will be 40,000 or fewer. The NMFS used that assumption, and the estimated number of Snake River sockeye, spring/summer, and fall Chinook salmon present in the GOA and BSAI to conclude that the GOA and BSAI groundfish trawl fisheries were not likely to jeopardize the continued existence of listed Snake River sockeye and Chinook salmon. The 1994 Biological Opinion contained conservation recommendations that, among other things, recommended that the Council and NMFS should take necessary actions to ensure that Chinook salmon PSC is minimized to the extent practicable, and does not exceed 40,000 Chinook salmon per year in the GOA fisheries.

Subsequent incidental take statements have maintained the 40,000 Chinook salmon threshold established in 1994. Data from coded wire tags retrieved from GOA trawl-caught Chinook salmon have supported the underlying assumption that taking fewer than 40,000 GOA Chinook salmon PSC per year would not be likely to jeopardize the continued existence of ESA-listed Snake River salmon[38], as only a small proportion of the tags indicated that the salmon originated from that protected river system.

4.5.3.2 Current Management of GOA Chinook PSC Limits

Regulations at 50 CFR 679.21(h) define the trawl Chinook salmon PSC limits for the GOA pollock fishery, and 50 CFR 679.21(i) defines the trawl Chinook salmon PSC limits for the non-pollock fisheries. Salmon retention is required until offload to a processing facility that takes the delivery. In the GOA trawl pollock fishery Chinook salmon PSC limits are set for the Western and Central reporting areas of the GOA. A PSC limit of 18,316 Chinook salmon is set for vessels engaged in directed fishing for pollock in the Central GOA. In the Western GOA, a limit of 6,684 Chinook salmon is set. Because the pollock fishery is only open to directed fishing by the inshore sector, this PSC limit is available to catcher vessels.

GOA non-pollock trawl Chinook salmon PSC limits are established for the trawl CP sector, the non-Rockfish Program CV sector, and the Rockfish Program CV sector (Table 73). The non-pollock PSC limit covers fishing in both the Central and Western GOA.[39] As a result, when the PSC limit is reached it closes both areas to directed fishing for the groundfish species subject to the limit. The CV PSC limit is also set for the entire calendar year. Therefore, when the PSC limit is taken and the fisheries are closed, the fisheries are not reopened until additional Chinook salmon are available. Additional Chinook PSC could become available through the reapportionment process established under GOA Amendment 103 or not until the next year when a new annual apportionment is available.

[38] Snake River salmon were the focus of this study. The Northwest Region's 2007 Supplemental Biological Opinion had a broader focus.
[39] Chinook salmon taken in the West Yakutat district does not currently accrue to a PSC limit. Only a small number of Chinook are taken in WY non-pollock trawling, as trawl activity in that area is historically low. The EA/RIR produced to support GOA FMP Amendment 97 noted that less than 2% of GOA Chinook salmon PSC occurred in WY.

Table 73 GOA non-pollock Chinook salmon PSC limits for combined Western and Central GOA (number of fish)

Sector	Baseline Annual Limit	If the previous year's annual use is less than:	The next year's limit will be:
Trawl CP	3,600	3,120	4,080
Rockfish Program CV	1,200	N/A	
Non-Rockfish Program CV	2,700	2,340	3,060

The reapportionment amendment (GOA Amendment 103) provides NMFS the authority to roll-over limited amounts of the Chinook salmon that is projected to be unused to the catcher vessel sectors. The action prohibited the reapportionment of Chinook salmon PSC from catcher vessel sectors to the catcher/processor sector. In summary the provision:

1. Rollover of Chinook salmon PSC from the Rockfish Program CV sector to the non-Rockfish Program CV sector would be made at the discretion of the NMFS Regional Administrator, and not prescribed by regulation. This changed the obligation of the Regional Administrator from being required to roll-over any unused Rockfish Program CV Chinook salmon PSC, in excess of 150, on October 1. The amendment gives the Administrator authority to determine if a rollover is appropriate at that time. A rollover to the non-Rockfish Program CV sector could also be made after October 1.
2. Limit the amount of roll-over PSC that a CV sector may receive such that the annual total does not exceed 50% of the sector's initial Chinook salmon PSC limit during a calendar year (excluding any uncertainty buffer that may have been added as a result of the previous year's performance per Amendment 97, as shown in Table 73).

The Chinook salmon PSC limit for the CP sector is established so that no more than 66% of the annual limit may be taken prior to June 1 (2,376 out of 3,600 fish). If the trawl CP sector has an annual Chinook salmon PSC limit of 4,080 Chinook salmon, then the sector's seasonal limit prior to June 1 is 2,693 Chinook salmon. The number of Chinook salmon available to the trawl CP sector as a PSC limit on June 1 through the remainder of the calendar year is equal to the annual limit minus the number of Chinook salmon PSC used by that sector prior to June 1.

4.5.3.3 GOA Non-Pollock CV Trawl Chinook Salmon PSC

Annual Chinook salmon PSC levels

Figure 2 through Figure 4 in Section 3.3.2 of this document summarizes annual GOA Chinook salmon PSC (pollock and non-pollock targets), Chinook PSC by area and operational-type sector (Central/Western GOA; CV/CP), and the average intra-annual distribution of Chinook salmon PSC in the GOA non-pollock trawl fisheries from 2003 through 2017.

Table 74, below, summarizes the NMFS Catch Accounting System estimates of non-pollock trawl CV Chinook salmon PSC that are used to manage the GOA hard caps. The table provides annual values, an average over the entire analyzed period (2007 through 2017), and averages over the sets of years that preceded or followed the 2013 implementation of the Observer Program restructuring. Figure 27 plots estimated Chinook salmon PSC for each sector against the non-pollock PSC limits that were implemented in 2015 under GOA Groundfish FMP Amendment 97. The PSC limits established under Amendment 97 were based on analysis of PSC levels from 2003 through 2011 for the non-Rockfish Program sector, and from 2007 through 2012 for the Rockfish Program CV sector. For comparison, Table 75 shows the historical average Chinook PSC that was reported in Section 4.4.9.2 of the RIR prepared for Amendment 97.

The total annual Chinook salmon PSC limit for these fisheries is set at 3,900 fish. Over the 2007 through 2017 period, the CV sector averaged 3,112 Chinook salmon per year, in aggregate. The highest level of GOA non-pollock Chinook PSC occurred in 2013 (5,805 fish), before the 3,900-fish hard cap was implemented in 2015. From 2007 through 2017, the CV hard cap level was (or would have been) exceeded in four of 11 years. The cap would also have been exceeded in 2003, when the combined non-pollock CV PSC level was 4,601 Chinook salmon.

The implemented cap for the non-Rockfish Program CV sector was exceeded in 2015, causing a temporary closure that halted the fishery in May and kept it closed until NMFS took an emergency action to reopen the fishery in August (see Section 1.2 of this document for further explanation). The 2015 fishing year was partly notable because of the early-year Chinook salmon PSC that occurred in the Western GOA Pacific cod trawl CV A season. As is evident in Table 74, the Western GOA non-pollock trawl CV sector had not recorded significant estimated Chinook salmon PSC levels in earlier years. Total estimated PSC for that sector had not previously exceeded 200 Chinook in any year, extending back to 2003 which marks the beginning of the time period that was considered when setting the Amendment 97 hard cap. In 2015, CVs targeting Pacific cod in the Western GOA had accumulated 874 estimated Chinook salmon PSC by the end of February. Similar to 2015, in 2017 the Western GOA non-pollock trawl CVs again reached of Chinook salmon PSC during the Pacific cod A season that was well above historically estimated annual totals. In 2017, Western GOA CVs targeting cod took 1,686 Chinook salmon by the end of February. To illustrate the high variance in estimated Chinook PSC levels, this same sector recorded 15 or fewer estimated Chinook PSC in 2013, 2014, and 2016 (also years under the restructured Observer Program).

The time-period averages provided in Table 74 highlight not only the inter-annual variation in annual Chinook PSC (variance relative to the average), but also the marked difference in estimated levels of Western GOA CV PSC before and after observer coverage was reprogrammed to sometimes select vessels less than 60' LOA. As noted in Section 4.5.1.1, three-quarters or more of the active Western GOA trawl CV fleet in a given year is made up of vessels less than 60' LOA. The average PSC estimate for Western GOA CVs (all sizes) during non-pollock fishing was 37 Chinook salmon per year from 2007 through 2012 but was 554 Chinook per year—with extreme variations—from 2013 through 2017. For reference, Western GOA CVs' average annual PSC estimate from 2003 through 2011—which was the figure presented in the analysis for Amendment 97—was 72 Chinook salmon per year.

Average annual Chinook salmon PSC within the Rockfish Program CV sector was 848 Chinook during the entire 2007 through 2017 period. The analysis presented to the Council when considering Amendment 97, which defined the 1,200 Chinook salmon PSC limit, identified an average annual PSC level of 847 during the 2007 through 2012 time-period. The RP CV sector's annual Chinook PSC has exceeded the level of the 1,200-fish cap three times since 2007. The sector recorded 1,690 Chinook in 2008, 1,261 Chinook in 2013, and 1,802 Chinook in 2015 after the cap was implemented.

The sector exceeded its cap in 2015 largely as a result of recording 899 Chinook PSC in a single weekly reporting period during the final week of the season (November). NMFS notes that this isolated PSC shock was idiosyncratic – partly an artifact of a trip where a low proportion of hauls was sampled due to inclement weather conditions, thus requiring extrapolation of a basket sample containing a high Chinook rate to an unusually large proportion of unsampled catch. NMFS had no recourse to close the fishery as the season was ending by regulation at that time, and also noted that total 2015 Chinook PSC for all trawl fisheries (pollock and non-pollock; CV and CP) was well below the aggregate PSC limit—18,452 Chinook were taken, compared to the overall trawl limit of 32,500 Chinook.

The relatively high years of Rockfish Program CV Chinook PSC in 2008 and 2013 are not easily explained by individual PSC events. High PSC years have multiple determining factors, including both fleet behavior and environmental factors, among other unobservable determinants. The analysis for Amendment 97 noted industry participants' anecdotal report that the early years of the Rockfish Pilot Program reflected a new fishery that was learning to utilize cooperative tools to minimize PSC, and also noted that halibut PSC was capped but Chinook salmon PSC was not. It is reasonable to hypothesize that in 2008 the fleet was focused on avoiding halibut PSC, and thus fished in a manner (higher off the bottom) that increased Chinook PSC rates. The sector's relatively high PSC level in 2013 might reflect a generally higher Chinook PSC encounter rate across all Central GOA trawl fisheries, suggesting that unpredictable environmental factors played a role. Given the large variations in year-on-year PSC levels in a fishery that has cooperative management tools, it is difficult to attribute PSC entirely to fleet behavior. If one were to argue that fully observed CVs cooperatives—with the time and aligned incentives to communicate with each other about bycatch conditions on the fishing grounds—can control Chinook PSC encounters with reliable precision, then one would have to conclude that Rockfish Program CVs prosecuted the fishery much differently in 2015 (1,802 Chinook) than in 2016 (158 Chinook). This analysis does not accept that argument, noting rather that Chinook PSC is highly variable under even the most favorable management conditions.

Table 74 Estimated Chinook salmon PSC for GOA non-pollock catcher vessels, 2007 through 2017

	Non-Rockfish Program CV			Rockfish	GOA CV
Year	CG	WG	Subtotal	Program CV	Total
2007	1,857	9	1,867	510	**2,376**
2008	749	107	856	1,690	**2,546**
2009	2,007	10	2,016	860	**2,877**
2010	4,161	0	4,161	995	**5,156**
2011	3,444	96	3,540	368	**3,908**
2012	942	1	943	800	**1,743**
2013	4,529	15	4,544	1,261	**5,805**
2014	1,430	1	1,430	503	**1,933**
2015	1,817	1,056	2,873	1,802	**4,675**
2016	412	13	425	158	**582**
2017	557	1,686	2,244	387	**2,631**
Total	21,905	2,994	24,899	9,332	**34,231**
Avg. 2007-17	1,991	272	2,264	848	**3,112**
Avg. 2007-12	2,193	37	2,230	870	**3,101**
Avg. 2013-17	1,749	554	2,303	822	**3,125**

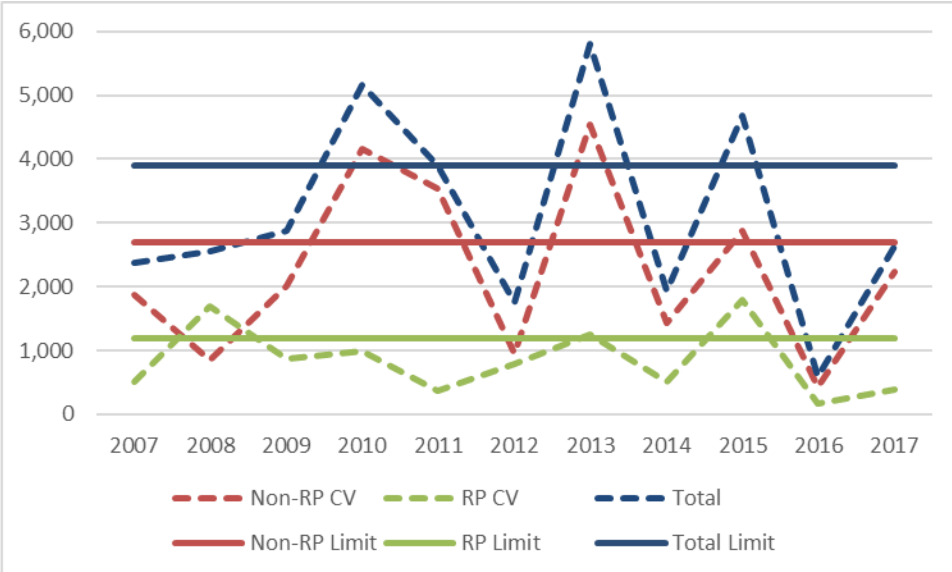
Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Table 75 Average Chinook salmon PSC reported in the RIR considered by the Council when taking action on GOA Groundfish FMP Amendment 97 (NPFMC 2014)

Basis Period	Sector	Avg. PSC
2003 - 2011	CGOA CV*	2,765
	WGOA CV	72
	GOA CV Total	2,837
2007 - 2012	Rockfish Prog. CV	847

* Average CGOA CV Chinook salmon PSC from 2003 through 2011 includes fishing that occurred under the Rockfish Pilot Program from 2007 through 2011.

Figure 27 Annual Chinook salmon PSC plotted against Amendment 97 PSC limits, 2007 through 2017



Chinook salmon PSC taken in the West Yakutat (WY) district is omitted from this data summary. There is no Chinook PSC hard cap for trawl gear in the WY district. Less than 1% of total estimated GOA trawl Chinook PSC from 2007 through 2017 occurred in WY, including both pollock and non-pollock fisheries (1,529 fish). Effort in the WY non-pollock trawl fisheries is very low; WY non-pollock trawl Chinook PSC accounted for only 29 Chinook salmon from 2007 through 2017. The data also do not include Chinook salmon PSC encountered in fixed-gear and state-managed trawl fisheries that occur in Prince William Sound and the Eastern GOA. Chinook PSC encountered in those fisheries does not accrue to the PSC hard caps that would be affected by this action. Moreover, incidental catch of Chinook salmon in federal fixed-gear (hook-and-line) fisheries was not well tracked prior to the 2013 observer restructure. NMFS does track this data and includes estimated Chinook PSC from the Prince William Sound trawl fishery as a component of total GOA Chinook salmon PSC estimates, which are published on the NMFS catch and landings report website.[40]

Chinook Salmon PSC Rates

The PSC rate represents the number of Chinook salmon that are estimated to be caught per metric ton of groundfish catch. Across all GOA non-pollock trawl CVs, including the Rockfish Program, the overall Chinook PSC rate from 2007 through 2017 was 0.071. This measure can also be read in the inverse as one Chinook salmon PSC estimated for every 14.14 mt of groundfish catch (1/0.071). The overall annual PSC rate for GOA non-pollock trawl CVs does not vary when looking separately at the set of years prior to observer restructuring (2007 through 2012) or after restructuring (2013 through 2017).

Table 76 provides PSC rates by non-pollock CV sector, and further breaks out the PSC rates for the non-Rockfish Program CVs into Western and Central GOA activity. Over the length of the analyzed period, the PSC rate for the Central GOA non-Rockfish Program fishery has remained fairly consistent and close to the overall PSC rate for the GOA non-pollock trawl CV fishery; this is intuitive because the Central

[40] For example, the 2017 PSC report is available at https://alaskafisheries.noaa.gov/sites/default/files/reports/car142_goa_salmon2017.pdf. The total estimate for GOA trawl Chinook salmon PSC is 24,810 Chinook, but that includes 281 Chinook from the PWS fishery that do not accrue to a hard cap. From 2010 through 2017, the average amount of Chinook PSC estimated for the PWS fishery was 237 Chinook (low of 27 Chinook and high of 471 Chinook).

GOA non-Rockfish Program fishery accounts for the majority of the Chinook PSC and basis weight that make up the GOA CV total.

Over the full analyzed period, the Rockfish Program CV sector has had a slightly higher PSC rate than the GOA CV total. This value is relatively more susceptible to the effects of a few high PSC years or events—such as the November 2015 PSC event described earlier—because total PSC and groundfish basis weight in the RP sector is comparatively low (Rockfish Program CVs account for 27% of total GOA trawl CV PSC from 2007 through 2017, and 24% of total weight landed).

The most remarkable element of Table 76 is the change in the Western GOA non-pollock CV sector's PSC rate before and after the restructured observer program increased coverage levels in that fishery. The Western GOA's PSC rate from 2007 through 2012 was 0.011, or one Chinook salmon per 91 mt of groundfish catch. From 2013 through 2017, the sector's PSC rate was 0.081—a roughly seven-fold increase to one Chinook per 12 mt of groundfish catch. The Western GOA PSC rate for the most recent set of years is not greatly out of line with the overall GOA non-pollock CV rate but is a notable departure from the rate that was estimated and considered when the Amendment 97 PSC limit was established based on data from 2003 through 2011.

Table 76 Chinook salmon PSC rate by non-pollock CV sector, 2007 through 2017

	Central GOA			Western GOA			Non-RP Total			RP CV			GOA Non-Pollock CV Total		
	PSC	mt	Rate	PSC	mt	Rate	PSC	mt	Rate	PSC	mt	Rate	PSC	mt	Rate
2007-2017	21,905	311,788	0.070	2,994	54,422	0.055	24,899	366,209	0.068	9,332	117,825	0.079	34,231	484,035	0.071
2007-2012	13,160	189,417	0.069	223	20,399	0.011	13,383	209,816	0.064	5,222	57,601	0.091	18,605	267,417	0.070
2013-2017	8,745	122,370	0.071	2,771	34,023	0.081	11,516	156,394	0.074	4,110	60,224	0.068	15,626	216,618	0.072

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

The Central GOA non-pollock trawl CV sector is the only fishery analyzed here that has a multispecies characteristic throughout the year. The fishery tends to focus on Pacific cod in January and February, but gradually shifts toward flatfish over the course of the spring. Effort is lower during the summer when vessels focus on the Rockfish Program fishery, BSAI groundfish, or work as a support vessel in the directed salmon fishery. Central GOA vessels return to the non-pollock fishery for the Pacific cod B season at the end of the summer, and those that remain active throughout the calendar year will fish flatfish in the late fall.

By volume (mt), trips targeting flatfish species account for 65% of the Central GOA non-pollock non-Rockfish Program CV sector's harvest from 2007 through 2017. Arrowtooth flounder represents 44% of harvest volume and shallow water flatfish represent 18%. Other species including rex sole, flathead sole, and deep-water flatfish make up the remainder of designated flatfish trip targets. Flatfish trips accounted for 72% of the sector's Chinook salmon PSC during the analyzed period, with a PSC rate of 0.089 (one Chinook per 11.2 mt of groundfish). The remainder of the sector's non-pollock activity is trips targeting Pacific cod in both the A and B seasons. In total, Pacific cod trips accounted for 35% of total landed volume and 18% of Chinook PSC, with a PSC rate of 0.036 (one Chinook per 28.1 mt of groundfish). Roughly 70% of the sector's Pacific cod harvest occurs in the A season and 30% occurs in the B season, while Chinook PSC over the entire period is split 50%/50% over the two seasons. That fact, coupled with A and B season PSC rates of 0.026 and 0.057, respectively, suggest a higher intrinsic rate of Chinook encounter in the fall (September/October). If one rejects the notion that CVs fish differently in the fall compared to the early portion of the year, it is reasonable to conclude that higher PSC rates occur either because target species are less aggregated in the fall—requiring more tow time to harvest the target quota—or that more Chinook salmon occur in trawl areas during the fall.

Seasonality of Chinook Salmon PSC

During the analyzed period, Chinook salmon PSC in the GOA non-pollock fisheries displays a consistent annual pattern (Table 77). In aggregate, the non-Rockfish Program fishery has accumulated 64% of its Chinook PSC from January 20 through the end of May. This period generally encompasses the Pacific cod A season and the Central GOA spring flatfish fishery. The bulk of Western GOA Pacific cod harvest and associated PSC occurs in February before much of the fleet turns to state-managed Pacific cod fixed-gear fisheries, while the Central GOA Pacific cod fishery may stretch into March depending on cod aggregation and how long the fleet spend targeting pollock after the January 20 opening. The Rockfish Program CV sector has accumulated 72% of its Chinook PSC during May and June; those months have historically represented 66% of the sector's groundfish harvest.

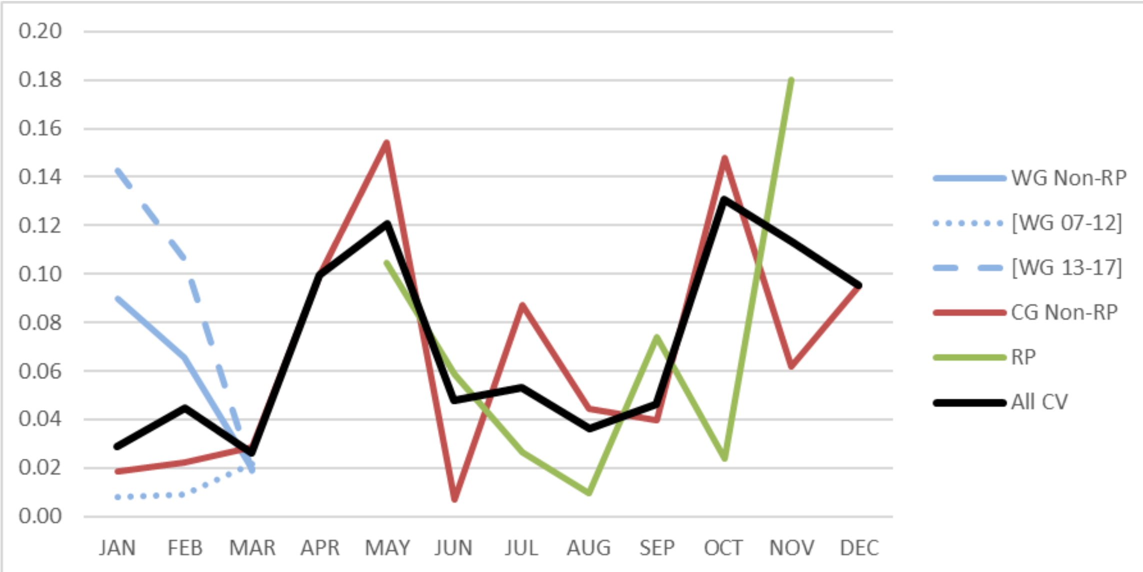
Table 77 Percent of average annual Chinook PSC by month, 2007 through 2017

Month	CG Non-RP	WG Non-RP	Total Non-RP	RP	All CV
JAN	2%	12%	3%		2%
FEB	3%	78%	12%		9%
MAR	5%	9%	6%		4%
APR	32%		28%		20%
MAY	16%		14%	53%	24%
JUN	0%		0%	19%	5%
JUL	4%		4%	4%	4%
AUG	4%		3%	1%	3%
SEP	7%		6%	7%	6%
OCT	23%		20%	1%	15%
NOV	3%		3%	16%	6%
DEC	1%		1%		1%

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

Figure 28 illustrates average monthly Chinook salmon PSC rates aggregated over the period 2007 through 2017. For reference, recall from Table 76 that the average annual overall GOA non-pollock trawl CV PSC rate for the period was 0.07 Chinook per mt of groundfish catch. The overall PSC rate is largely driven by the Central GOA non-Rockfish Program CV sector, as that fishery accounts for the greatest proportion of total non-pollock harvest and PSC. The overall rate is relatively low during the Pacific cod A season, but rises above the annual average in April and May when the Central GOA non-Rockfish Program fishery tends to shift focus to flatfish species. PSC rates also trend higher in the late fall, again when vessels increase flatfish targeting (though, as noted above, PSC rates in the Pacific cod B season are higher than in the Pacific cod A season). The uptick in Rockfish Program CV PSC rates at the end of the year could reflect changing seasonal environmental factors such as target fish aggregation and/or presence of Chinook PSC; especially high rate levels in November might also be an artifact of previously noted "lightning strike" events that were large enough to skew the data. Finally, note that the trend in Western GOA CV PSC rates reflect the trend from the five years since the observer restructuring more so than the six years prior to restructure. The Western GOA Pacific cod trawl CV fishery tends to decrease its PSC rate as the fishery progresses from January to March, which could reflect target fish aggregation (catch per unit effort, and trawl-time with nets in the water) or could reflect the fleet learning the PSC conditions on the fishing grounds in real-time.

Figure 28 Average monthly Chinook salmon PSC rates by non-pollock CV sector, 2007 through 2017



Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

4.5.4 Processors

From 2010 through 2017, between 10 and 15 inshore processing facilities received deliveries from GOA non-pollock non-Rockfish Program trawl CVs in a given year. Eighteen total facilities processed GOA non-pollock groundfish during that period. Table 78 reflects that Kodiak has the most individual facilities involved in this GOA fishery. Of the communities situated in the Western GOA (King Cove, Sand Point, Akutan, Dutch Harbor/Unalaska, and False Pass), only King Cove and Sand Point had a facility that was active in the fishery during every year; each of those communities has a single processing facility. Those two facilities combined to account for 97% of the gross first wholesale value that was derived from non-pollock trawl-caught groundfish in the "Western GOA" communities during this time period (60% in Sand Point; 37% in King Cove). The processing facilities that are listed under Washington state represent floating processing plants, whose "Intent to Operate" city designation is based on the location of the firm that owns the floating processor. Five different floating processors have participated in the GOA non-pollock non-Rockfish Program CV fishery since 2010. Two floating processors are associated with a firm or firms based in Kirkland, WA, and three are associated with firm(s) based in Seattle, WA. The floating processors were primarily engaged in the processing of Pacific cod in the Central GOA, and pollock in the Western GOA. From 2010 through 2017, floating processors combined to receive only 1.8% of the total groundfish caught by the non-Rockfish Program CV sector, accounting for 3% of total gross first wholesale revenue.

On average, shore-based and stationary floating processors received 32,200 mt of non-pollock non-Rockfish Program groundfish per year from 2010 through 2017. Additional information of harvest levels and ex-vessel revenues is provided in Section 4.5.2 of this document. The City of Kodiak received 78% of those deliveries (be weight landed), and Western GOA communities received 20%. Kodiak's share of landings was particularly high in 2010 and 2011; excluding those years, Kodiak received an average of 73% of non-pollock non-Rockfish Program landings and Western GOA communities received 26%. The RIR prepared for the analysis of GOA Groundfish FMP Amendment 97 noted that Kodiak accounted for 93% of non-pollock processing by volume and 90% of processing revenues for this sector from 2007 through 2011. The relative decrease in Kodiak's share of total processing market share is mostly attributed to increased non-pollock production in Sand Point and King Cove. In 2010 and 2011 the plants in Sand Point and King Cove combined to account for roughly 7% of total first wholesale revenue from

GOA non-pollock non-Rockfish Program trawl fisheries; during the 2012 through 2016 period that percentage rose to between 27% to 33%. Furthermore, the processing plant in Akutan dramatically increased its pollock processing volume in 2016 and 2017 relative to previous levels; the development of that plant has also involved a modest increase in the amount of non-pollock groundfish that are processed there.

Table 78 Number of processing plants in the inshore sector that took deliveries of GOA non-pollock non-Rockfish Program trawl groundfish, 2010 through 2017

City	2010	2011	2012	2013	2014	2015	2016	2017
Kodiak	8	9	7	7	7	5	6	5
King Cove, Sand Point, Akutan, Dutch Harbor/Unalaska, False Pass	4	3	2	3	3	3	3	4
Sitka, Seward	1	2	2	1	0	0	0	0
Washington	1	1	1	1	2	2	3	2
Total	**14**	**15**	**12**	**12**	**12**	**10**	**12**	**11**

Source: AKFIN summary of CAS and COAR data

Table 79 GOA non-pollock non-Rockfish Program groundfish CV trawl deliveries (mt) by community, 2010 through 2017

City	2010	2011	2012	2013	2014	2015	2016	2017	Total
Kodiak	33,639	31,251	21,805	26,045	25,780	20,776	23,386	18,120	200,804
King Cove, Sand Point, Akutan, Dutch Harbor/Unalaska, False Pass	1,833	2,114	8,574	8,649	9,526	6,569	7,117	7,126	51,509
Sitka, Seward	C	C	C	C					789
Washington	C	C	C	C	C	C	554	C	4,499
Total	*	**34,609**	**30,602**	*	*	*	**31,057**	*	**257,601**

Source: AKFIN summary of CAS and COAR data

The Central GOA Rockfish program includes a requirement that all fish harvested under RP cooperative quota is delivered to a processor located in the City of Kodiak. The Council included the Kodiak delivery requirement to address concerns that the Rockfish Program would allow harvesters to deliver outside of the traditional landing port. In addition to protecting historical processors, the requirement was intended to protect other local business and onshore workers who are reliant on the fishery. From 2010 through 2017, as many as eight different shore-based facilities processed fish caught under the Rockfish Program. The annual number of processors has decreased from eight in 2010 to six during the 2015 through 2017 period. Dating back to the implementation of the Rockfish Pilot Program in 2007, the average annual shoreside landings of RP groundfish is 10,700 mt. Nominal average annual gross first wholesale value from 2007 through 2016 (the most recent year for which pricing information is available) was $9.2 million. That value peaked at a high of $14.7 million in 2012.

Table 80 summarizes the nominal gross first wholesale value generated by inshore processing facilities that received GOA non-pollock trawl groundfish from 2007 through 2016. Overall, GOA groundfish trawl CV deliveries generated around 10% of these processors’ aggregate first wholesale revenues. Pollock landings contributed roughly 5% of total gross first wholesale revenues, with non-pollock and Rockfish Program CV landings contributing the other 5%. Other contributors to GOA processors’ gross revenues included fixed-gear Pacific cod, salmon, halibut and sablefish IFQ, crab, and herring.

Table 80 Nominal gross first wholesale revenue ($million) generated by inshore processing facilities that received GOA non-pollock trawl groundfish, 2007 through 2016

	GOA Groundfish Trawl Fisheries						All Fisheries	
Year	**Non-Pollock**	**% Total**	**Rockfish Prog.**	**% Total**	**Pollock**	**% Total**	**Total**	**% GOA Trawl**
2007	20.4	4.5%	5.0	1.1%	12.9	2.9%	449.4	8.5%
2008	27.0	4.9%	5.3	1.0%	18.6	3.4%	554.6	9.2%
2009	13.8	3.4%	3.7	0.9%	14.1	3.5%	403.9	7.8%
2010	20.8	4.1%	5.0	1.0%	26.8	5.3%	508.0	10.4%
2011	22.8	3.3%	9.0	1.3%	28.1	4.0%	696.6	8.6%
2012	23.3	3.1%	14.7	2.0%	37.2	5.0%	740.0	10.2%
2013	21.4	3.2%	11.1	1.7%	34.6	5.2%	667.2	10.1%
2014	24.1	3.7%	12.3	1.9%	40.2	6.1%	654.0	11.7%
2015	20.3	3.3%	12.9	2.1%	40.7	6.6%	619.2	11.9%
2016	18.8	3.3%	12.7	2.2%	33.1	5.7%	576.1	11.2%
Total	**212.7**	**3.6%**	**91.7**	**1.6%**	**286.2**	**4.9%**	**5,869.0**	**10.1%**

Source: AKFIN summary of CAS and COAR data

For the 2007 through 2016 period, processors located in Kodiak accounted for 94% of the gross first wholesale revenues generated from the Central GOA non-pollock non-Rockfish Program trawl CV fisheries. Other processing communities—including Sand Point, King Cove, Akutan, and floating processors owned by Washington-based companies—must be reported in aggregate in order to preserve confidentiality. Kodiak processors generated 58% of their total wholesale revenues from January through May, 11% from June through August, and 31% from September through December (27% occurred during September and October, spanning the Pacific cod B season). Processors in other municipalities generated 94% of their gross first wholesale revenues from January through April, reflecting the fact that they were mostly participating in the Pacific cod A season.

Processors that participated in the Western GOA non-pollock non-Rockfish Program trawl CV fisheries were located in Sand Point, King Cove, Unalaska, Akutan, False Pass, Kodiak, and on floating processors owned by Washington-based companies. Virtually all gross first wholesale revenues were generated from January through March, with 68% occurring in February.

The best available information on processing plant workers who participate in the GOA groundfish trawl fisheries (including pollock) is available in Section 5.2 of the Preliminary Social Impact Assessment that was prepared for the Council's consideration of the GOA Trawl Bycatch Management Program in December 2016.[41] That analysis relies on information from 2015 Economic Data Reports for shoreside processing operations and a 2014 social science survey that was administered by the Alaska Fisheries Science Center. Table 81 provides labor payment information for processing workers at GOA shoreside processors that accepted trawl-caught groundfish deliveries in 2015. While the shoreside processors in Kodiak consisted exclusively of shore-based processing plants, the shoreside processors outside of Kodiak include shore-based plants in Sand Point, King Cove, and False Pass, plus three stationary floating processors. Table 82 provides wage and salary information for non-processing workers at shoreside processors in Kodiak and elsewhere that accepted GOA trawl-caught deliveries in 2015.

[41] http://npfmc.legistar.com/gateway.aspx?M=F&ID=e3852a81-a379-4676-a27a-ef2d3938b3e1.pdf

Table 81 GOA groundfish processor workers and labor hours/payments by month, 2015

Month	Number of Federal Processor Permits	Number of Groundfish Processing Employees	Processing Labor Person-Hours		Processing Labor Payment	
			Housed	Not Housed	Housed	Not Housed
Kodiak						
January	7	1,422	34,440	182,484	$326,052	$2,165,849
February	7	1,645	127,474	214,655	$1,339,541	$2,659,635
March	7	1,686	126,612	315,540	$2,390,093	$3,958,886
April	7	1,567	82,725	213,604	$954,102	$2,785,893
May	7	1,136	25,805	160,411	$286,175	$1,874,488
June	7	1,123	18,898	119,953	$225,211	$1,478,947
July	7	533	6,714	83,271	$82,558	$1,024,004
August	7	532	6,903	78,400	$97,876	$952,292
September	7	1,447	98,001	264,578	$1,095,659	$3,411,559
October	7	1,403	107,747	244,705	$1,272,712	$3,172,959
November	7	1,108	28,320	100,738	$340,911	$1,286,226
December	7	407	4,768	46,271	$68,512	$579,133
Total	**--**	**--**	**668,407**	**2,024,610**	**$8,479,402**	**$25,349,871**
All Other Geographies						
January	6	890	109,932	0	$1,228,038	$0
February	6	1,201	255,023	101	$2,810,615	$1,446
March	6	1,186	364,564	627	$4,417,681	$1,395
April	5	1,017	260,233	0	$3,100,578	$0
May	5	176	27,440	0	$322,100	$0
June	5	500	31,835	0	$392,269	$0
July	5	474	124,382	0	$1,575,885	$0
August	5	488	97,974	0	$1,260,775	$0
September	5	601	250,365	0	$3,053,302	$0
October	5	544	192,045	0	$2,291,918	$0
November	5	236	13,558	0	$168,687	$0
December	5	0	0	0	$0	$0
Total	**--**	**--**	**1,727,351**	**728**	**$20,621,848**	**$2,841**

Source: NMFS 2016.

Table 82 Total wages and salaries for GOA groundfish processor non-processing employees, 2015

Community	Number of Non-Processing Employees	Total Wages and Salaries
Kodiak	105	$6,046,418
All Others	687	$11,109,935
Total	**792**	**$17,156,353**

Source: NMFS 2016.

4.5.5 Communities

Table 83 lists the self-reported communities of residence for the owners of trawl CVs that participated in the GOA non-pollock groundfish fisheries from 2007 through 2016.[42] In total, 86 unique CVs participated during that period, but 112 vessel owners are listed due to cases with more than one name and/or residence for some vessels. Table 84 lists the 13 different self-reported homeport communities for CVs that harvested GOA non-pollock groundfish from 2007 through 2016. Seven of the listed homeport communities are in Alaska, with the other six located in Oregon and Washington.

Table 83 Communities of residence for owners listed on trawl CVs that harvested GOA non-pollock groundfish, 2007 through 2016

Alaska	Count	Washington	Count	Oregon	Count	Other	Count
Anchorage	1	Anacortes	1	Brookings	1	Holualoa, HI	1
Girdwood	2	Bellingham	4	Charleston	1	Kailua Kona, HI	1
King Cove	5	Camas	1	Dallas	1	Fruitland, ID	1
Kodiak	35	East Wenatchee	1	Depoe Bay	1	Tenants Harbor, ME	1
Petersburg	3	Edmonds	1	Florence	2		
Sand Point	12	Gig Harbor	1	Independence	1		
		Issaquah	1	Newport	9		
		Lynnwood	1	Port Orford	1		
		Mercer Island	1	Siletz	1		
		Renton	2	South Beach	1		
		Seattle	21	Warrenton	1		
		South Bend	2				
		Spanaway	1				
		Vashon	1				

Source: NMFS LLP database and COAR data provided by AKFIN.

Table 84 GOA non-pollock trawl CVs by homeport, 2007 through 2016

State	City	# Vessels
AK	Kodiak	29
	Sand Point	14
	King Cove	6
	Petersburg	4
	Juneau	3
	Unalaska	1
	Girdwood	1
OR	Newport	9
	Portland	2
	Charleston	1
	Brookings	1
WA	Seattle	14
	Blaine	1

Source: NMFS LLP database and COAR data provided by AKFIN.

[42] The data for these tables is drawn from revenue diversification information, which is not yet available for 2017.

4.5.5.1 Community Profiles

Detailed community profiles that provide the specific context of GOA groundfish trawl fishery participation are available in Section 5 of the December 2016 Preliminary SIA that was prepared for the Council's consideration of the GOA Trawl Bycatch Management Program.[43] That document covers the Alaska communities of Kodiak, Sand Point, King Cove, Akutan, Unalaska, Petersburg, Homer, Seward, and Anchorage, as well as the Seattle, WA municipal area, "Other Washington communities," Newport, OR, and "Other Oregon communities." The reader is also referred to the SIA that was prepared in October 2017 for the Central GOA Rockfish Program review.[44] Section 5 of that document provides the community context for the Rockfish Program with specific information on Kodiak, "Other Alaska communities," the Seattle, WA municipal area, "Other Washington communities," Lincoln County, OR, and "Other Oregon communities."

The Alaska Fisheries Science Center's Resource Ecology & Fisheries Management (REFM) division has compiled community profiles, community snapshots, interactive mapping tools, and a compendium of social science analyses on its website, available at https://www.afsc.noaa.gov/REFM/Socioeconomics/Projects/communities.

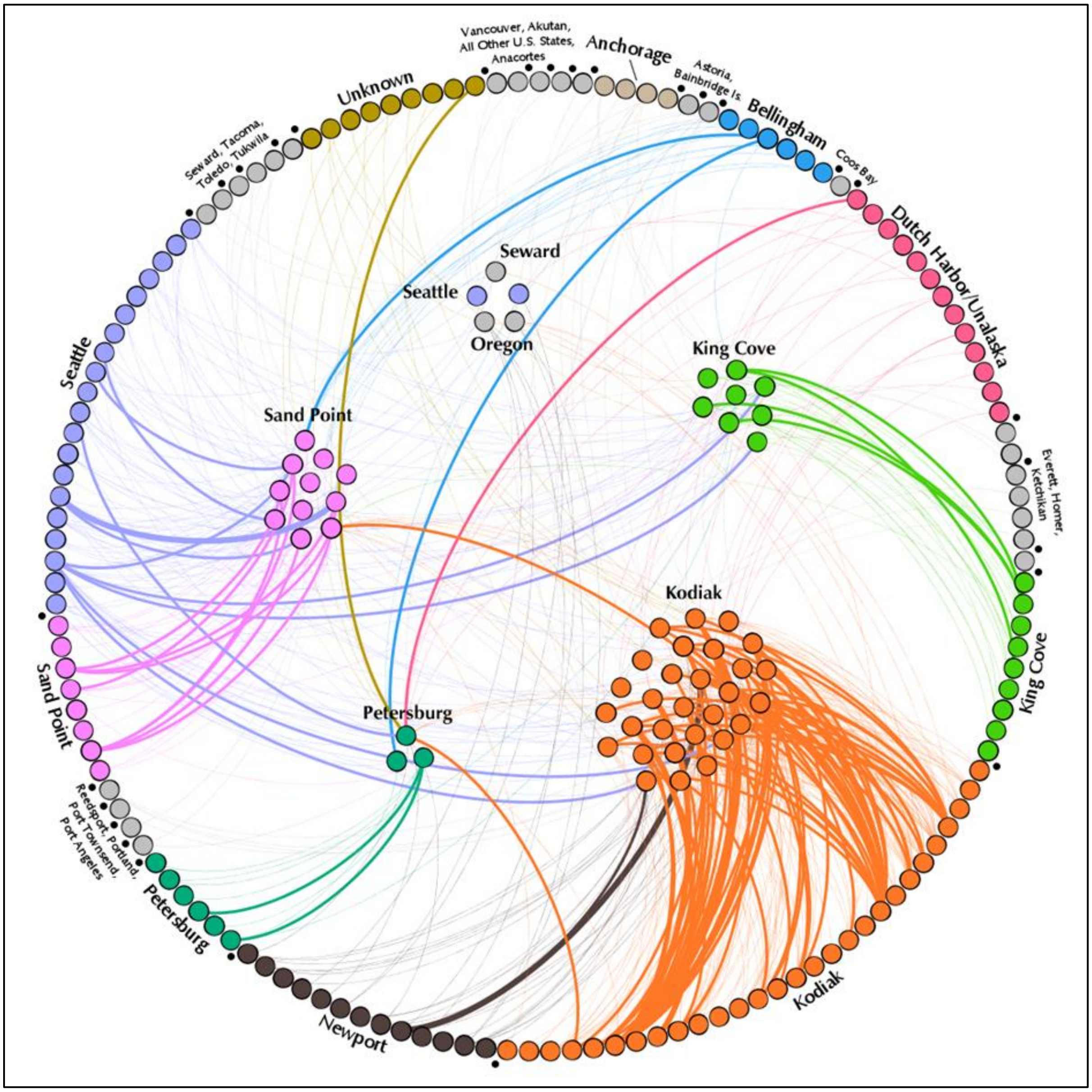
4.5.5.2 Support services

Section 5 of the December 2016 Preliminary SIA cited above provides the best available description of engagement and reliance upon the GOA trawl groundfish fishery for support services sectors. Support sectors include a range of businesses that cater to the commercial fishing industry, including fishmeal plants, marine hardware/gear supply, hydraulics, welding, marine electronics, marine mechanical, fuel sales, general stores, boatyard services, bookkeeping, and shipping. The 2016 SIA notes that Kodiak is distinguished from most other Alaskan fishing ports by the number and range of support service businesses that it provides. Many support service businesses in Kodiak are independent operators, while most fishery-linked support businesses in Sand Point and King Cove are provided through the local processing plants and/or buying stations.

Figure 29 graphically illustrates the relationship of the community of GOA trawl catcher vessel ownership and the communities where those vessels obtain support services, utilizing data from the 2014 AFSC GOA Trawl Social Survey. Vessels and their community of ownership are shown as clustered dots within the circle, and support service businesses are shown, arranged by community where goods and services were obtained, as dots forming the circle itself. Thicker connecting lines represent multiple mentions for single businesses, while the thin lines in the background show the pervasive interconnections that result from unique mentions on the survey. The figure reflects the greater provision and utilization of local support services in Kodiak relative to other communities of vessel ownership.

[43] http://npfmc.legistar.com/gateway.aspx?M=F&ID=e3852a81-a379-4676-a27a-ef2d3938b3e1.pdf
[44] http://npfmc.legistar.com/gateway.aspx?M=F&ID=1c813c58-b346-4cef-aa74-44dbe2a24b42.pdf

Figure 29 Community of GOA Trawl Catcher Vessel Ownership and Community of Vessel Support Service Businesses Utilized by those Vessels, 2014



Source: NOAA 2015.

4.5.5.3 Taxes Generated by GOA Trawl Fisheries

4.5.5.3.1 State of Alaska Taxes

The State of Alaska levies three fisheries taxes on groundfish. The descriptions of these taxes are taken from the Alaska Department of Revenue Tax Division website, which provides additional information about resource taxes in Alaska.[45,46] The first two taxes are levied as a percentage of ex-vessel value, and

[45] http://www.tax.alaska.gov/programs/programs/index.aspx?60620

[46] The State also levies taxes on commercially caught salmon, including the Regional Seafood Development Tax. That 1% tax is levied on Prince William Sound and Bristol Bay gillnet fishers. While Chinook salmon are not a primary target in those fisheries, a portion of the salmon that are taken in the GOA trawl fisheries have been traced back to

the third is based on first wholesale value. Aggregated, annual average tax liabilities are presented in order to preserve processor confidentiality.

1) A **Fisheries Business Tax** is levied on persons who process or export fisheries resources from Alaska. The tax is based on the price paid to commercial fishers or fair market value when there is not an arms-length transaction. Fisheries business tax is collected primarily from licensed processors and persons who export fish from Alaska. The state shares 50% of tax collected with the incorporated city or organized borough in which the processing took place. If an incorporated city is within an organized borough—such as Kodiak or municipalities within the Aleutians East Borough—the Division divides the 50% shareable amount equally between the incorporated city and the organized borough equally.

   Shore-based processors are assessed at a rate of 3%, and floating processors are assessed at a rate of 5% of the ex-vessel price paid to GOA CVs. Between 2007 and 2016, GOA trawl-caught non-pollock groundfish were delivered to 20 different shore-based processors and five floating processors. During the analyzed period the GOA shore-based processors, in aggregate, paid the State an average of $657,362 per year in Fisheries Business Tax levied on non-pollock groundfish trawl product. Over the same period, the five floating processors paid a combined average of $10,284 per year.

2) A **Fishery Resource Landing Tax** is levied on fishery resources processed outside the 3-mile limit and first landed in Alaska or any processed fishery resource subject to Section 210(f) of the American Fisheries Act. The tax is based on the unprocessed value of the resource (ex-vessel value), which is determined by multiplying a statewide average price (determined by the Alaska Department of Fish and Game data) by the unprocessed weight. The Fishery Resource Landing Tax is collected primarily from factory trawlers and floating processors which process fishery resources outside of the state's 3-mile limit and bring their products into Alaska for transshipment. The Fishery Resource Landing Tax is levied at a rate of 3% of ex-vessel value. Because this action would not directly regulate catcher/processors, no estimate of recently collected Landing Taxes is provided.

3) A **Seafood Marketing Assessment** is levied at a rate of 0.5% of the value of seafood processed products first landed in or exported from Alaska. Taxes collected under this assessment are deposited into the State of Alaska General Fund; the legislature may appropriate funds to the Alaska Seafood Marketing Institute.

   The Seafood Marketing Assessment is based upon the first wholesale value of seafood products, regardless of whether the products were processed at sea or onshore. The first wholesale prices used in this analysis are provided by AKFIN and are based upon COAR data. The action under consideration only affects inshore processing at shore-based plants or on stationary floating processors. From 2007 through 2016, the 25 facilities that processed CV trawl-caught non-pollock groundfish in the GOA collectively paid the State an average of $110,902 per year under the Seafood Marketing Assessment.

4.5.5.3.2 Municipality Raw Fish Taxes

In addition to sharing in the State's Fisheries Business Tax revenues, some municipalities levy raw fish taxes on fish first landed at processing plants located in their community. Municipalities that levied fish taxes and had processors that took deliveries of GOA non-pollock groundfish between 2007 and 2017 are listed in Table 85. The table reports the borough or municipalities' populations, raw fish tax rates, and reported 2017 raw fish tax revenues for all species as reported in the Alaska Department of Commerce,

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genetic stocks that return to those areas (refer to Section 3.3.4 of this document for information on the genetic stock of origin for Chinook salmon encountered in GOA trawl fisheries.

Community, and Economic Development's 2017 Municipal Taxation Supplement (DCCED).[47] Estimated raw fish tax revenues from non-pollock trawl fishing are not reported due to confidentiality restrictions, as the number of plants in most of the relevant communities is less than three. General information on the scale and trends of public revenues generated from groundfish landings in Kodiak, Sand Point, and King Cove are discussed below; greater detail is available in Section 5.2 of the Preliminary Social Impact Analysis that was prepared for the development of the GOA Trawl Bycatch Management Program in December 2016.[48]

Table 85 Raw fish taxes levied by GOA groundfish trawl communities in 2017

Municipality	Population	Raw Fish Tax	2017 Raw Fish Tax Revenue
Kodiak Island Borough	13,563	1.075%	$1,306,507
Unalaska	4,448	2.0%	$4,766,264
Aleutians East Borough	3,032	2.0%	$4,714,403
King Cove	923	2.0%	$949,142
Sand Point	943	2.0%	$590,065
Akutan	1,000	1.5%	Not Reported

Raw fish taxes accounted for roughly 7% of the Kodiak Island Borough's local tax revenues in 2017. The Borough collected roughly $15.7 million in local property tax, as well as a 5% bed tax and a motor vehicle flat tax. The City of Kodiak, with a population of 6,124, does not levy its own raw fish tax, but shares in state taxes on fishery activity. Additional information on Kodiak's reliance on fishing for public revenues is provided in Table 86, below.

The $4.8 million in local fish tax collected by Unalaska in 2017 accounted for roughly 20% of local tax revenues. Other taxes included $11.0 in sales tax, $6.2 in local property tax, and $195,000 from 5% local bed tax.

The $950,000 in raw fish taxes collected by King Cove accounted for 56% of the municipality's local tax revenues, with the balance coming from a 6% sales tax. King Cove also collects an additional flat Fisheries Business Impact Tax of $100,000 per year from the processing plant located in the community.

Sand Point's $590,000 in raw fish tax accounted for roughly 44% of 2017 local tax revenues. The balance comes from a 4% sales tax and a 7% bed tax.

DCCED does not report Akutan's revenues from the 1.5% local fish tax in its 2017 Alaska Taxable Supplement, but the department's community profile lists *combined* 2016 revenues from the local tax and a share of the 2% Borough tax at $1.8 million.[49]

While the City of Kodiak does not collect its own municipal raw fish tax, it shares in Borough and State tax levies and those receipts make up a significant portion of public revenues. The SIA that was prepared for the 2017 Central GOA Rockfish Program LAPP Review notes that fish taxes contributed roughly 6% to 8% of the city's general fund in any given year, from 2003 to 2016.[50] The Rockfish Program SIA also

[47] https://www.commerce.alaska.gov/dcra/DCRARepoExt/RepoPubs/Taxable/2017-AlaskaTaxableSupplement.pdf
[48] http://npfmc.legistar.com/gateway.aspx?M=F&ID=e3852a81-a379-4676-a27a-ef2d3938b3e1.pdf
[49] Akutan community profile available at https://www.commerce.alaska.gov/dcra/
[50] See Section 5.2.1.6, at http://npfmc.legistar.com/gateway.aspx?M=F&ID=1c813c58-b346-4cef-aa74-44dbe2a24b42.pdf

notes that Kodiak's boat harbor brings in revenue that is separate from the general fund, but not insignificant, generally totaling between $2.2 to $2.6 million per year from 2009 through 2016.

Table 86 Selected fisheries related revenues (nominal dollars), City of Kodiak, 2003 through 2016

	General Fund Revenue					
	Shared Fisheries Tax Revenue					
Year	Shared Fisheries Business Tax Revenue	Shared Fisheries Resource Landing Tax Revenue	Total Shared Fisheries Tax Revenue	All Other General Fund Revenue	Total General Fund Revenue	Total Shared Fisheries as a Percent of Total General Fund Revenue
2003	$562,000	$65,719	$627,719	$10,246,779	$10,874,498	5.8%
2004	$788,947*	$37,048	$825,995	$10,025,735	$10,851,730	7.6%
2005	$597,723	$45,837	$643,560	$10,654,165	$11,297,725	5.7%
2006	$655,636	$56,788	$712,424	$11,374,385	$12,086,809	5.9%
2007	$760,099	$68,674	$828,773	$12,095,045	$12,923,818	6.4%
2008	$823,097	$62,581	$885,678	$14,498,488	$15,384,166	5.8%
2009	$946,635	$70,855	$1,017,490	$14,303,651	$15,321,141	6.6%
2010	$1,046,010	$68,818	$1,114,828	$14,517,148	$15,631,976	7.1%
2011	$740,229	$87,810	$828,039	$13,883,507	$14,711,546	5.6%
2012	$1,123,205	$120,822	$1,244,027	$15,228,387	$16,472,414	7.6%
2013	$1,252,420	$90,469	$1,342,889	$16,290,881	$17,633,770	7.6%
2014	$1,189,750	$106,436	$1,296,186	$16,802,027	$18,098,213	7.2%
2015	$1,164,404	$90,093	$1,254,497	$18,857,391	$20,111,888	6.2%
2016	$1,021,500	$88,138	$1,109,638	$16,741,076	$17,850,714	6.2%

*Includes revitalization aid.

Source: DCCED 2017

4.5.6 Markets for Alaska Non-Pollock Groundfish Products

This section summarizes market and price trend information for groundfish species that are targeted in the non-pollock GOA trawl CV fisheries. Much of this information is sourced from the Alaska Fisheries Science Center's 2016 Economic SAFE report, which contains a greater level of detail.[51] The Economic SAFE includes market profiles, which are extracted from a more comprehensive document, *Alaska Groundfish Wholesale Market Profiles*, which was published in May 2016.[52]

The U.S., Europe, and Japan are the largest markets for finished products derived from Alaska groundfish and crab, typically accounting for more than 80% of first wholesale value. Approximately one-third of the production volume is reprocessed in China and re-exported to markets in Europe, the U.S., and Japan. A significant percentage of product exported to South Korea is held in cold storage facilities or secondarily processed and re-exported to Japan and Europe. Most species face market competition from fisheries in other countries. The Economic SAFE provides data on Alaska groundfish species' global market share up to 2013; data aggregates both the GOA and BSAI, across all gear types. In 2013 Alaska Pacific cod accounted for 18% of global cod harvest; flatfish had a 32% global market share, rockfish had a 28% market share, and sablefish had 78% market share. The primary markets for Pacific cod, flatfish, and rockfish was China, which functioned mainly as a reprocessing and

[51] http://www.afsc.noaa.gov/refm/docs/2017/economic.pdf
[52] (http://www.afsc.noaa.gov/News/pdfs/Wholesale_Market_Profiles_for_Alaskan_Groundfish_and_Crab_Fisheries.pdf).

re-export market (Economic SAFE Table 7.3, p.163). From 2010 through 2014, 12% of the volume of Alaska groundfish and crab, in aggregate, were sold directly into the domestic U.S. market. That volume accounted for 26% of the total first wholesale value generated in Alaska groundfish and crab fisheries over that period. Table 87 provides a snapshot of 2014 production by export market on a species basis—again aggregating across the GOA/BSAI and all gear types (adapted from Economic SAFE Table 7.7, p.168). During that year, roughly 23% of wholesale production of the species primarily targeted by GOA non-pollock CVs was sold directly into the U.S. domestic market.

Table 87 Wholesale sales of selected Alaska groundfish (mt), 2014

Species	Wholesale Production	U.S.	Europe	China	Japan	Other	Total Exported
Pacific cod	134,206	30,394	20,975	57,195	16,571	9,071	103,812
Flatfish	167,185	40,045	717	107,486	4,356	13,581	127,140
Rockfish	32192	8,390	58	15,566	6,861	1,317	23,802
Sablefish	6696	593	173	559	4,648	723	6,103
Subtotal	340,279	79,422	21,923	180,806	32,436	24,692	260,857
		23%	6%	53%	10%	7%	77%
Total*	620,134	66,096	159,457	274,903	57,976	61,702	554,038
		11%	26%	44%	9%	10%	89%

*Includes pollock, Atka mackerel, and Pacific halibut.

Prices for Alaska products have been negatively impacted by a stronger U.S. dollar in recent years. The Economic SAFE notes that the magnitude of this shift is unusually large, and that it swiftly altered the bargaining position of Alaska producers. A stronger dollar relative to the currencies of key export markets and competing suppliers makes Alaska seafood more expensive and competing product less expensive from foreign consumers' point of view.

Whitefish, which refers to pollock, cod and flatfish among other species, competes in a global market that includes both wild capture and aquaculture seafood production. Alaska's commercial fisheries produce larger harvests than every other U.S. state combined and 80% of Alaska's harvest volume came from high-volume whitefish fisheries (pollock, cod, and flatfish) in 2013. Despite the impressive scale of its high-volume whitefish fisheries, Alaska is only a fractional part of global whitefish production. In 2013, Alaska production accounted for 13.5% of global wild and farmed whitefish production. As a result, Alaska's groundfish industry is a usually a price taker, where the value of its cod, pollock, and flatfish are impacted by competing suppliers and competing whitefish species. However, low volume Alaska whitefish species like sablefish, rockfish, and halibut have more defined markets where Alaska is the primary export supplier and accounts for a larger percentage of the global supply in niche markets. As a result, species substitution is less common in markets for these species and price is mostly a function of Alaska's harvest volume.

The 2016 Economic SAFE report makes several notes regarding markets for species that are prosecuted by the GOA non-pollock trawl CV sector and the Central GOA Rockfish Program CV sector. The SAFE notes that Pacific cod had been recently marketed in Europe as a substitute for declining Atlantic cod stocks, but that rebounding Atlantic stocks and protective tariffs combined with unfavorable currency exchange rates have made it more difficult for Pacific cod to compete. Flatfish markets have been negatively affected by the rising strength of the U.S. dollar compared to the Euro, and by increasing re-processing labor costs in China. Rockfish prices from Asia have recently been supported by a reduced supply of Atka mackerel (a substitute), but rebounding Atka mackerel quotas could impact prices for

Pacific ocean perch and other rockfish. As with other species, currency exchange rates with the main reprocessing market in China have decreased demand for raw material from Alaska. Finally, sablefish processors have experienced continuing high demand and prices that reflect relatively low TACs compared to historical levels. While sablefish prices peaked in 2011 they remain high; demand has increased in markets outside of Japan, which was the traditional market driver.

The 2016 Economic SAFE also provides information on trends in first wholesale value of key Alaska groundfish species. The SAFE authors use historical data from the Commercial Operators Annual Report (COAR) along with export prices, global estimated catch, and exchange rates to project product values through 2019. These projections do not distinguish between at-sea and shoreside production; nevertheless, this measure reflects the direction in which GOA trawl species' value are expected to move in the future. Values for 2017 (and beyond) are presented as estimates with a 90% confidence interval because COAR data for that year was not finalized at the time that the Economic SAFE was compiled (November 2017).

Readers may find additional market and value information in each chapter of the Groundfish SAFE reports[53] under the heading of "Economic Performance Report." These entries are a new addition to the SAFE document in 2017 and will continue to be developed to provide a time series of market snapshots.

Table 88 Average first wholesale groundfish product price summary and projections (2014 through 2019); 2017 through 2019 projections include 90% confidence interval

Species	Product	2014	2015	2016	2017	2018	2019
Pacific cod	Fillet	2.91	2.65	3.32	3.47	3.49	3.59
					(3.36 - 3.58)	(2.81-4.25)	(2.68-4.72)
	H&G	1.26	1.35	1.28	1.39	1.40	1.41
					(1.31-1.46)	(1.04-1.86)	(0.97-2.03)
	Other	0.78	0.86	0.87	0.88	0.91	0.90
					(0.84-0.93)	(0.72-1.16)	(0.63-1.28)
Sablefish	H&G	6.93	6.95	8.02	8.31	8.38	8.80
					(8.11-8.53)	(7.01-10.00)	(6.90-11.22)
Rockfish	H&G	1.18	1.04	0.93	0.92	0.95	0.97
					(0.85-0.99)	(0.71-1.26)	(0.61-1.47)
Arrowtooth Flounder	H&G	0.70	0.65	0.82	0.74	0.85	0.89
					(0.65-0.84)	(0.53-1.36)	(0.54-1.46)
Flathead Sole	H&G	0.70	0.64	0.77	0.78	0.78	0.76
					(0.74-0.82)	(0.62-0.96)	(0.54-1.05)
Rex Sole GOA	H&G	0.98	0.84	1.01	1.00	0.99	1.00
					(0.95-1.04)	(0.81-1.22)	(0.75-1.30)
Shallow-Water Flatfish GOA	Fillet	1.39	2.37	2.42	2.32	2.24	2.25
					(2.24-2.41)	(1.63-3.17)	(1.51-3.31)

*Source: 2016 Economic SAFE Table 6.1

4.6 Description of Potentially Affected Chinook Salmon Fisheries

North Pacific Chinook salmon are the subject of commercial, subsistence, personal use, and sport/recreational (used interchangeably) fisheries. Chinook salmon are the least abundant of the five salmon species found on both sides of the Pacific Ocean, and the least numerous in the Alaska

[53] https://www.afsc.noaa.gov/refm/stocks/assessments.htm

commercial harvest. The majority of the Alaska commercial catch is made in Southeast Alaska, Bristol Bay, and the Arctic-Yukon-Kuskokwim area. The majority of commercial catch is made with troll gear or gillnets. Historically, most of the subsistence harvest of Chinook occurred in the Yukon and Kuskokwim rivers. In 2010, for example, 86% of the statewide harvest took place in these rivers.[54] However, since 2010, subsistence harvests of Yukon and Kuskokwim river Chinook have declined and accounted for just 55% of the harvest in 2015 (Fall et al. 2018). Predominant gear types in the subsistence fishery include gill nets (drift and set), seines, fish wheels, and long lines. Alaska Department of Fish & Game (ADF&G) reports that harvest by subsistence and personal use fishermen averaged 114,934 Chinook salmon from 2006 through 2015, with 98% of this total taken in subsistence fisheries (Fall et al. 2018). The Chinook salmon is one of the most highly prized sport fish in Alaska and is extensively fished by anglers in the Southeast and Cook Inlet areas. ADF&G reports that the Alaska sport fishing harvest averaged 129,721 Chinook salmon per year from 2007 through 2016 (51% taken in Southcentral Alaska; 46% in Southeast Alaska; and 2% in the Arctic-Yukon-Kuskokwim area). Unlike other Pacific salmon species, Chinook salmon rear in inshore marine waters and are, therefore, available to commercial and sport fishermen all year round.[55]

The Alaska State Constitution establishes, as state policy, the development and use of replenishable resources, in accordance with the principle of sustained yield, for the maximum benefit of the people of the state. In order to implement this policy for the fisheries resources of the state, the Alaska Legislature created the Alaska Board of Fisheries (BOF) and the Alaska Department of Fish & Game. The BOF was given the responsibility to establish regulations guiding the conservation and development of the state's fisheries resources, including the distribution of benefits among subsistence, commercial, recreational, and personal uses. ADF&G was given the responsibility to implement the BOF's regulations and management plans through the scientific management of the state's fisheries resources. Scientific and technical advice is provided by ADF&G to the BOF during its rule-making process. The first priority for management is to meet spawning escapement goals in order to sustain salmon resources for future generations. After escapement needs, the highest priority use is for subsistence, under both state and Federal law. Salmon surpluses above escapement needs and subsistence uses are made available for other uses.[56]

ADF&G's fishery management activities fall into two categories: inseason management and applied science. For inseason management, the division employs fishery managers near the fisheries. Local fisheries managers are given authority to open and close fisheries to achieve two goals: the overriding goal is conservation to ensure an adequate escapement of spawning stocks, and the secondary goal is an allocation of fish to various user groups, based upon management plans developed by the BOF. The BOF develops management plans in open, public meetings after considering public testimony and advice from various scientists, advisors, fishermen, and user interest groups (Woodby et al. 2005). Decisions to open and close fisheries are based on the professional judgment of area managers, the most current biological data from field projects, and fishery performance. Research biologists and other specialists conduct applied research in close cooperation with the fishery managers. The purpose of the division's research staff is to ensure that the management of Alaska's fisheries resources is conducted in accordance with the sustained yield principle, and that managers have the technical support they need to ensure that fisheries are managed according to sound scientific principles, utilizing the best available biological data. The division works closely with the ADF&G Division of Sport Fisheries in the conduct of both management and research activities.

[54] http://www.adfg.alaska.gov/techpap/TP381.pdf
[55] http://www.adfg.alaska.gov/sf/sportfishingsurvey/index.cfm?ADFG=region.results
[56] http://www.adfg.alaska.gov/index.cfm?adfg=chinook.management

By far, most salmon in Alaska are caught in commercial troll, gillnet, and purse seine fisheries, in which participation is restricted by a limited entry system. Troll gear works by dragging baited hooks through the water. Gillnet gear works by entangling the fish as they attempt to swim through the net. Gillnets are deployed in two ways: from a vessel that is drifting and from an anchored system out from the beach. Purse seines work by encircling schools of fish with nets that are drawn up to create giant "purses" that hold the school until the fish can be brought aboard. Other kinds of gear used in Alaska's smaller fisheries include fishwheels, which scoop fish up as the wheel is turned by river currents (Woodby et al., 2005).

4.6.1 State Commercial Salmon Fishery Management

Commercial fishing is defined by the State of Alaska as the taking of fish with the intent of disposing of them for profit, or by sale, barter, trade, or in commercial channels (AS 16.05.940 (5)). Commercial fisheries in Alaska fall under a mix of state and Federal management jurisdictions. In general, the state has management authority for all salmon, herring, and shellfish fisheries, and for groundfish fisheries within three nautical miles of shore.[57] Under the Magnuson-Stevens Act, the Federal Government has management authority for the majority of groundfish fisheries, three to two hundred nautical miles offshore, and Pacific halibut fisheries from the shoreline, seaward to 200 nautical miles.

At present, there are no GOA non-pollock groundfish trawl fisheries occurring in state waters that accrue against the State of Alaska's guideline harvest level (GHL). The only state waters GOA trawl fishery that is managed under the GHL is the Prince William Sound pollock fishery. Other groundfish fisheries that occur in state waters are managed as parallel fisheries, and harvest accrues against the Federal TAC.

The state manages a large number of commercial salmon fisheries in waters from Southeast Alaska to the Bering Strait. Management of the commercial salmon fisheries is the responsibility of the ADF&G Division of Commercial Fisheries, under the direction of the BOF. The fisheries are managed under a limited entry system; participants need to hold a limited entry permit for a fishery in order to fish, and the number of permits for each fishery is limited. The state originally issued permits to persons with histories of participation and economic dependence in the various salmon fisheries. Permits can be freely transferred, bought and sold; thus, new persons have entered into the commercial fishery since the original limitation program was implemented. Table 92 shows the number and estimated market value of active CFEC permits for Alaska salmon fisheries (all salmon species). CFEC's permit value report estimates value based on the average sale price of actual permit transactions. The range reported in the table is the difference between the highest and lowest sale prices that were used to calculate the estimated value, and the standard deviation is a measure of the variance of observations around the average.

Alaska's commercial salmon fisheries are administered through the use of management areas throughout the state. For information on commercial regulations refer to: http://www.adfg.alaska.gov/index.cfm?adfg=fishregulations.commercial.

The value of the commercial salmon harvest can vary widely dependent on a number of factors including the size of the runs, the size of the fish, international markets, foreign currency exchange rates, world aquaculture production, and economic conditions in our domestic and international markets.

Information on the annual commercial Chinook salmon harvest in Alaska is reported at http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyfisherysalmon.salmon_grossearnings_byspecies .

[57] The State of Alaska manages crab under delegated Federal FMP authority, subject to compliance with MSA requirements.

Table 89 summarizes state-wide commercial Chinook salmon harvest and nominal ex-vessel value from 2003 through 2016. Table 90 shows total commercial Chinook salmon harvest and nominal ex-vessel value aggregated over 2003 through 2016 by ADF&G management area within the GOA. Annual harvest cannot be reported by year at the gear/area-level due to confidentiality constraints (fewer than three processors in the Chignik seine fishery). Table 91 shows average annual harvest (# fish) across all gear types for the 2003 through 2016 period. Chignik and Alaska Peninsula are combined for confidentiality.

Table 89 Alaska commercial Chinook salmon harvest and ex-vessel value, 2003 through 2016

Year	Number of Fish	Pounds (Million)	Ex-vessel Value (million$)
2003	607,887	10.0	14.0
2004	794,946	12.7	23.7
2005	679,264	10.5	23.0
2006	624,265	9.9	28.8
2007	562,314	8.6	26.8
2008	344,895	5.2	22.3
2009	361,168	5.1	13.9
2010	378,772	5.4	18.6
2011	459,798	6.2	22.1
2012	342,223	4.6	18.0
2013	321,955	4.1	17.2
2014	490,077	6.0	25.4
2015	506,716	6.0	20.7
2016	408,723	4.9	21.6

Source: ADF&G Commercial Fisheries Division:
http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyfisherysalmon.salmon_grossearnings_byspecies

Table 90 Total GOA commercial Chinook salmon harvest and ex-vessel value (million$), 2003 through 2016

Area	Gillnet		Seine		Troll		Total	
	# Fish	Ex-Vessel	# Fish	Ex-Vessel	# Fish	Ex-Vessel	# Fish	Ex-Vessel
Southeast Alaska	438,338	18.06	775,000	17.08	3,575,971	195.19	4,789,309	230.33
Prince William Sound	309,179	32.13	3,829	0.08			313,008	32.22
Kodiak	30,823	0.30	194,841	1.49			225,664	1.79
Cook Inlet	186,324	7.35	1,251	0.01			187,575	7.35
Chignik/AK Pen.	20,185	0.26	172,772	1.44			192,957	1.69
Total	984,849	58.10	1,147,693	20.09	3,575,971	195.19	5,708,513	273.38

Source: CFEC gross earnings (ex-vessel) from compiled Fish Ticket data, provided by ADF&G.

Table 91 Average annual commercial Chinook salmon harvest (# fish) by area, 2003 through 2016

Area	Average Harvest (# Fish)
Southeast Alaska	342,094
Prince William Sound	22,358
Kodiak	16,119
Cook Inlet	13,398
Chignik/AK Pen.	C
Total	407,751

Source: CFEC gross earnings (ex-vessel) from compiled Fish Ticket data, provided by ADF&G.

Table 92 Number and estimated value of CFEC salmon permits (all species) by fishery and area, 2017

Gear	Area	#Active Permits			2017 Permit Value		
		Total	AK Res.	Non-Res.	Estimated	Range	St. Dev.
Troll - power	Statewide	961	788	173	$33,400	$7,000	$1,600
Troll - hand	Statewide	950	851	99	$10,100	$2,500	$500
Seine - purse	Southeast	315	172	143	$206,300	$25,000	$9,800
	Pr. Wm. Sound	267	194	73	$154,500	$27,500	$7,700
	Cook Inlet	84	77	7	$59,500	$40,000	$16,600
	Kodiak	375	301	74	$27,200	$7,000	$2,650
	Chignik	91	77	14	$167,200	$120,000	$55,450
	Aleutian Pen.	119	82	37	$57,800	$15,000	$6,350
Seine - beach	Kodiak	30	21	9	$4,900	$3,000	$1,300
Gillnet - drift	Southeast	473	384	89	$88,800	$20,000	$5,850
	Pr. Wm. Sound	537	414	123	$147,800	$29,000	$8,650
	Cook Inlet	569	418	151	$42,400	$17,000	$4,800
	Aleutian Pen.	162	89	73	$122,000	$51,000	$19,750
	Bristol Bay	1,863	842	1,021	$133,300	$32,900	$6,050
Gillnet - set	Yakutat	167	136	31	$16,600	$9,000	$4,400
	Pr. Wm. Sound	29	20	9	$190,800	$285,000	$121,350
	Cook Inlet	735	619	116	$15,600	$3,600	$950
	Kodiak	188	126	62	$77,500	$5,000	$2,900
	Aleutian Pen.	111	95	16	$56,800	$3,200	$1,550
	Upper Yukon	46	45	1	$3,300	$4,500	$1,850
	Bristol Bay	972	635	337	$38,700	$8,000	$2,400
	Kuskokwim	700	693	7	$7,300	$500	$300
	Kotzebue	161	161	0	$9,000	$6,000	$3,400
	Lower Yukon	648	646	2	$9,700	$2,500	$650
	Norton Sound	181	181	0	$12,100	$3,500	$1,550

Source: Commercial Fisheries Entry Commission. Permit status reports are available at https://www.cfec.state.ak.us/pstatus/mnusalm.htm; permit value reports are available at https://www.cfec.state.ak.us/pmtvalue/mnusalm.htm.

4.6.2 State Management of Personal Use and Sport Salmon Fisheries

The State of Alaska defines personal use fishing as the taking, fishing for, or possession of finfish, shellfish, or other fishery resources, by Alaska residents for personal use and not for sale or barter, with gill or dip net, seine, fish wheel, longline, or other means defined by the BOF (AS 16.05.940(25)). Personal use fisheries differ from subsistence fisheries, because they either do not meet the criteria established by the Joint Board of Fisheries and Game (Joint Board) for identifying customary and traditional fisheries (5 AAC 99.010) or because they occur within designated nonsubsistence areas.

The Joint Board is required to identify "nonsubsistence areas,'" where "dependence upon subsistence is not a principal characteristic of the economy, culture, and way of life of the area or community" (AS 16.05.258(c)). The BOF may not authorize subsistence fisheries in nonsubsistence areas. Personal use fisheries provide opportunities for harvesting fish with gear other than rod and reel in nonsubsistence areas. The Joint Board has identified Ketchikan, Juneau, Anchorage-Matsu-Kenai, Fairbanks, and Valdez as nonsubsistence areas (5 AAC 99.015). Persons may participate in personal use or recreational harvests for consumptive uses within nonsubsistence areas, but such noncommercial harvests do not have a preference in those areas.

Generally, fish may be taken for personal use purposes only under authority of a permit issued by ADF&G. Personal use fishing is primarily managed by ADF&G, Division of Sport Fish, but some regional or area fisheries for various species of fish are managed by the Division of Commercial Fisheries. For more information on state management of personal use fisheries, refer to the ADF&G website: www.adfg.alaska.gov/index.cfm?adfg=fishingPersonalUse.main.

Since 1994, sockeye salmon have composed a very large portion of personal use salmon harvests in Alaska, about 96%. Chinook salmon made up about 0.8% of the personal use harvest over that time period, about 3,874 fish. In 2015, of a total personal use harvest of 787,053 salmon, 1,817 (0.2%) were Chinook (Fall et al. 2018).

The ADF&G Division of Sport Fish also manages the state's recreational fisheries. Alaska statute defines sport fishing as the taking of or attempting to take for personal use, and not for sale or barter, any fresh water, marine, or anadromous fish, by hook-and-line held in the hand, or by hook-and-line with the line attached to a pole or rod that is held in the hand or closely attended, or by other means defined by the BOF (AS 16.05.940(30)). By law, the division's mission is to protect and improve the state's recreational fisheries resources. For more information on state management of recreational fisheries, refer to the ADF&G website: www.adfg.alaska.gov/index.cfm?adfg=fishingSport.main.

Per Alaska statute (5 AAC 75.075(c)), the ADF&G, Division of Sport Fish is also responsible for overseeing the annual licensing of sport fish businesses and guides. A "sport fishing guide" means a person who is licensed to provide sport fishing guide services to persons who are engaged in sport fishing (AS 16.40.299). "Sport fishing guide services" means assistance, for compensation or with the intent to receive compensation, to a sport fisherman to take or to attempt to take fish by accompanying or physically directing the sport fisherman in sport fishing activities during any part of a sport fishing trip. Salmon is one of the primary species targeted in the states' recreational fisheries. For further information, refer to the ADF&G website: www.adfg.alaska.gov/index.cfm?adfg=prolicenses.sportfishguides. This site contains information important to the ADF&G requirements for sport fish charter businesses, sport fish guides, and saltwater charter vessels.

Chinook salmon are a prized sport fish in Alaska's recreational fisheries, and most anglers sport fishing for anadromous (sea-run) Chinook (king) salmon must have purchased (and have in their possession) a current year's king salmon stamp. For further information, refer to the ADF&G website: http://www.sf.adfg.state.ak.us/Guides/index.cfm/FA/guides.home. This site contains information important to the ADF&G requirements for sport fish charter businesses, sport fish guides, and saltwater charter vessels. Table 93 reports Alaska's regional and total sport harvest of Chinook salmon for recent years.

Table 93 Statewide sport harvest of Chinook salmon by region, freshwater and saltwater combined, 2007 through 2016 (number of fish)

Region	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Southeast	82,848	49,265	69,565	58,503	66,575	46,495	56,392	86,942	79,759	68,347
Southcentral	101,059	77,334	59,855	55,291	57,511	33,348	44,091	43,120	57,811	71,825
Arctic-Yukon-Kuskokwim	8,909	5,658	3,908	3,850	4,021	1,512	602	931	1,356	528
Alaska Total	192,816	132,257	133,328	117,644	128,107	81,355	101,085	130,993	138,926	140,700

Source: http://www.adfg.alaska.gov/sf/sportfishingsurvey/index.cfm?ADFG=region.results

4.6.3 State Subsistence Management

ADF&G, under the direction of the Alaska BOF, manages subsistence, personal use, and commercial salmon harvests in waters within the State of Alaska out to the three-nautical-mile limit. The state has 82 local fish and game advisory committees that review, make recommendations, submit proposals, and testify to the Alaska BOF concerning subsistence and other uses in their areas.

The state defines subsistence uses of wild resources as noncommercial, customary, and traditional uses for a variety of purposes. These include:

> Direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation, for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption, and for the customary trade, barter, or sharing for personal or family consumption (AS 16.05.940[33]).

Under Alaska's subsistence statute, the BOF must identify fish stocks that support subsistence fisheries and, if there is a harvestable surplus of these stocks, determine the amount of the harvestable surplus that is reasonably necessary for subsistence uses, and adopt regulations that provide reasonable opportunities for these subsistence uses to take place. Statute defines "reasonable opportunity" as an opportunity that allows a subsistence user to participate in a subsistence fishery that provides a normally diligent participant with a reasonable expectation of success of taking of fish (AS 16.05.258(f)). The BOF evaluates whether reasonable opportunities are provided by existing or proposed regulations by reviewing harvest estimates relative to the "amount reasonably necessary for subsistence use" findings as well as subsistence fishing schedules, gear restrictions, and other management actions. Whenever it is necessary to restrict harvest, subsistence fisheries have a preference over other uses of the stock (AS 16.05.258). ADF&G, Division of Commercial Fisheries, manages subsistence fisheries in the area of potential effect of this proposed Chinook PSC action. Subsistence and other uses may be restricted or closed to provide for sustainability, based upon relevant adopted fishery management plans.

Alaska subsistence fishery regulations do not, in general, permit the sale of resources taken in a subsistence fishery. State law recognizes "customary trade" as a legal subsistence use. Alaska statute defines customary trade as "…the limited noncommercial exchange, for minimal amounts of cash, as restricted by the appropriate board, of fish or game resources" (AS 15.05.940(8)). This is applicable in certain regions of Alaska, including the customary trade in finfish (including salmon) within the Norton Sound-Port Clarence Area (5 AAC 01.188). Presently, the BOF has not received regulatory change proposals to allow customary trade in salmon resources under state subsistence regulations in other areas under consideration in this document.

ADF&G Division of Commercial Fisheries prepares annual fishery management reports for most fishery management areas in the state. Although fishery management reports focus primarily on commercial fisheries, most also routinely summarize basic data for programs that collect harvest information for subsistence fisheries. Detailed annual reports about subsistence fisheries harvest assessment programs are prepared for the Norton Sound/Kotzebue, Yukon River, and Kuskokwim areas. Also, since 1996, the department has prepared an annual statewide report with summaries of subsistence salmon harvests by management area (e.g. Fall et al. 2018). However, it is important to recognize the challenges associated with the effort to present a comprehensive annual summary of Alaska's subsistence salmon fisheries. Because of such limitations, harvest data may be a conservative estimate of the number of salmon being taken for subsistence uses in Alaska. These limitations include:

1) Annual harvest assessment programs do not take place for all subsistence fisheries, although programs are in place for most salmon fisheries such as the Yukon and Kuskokwim river drainages through post-season household surveys and for the Bristol Bay Area, and other

relatively large subsistence fisheries such as Southeast Alaska and the Copper River, through subsistence salmon permits. There is no longer an annual subsistence harvest monitoring program for the Kotzebue Fisheries Management District.

2) Annual subsistence harvest data are largely dominated by fish harvested under efficient gear types authorized by regulation, which, especially for salmon, generally means fish taken with gillnets, beach seines, or fish wheels. However, in portions of the Kotzebue Fisheries Management District (5 AAC 01.120(b) &(f)), Norton Sound-Port Clarence Area (5 AAC 01.170(b) & (h)), and Yukon Area (5 AAC 01.220(a) & (k)), as well as the entire Kuskokwim Fisheries Management Area (5 AAC 01.270(a)), hook-and-line attached to a rod or pole (i.e., rod and reel) are recognized as legal subsistence gear under state subsistence fishing regulations. In these areas significant numbers of households take salmon for subsistence uses with rod and reel or retain salmon from commercial harvests for home use. Where the BOF has recognized rod and reel gear as legal subsistence gear, annual harvest assessment programs or subsistence fishing permits also document salmon harvested with rod and reel. Federal subsistence management represents different subsistence gear regulations in some cases. For example, in Kotzebue Sound federally qualified users are authorized under Federal subsistence regulations to harvest salmon by gillnet, beach seine, or rod and reel, but these harvests are no longer documented through either a state or Federal harvest monitoring program and the numbers of salmon (largely chum salmon) harvested by gillnet or beach seine compared to rod and reel is unknown.
3) Subsistence permits are used as a basis for annual harvest assessments in many areas of the state, but such permits are not required in some areas (such as the Yukon and Kuskokwim river drainages). No subsistence salmon harvest data collection has taken place in the Kotzebue area since 2004, due to a lack of funding.
4) Between management areas, and sometimes between districts within management areas, there are some inconsistencies in how subsistence harvest data are collected, analyzed, and reported, although progress has been made to develop a more uniform system
5) In some areas there are no routine mechanisms for evaluating the quality of subsistence harvest data. For example, in some areas, it is not known if all subsistence fishermen are obtaining permits and providing accurate harvest reports. This can result in an underestimation of harvests.
6) There are few programs for contextualizing annual subsistence harvest data so as to interpret changes in harvests. However, in some cases, Fishery Management Reports and the annual subsistence harvest report do contain discussions of data limitations and harvest trends.

For more information on state management of salmon subsistence fisheries, refer to the ADF&G website at www.adfg.alaska.gov/index.cfm?adfg=fishingSubsistence.main. The Alaska Subsistence Salmon Fisheries 2015 Annual Report is not available as of February 2018; it will be published as ADF&G Division of Subsistence Technical Paper No. 438 (Fall et al. 2018). The 2014 report was published in January 2017 and is available at http://www.adfg.alaska.gov/techpap/TP427.pdf.

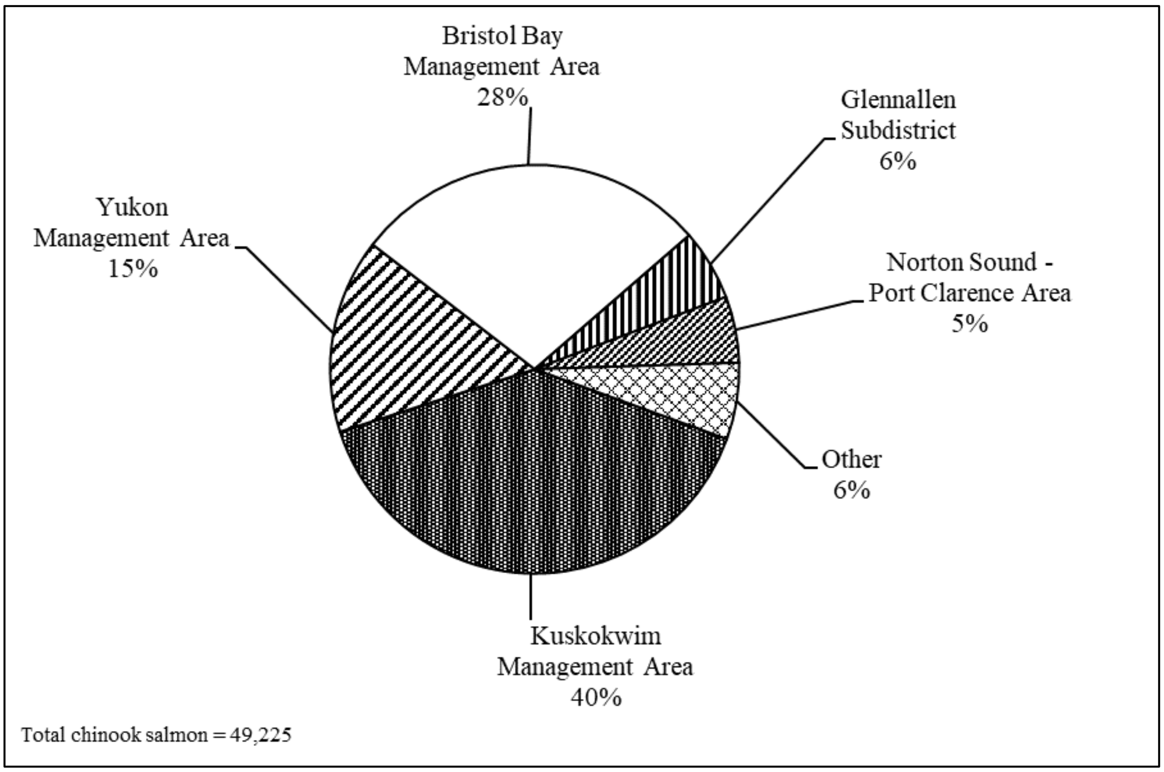
Chinook salmon are the first salmon to arrive in the spring, which is fundamental to their importance for subsistence. In 2015, subsistence take of Chinook salmon was estimated at 49,225 fish. That amount of Chinook accounted for 6% of the total 860,809 subsistence salmon harvested (ADF&G personal communication, December 2017).

The amount of Chinook salmon harvested for subsistence use and the portion of subsistence Chinook salmon harvested relative to other species of salmon vary greatly by region and has declined since 2010. Thirteen subsistence fishing areas are defined in the state of Alaska: Arctic-Kotzeube, Norton Sound–Port Clarence, Yukon, Kuskokwim, Bristol Bay, Aleutian Islands, Alaska Peninsula, Chignik, Kodiak, Cook

Inlet, Prince William Sound/Copper River, Yakutat, and Southeast.[58] The largest estimated subsistence harvests of Chinook salmon in 2015 occurred in the Kuskokwim Area (19,437 salmon, 40%), followed by the Bristol Bay Area (13,874 salmon; 28%), Yukon Area (7,582 salmon; 15%), the Glennallen Subdistrict of the Upper Copper River District (2,762 salmon; 6%), and the Norton Sound–Port Clarence Area (2,588 salmon; 5%).

For the period 1994 through 2011, subsistence Chinook salmon harvests in the state averaged 157,321 fish for about 16% of the annual subsistence salmon harvest. In contrast, the annual average for 2012 through 2015 was 62,792 Chinook salmon, or about 7% of the annual subsistence salmon harvest. Large declines in harvests of Chinook salmon in the Yukon and Kuskokwim subsistence fisheries, due to regulatory restrictions in response to conservation concerns, account for most of this change (Fall et al. 2018).

Figure 30 Alaska subsistence Chinook salmon harvest by area, 2015



Source: Fall et al. 2018, Figure 2-4.

4.6.4 Federal Subsistence Management

The Alaska National Interest Lands Conservation Act (ANILCA) of 1980 mandates that, among consumptive uses of fish and wildlife, rural residents of Alaska be given a priority opportunity for customary and traditional subsistence use on Federal lands. In 1986, Alaska amended its subsistence law, mandating a rural subsistence priority to bring it into compliance with ANILCA. However, in the 1989 McDowell decision, the Alaska Supreme Court ruled that the priority in the state's subsistence law could not be exclusively based on location of residence under provisions of the Alaska Constitution. Other Federal court cases regarding the state's administration of Title VIII of ANILCA ruled that the state would not be given deference in interpreting Federal statute. Proposed amendments to ANILCA and the constitution were not adopted to rectify these conflicts, so the Secretaries of Interior and of Agriculture

[58] See Figure 1-1 of the Alaska Subsistence Salmon Fisheries 2015 Annual Report (p. 5) for a map of the Alaska subsistence areas.

implemented a duplicate regulatory program to assure the rural subsistence priority is applied under ANILCA on Federal lands. As a result, beginning in 1990, the state and Federal governments both provide subsistence uses on Federal public lands and waters in Alaska, which covers about 230 million acres or 60% of the land within the state.[59] In 1992, the Secretaries of the Interior and of Agriculture established the Federal Subsistence Board and ten Regional Advisory Councils to administer the responsibility. The Board's composition includes a chair, appointed by the Secretary of the Interior with concurrence of the Secretary of Agriculture; the Alaska Regional Director, U.S. Fish and Wildlife Service; the Alaska Regional Director, National Park Service; the Alaska State Director, Bureau of Land Management; the Alaska Regional Director, Bureau of Indian Affairs; and the Alaska Regional Forester, U.S. Department of Agriculture Forest Service.

Through the Federal Subsistence Board, these agencies participate in developing regulations which establish the program structure, determine which Alaska residents are eligible to take specific species for subsistence uses, and establish seasons, harvest limits, methods and means for subsistence take of species in specific Federal areas. The Regional Advisory Councils provide recommendations and information to the Federal Subsistence Board; review proposed regulations, policies, and management plans; and provide a public forum for subsistence issues. Each Regional Advisory Council consists of residents representing subsistence, sport, and commercial fishing and hunting interests. Further information on the Federal Subsistence Management Program can be found at https://www.doi.gov/subsistence.

4.6.5 Pacific Salmon Treaty

Overview information on the Pacific Salmon Treaty can be found at:
http://www.psc.org/about_treaty.htm.

Interception of Pacific salmon bound for rivers of one country in fisheries of the other has been the subject of discussion between the Governments of Canada and the United States (among others) for over a century. Intercepting fisheries were identified through research conducted by the U.S. and Canada on species and stocks originating from Alaska, British Columbia, Washington, and Oregon. Management of stocks subject to interception became a matter of common concern to both Canada and the United States. A mechanism to enable the countries to reap the benefits of their respective management and enhancement efforts was required and that mechanism is currently provided through the Pacific Salmon Treaty, ratified by the United States and Canada in 1985.

The Pacific Salmon Treaty is built upon two basic principles:

- Prevent overfishing and provide for optimum production (both countries agree to respond to conservation concerns related to the interception of stocks of mutual concern).
- Equity (each country should receive benefits equivalent to the production of salmon originating in its waters).

The twin principles of conservation and equity are to be implemented, taking into account:

- The desirability in most cases of reducing interceptions;
- The desirability in most cases of avoiding undue disruption of existing fisheries; and
- Annual variations in abundance.

[59] The U.S. Supreme Court has ruled that ANILCA's use of "in Alaska" refers to the boundaries of the State of Alaska and concluded that ANILCA does not apply to the outer continental shelf region (*Amoco Prod. Co. v. Village of Gambell*, 480 U.S. 531, 546-47 (1987)). However, NMFS aims to protect such uses pursuant to other laws, such as the National Environmental Policy Act and the Magnuson-Stevens Act.

The arrangements and institutions established in 1985 were effective in the early years of the Treaty but became outmoded after 1992 when the original fishing arrangements expired. From 1992 to 1998, Canada and the United States were not able to reach agreement on comprehensive, coast-wide fisheries arrangements. In 1999, government-to-government negotiations culminated in the successful renewal of long-term fishing arrangements under the Pacific Salmon Treaty.

Some of the key elements introduced with the 1999 Agreement include the creation of the Transboundary Panel and the Committee on Scientific Cooperation; the inclusion of habitat provisions in the Treaty; a move from fisheries based on negotiated catch ceilings to abundance-based management fisheries; and the establishment of the Northern and Southern Restoration and Enhancement funds ("Northern Fund" and "Southern Fund").

In May 2008, the Pacific Salmon Commission recommended a new bilateral agreement for the conservation and harvest sharing of Pacific salmon to the Governments of Canada and the United States. The product of nearly 18 months of negotiations, the agreement represents a major step forward in science-based conservation and sustainable harvest sharing of the salmon resource between Canada and the United States of America. Approved in December 2008 by the respective governments, the new fishing regimes are in force from the beginning of 2009 through the end of 2018.

The agreement replaces previous versions of the Chapters. The new fishing regimes are contained in the following Chapters of Annex IV of the Treaty:

- Chapter 1. Transboundary Rivers
- Chapter 2. Northern British Columbia and Southeast Alaska Boundary Area
- Chapter 3. Chinook salmon
- Chapter 5. Coho Salmon
- Chapter 6. Southern British Columbia and Washington State Chum Salmon

4.6.6 Summary of Alaska Chinook Salmon Stock Status

Chinook salmon runs in Alaska have been below average since 2007, and management of the fisheries has been conservative in many systems. Implementation of strict fishery management actions has been necessary to meet escapement objectives, and many fisheries have been curtailed to protect Chinook salmon. These restrictions have resulted in forgone subsistence, personal use, sport, and commercial fishing opportunity resulting in hardship across coastal and interior Alaska. These impacts have been most profound in Western Alaska where early Chinook salmon returns provide the first fresh fish after the winter, in mixed-stock salmon fisheries where Chinook salmon conservation measures have resulted in lost harvest opportunity on more abundant species of salmon, and in sport fisheries where opportunity to harvest Chinook salmon in popular and easily accessible sport fisheries has been eliminated in recent years.

There are currently 66 stock-specific Chinook salmon escapement goals. In 2017, 49% of the Chinook salmon escapement goals were met or exceeded statewide. This is a decrease from 54% in 2016 and second year of decline since an increasing trend between 2012 and 2015 (Figure 22). Chinook salmon stock status across Alaska is expected to be below average in 2018 with Southeast Alaska predicted to experience the worst returns on record.[60] Additional information on Chinook salmon stocks by area is included in Section 3.3.5 of this document.

[60] http://www.adfg.alaska.gov/index.cfm?adfg=pressreleases.pr12222017

Geographically, the percentage of Alaska Chinook salmon escapement goals met or exceeded are as follows:

- Southeast Alaska - 17% (2 of 12 goals met)
- Copper River and NE GOA
  - Prince William Sound - 100% (1 goals met)
- NW GOA
  - Upper Cook Inlet - 32% (6 of 19 goals met)
  - Lower Cook Inlet - 100% (All 3 goals met)
  - Kodiak, Chignik, Alaska Peninsula - 0% (0 of 4 goals met)
- Not present in GOA Trawl Chinook PSC
  - AYK Region - 85% (17 of 20 goals met)
  - Bristol Bay - 50% (1 of 2 goals met)

4.7 Analysis of Impacts

This section describes the nature of impacts on the GOA trawl CV harvest sector, processors involved in the fishery and, by extension, the communities where those stakeholders reside or contribute to net social and economic benefits through their participation. This section also considers impacts on commercial and non-commercial users of the Chinook salmon resource. The No Action alternative would leave existing PSC limits in place at the level established in GOA Amendment 97, as modified by the flexibility for NMFS to make inseason PSC reallocations established under GOA Amendment 103. Alternatives 2 and 3 are defined as either simple linear increases to the existing PSC limits for the non-pollock non-Rockfish Program CV sector and the Rockfish Program CV sector (Options 1 through 3), or a direct within-sector rollover of unused PSC from one year to the next (Option 4). Because of that simple construction, this section addresses most of the qualitative description of impacts under Alternative 1 (Section 4.7.1) and approaches the impacts of Alternative 2 and 3 as changes “by degree.” Describing the impacts of the action alternatives in qualitative terms is justified by the fact that annual Chinook PSC levels vary widely and without a predictable trend (Table 74), so neither the status quo PSC limits nor the modified limits considered under the action alternatives guarantee that a fishery will be curtailed or fishing behavior will be modified in any year. In other words, the direct effect of the action alternatives is a reduction in the *likelihood*, all else equal, that the GOA non-pollock trawl CV fisheries will be closed by Chinook PSC in any given year.

4.7.1 Alternative 1, No Action

Selecting the No Action alternative would maintain status quo Chinook salmon PSC limits for GOA non-pollock trawl CV fisheries (see Table 1 in Section 2.1). The status quo PSC limits were established in the preferred alternative for GOA Groundfish FMP Amendment 97 (NPFMC 2014). As such, the broad effects of selecting Alternative 1 are similar in nature to the effects described in that analysis. This section considers the potential impacts on GOA non-pollock trawl CV harvesters, processors, and communities as well as the Chinook salmon resource and its users.

Non-pollock trawl CVs are apportioned 3,900 Chinook PSC per year, of which 1,200 is apportioned to the Rockfish Program CV sector. Under Alternative 1, the non-Rockfish Program CV sector would still be eligible to carry an additional 360 Chinook salmon into a year if its PSC level was below 2,340 in the previous year. Both the non-Rockfish Program and the Rockfish Program CV sectors are eligible to receive inseason reallocations of Chinook PSC from other GOA trawl sectors up to a cap of 50% of their base PSC limit – 1,350 Chinook PSC for the non-Rockfish Program sector and 600 Chinook PSC for the

Rockfish Program sector. Finally, the non-Rockfish Program sector is eligible to receive a rollover of unused Chinook PSC from the Rockfish Program CV sector on October 1.

All told, the absolute maximum amount of Chinook PSC that each sector affected by this action could use in one year is:

- 4,410 Chinook in the non-Rockfish Program CV sector (2,700 base limit + 360 incentive buffer + 1,350 maximum reapportionments), and
- 1,800 Chinook in the Rockfish Program CV sector (1,200 base limit + 600 maximum reapportionments).

These maximum PSC levels are more theoretical than likely, as they are largely contingent on inseason reallocations of Chinook PSC that is unneeded in other GOA trawl sectors. The most likely source of inseason reapportionments to the non-pollock CV sectors would be from the pollock fisheries, and NMFS would be cautious about reallocating too much Chinook PSC from the pollock to non-pollock sectors before the pollock C and D seasons occur (August 25 through November 1); historically, Chinook PSC rates in the pollock fishery are highest in October during the D season. Inseason reallocations are most likely to occur late in the year when remaining PSC demand in the pollock fishery can be projected with more precision. In cases when pollock A/B season Chinook PSC rates are significantly lower than historically observed levels, NMFS might use its management expertise to make a moderate PSC reallocation earlier in the year if a non-pollock fishery closure is imminent, but during the development of GOA Amendment 103 the agency cautioned that such actions cannot be counted upon. Making aggressive inseason reallocations from the pollock to the non-pollock fisheries might have a low expected net benefit, since most GOA non-pollock trawl vessels (and processors) actually rely upon their own participation in the pollock fishery for a significant portion of annual GOA revenues (refer to diversification tables at Table 69 and Table 80).

Under current regulations, the absolute maximum amount of Chinook PSC that can be taken across all sectors of the GOA trawl fishery is 33,340 Chinook salmon. That total includes the base limits defined in Table 1 (32,500 Chinook), plus the incentive buffers for the non-pollock non-Rockfish Program CV sector (360 Chinook) and the GOA trawl CP sector (480 Chinook). As noted above, the mechanism behind the earned incentive buffer ensures that the maximum Chinook salmon PSC that can be taken over any two consecutive years cannot exceed 32,500 Chinook per year. That amount of Chinook salmon PSC is below the maximum allowable level of 40,000 that is defined in the NMFS incidental take statement described in Section 4.5.3.1 of this document.

When establishing the existing GOA non-pollock Chinook PSC limits under Amendment 97, the Council considered levels that would have placed maximum annual removals between 30,000 and 37,500. The rationale for selecting 32,500 is based on the information presented in Section 4.9 of the EA/RIR for Amendment 97 (NPFMC 2014) and is articulated in the Final Rule that implemented the amendment (79 FR 71350, December 2, 2014).[61] Those documents presented the best available information at the time, which included NMFS's Catch Accounting System's estimates of PSC from 2003 to 2012. The Council's rationale for its preferred alternative (the current status quo) was rooted in balancing National Standards 1 (optimum yield), 2 (best available science), 8 (community considerations), and 9 (bycatch minimization). At the time, the Council spoke to its choice of a conservative PSC limit, relative to other alternatives considered, as a necessary response to concern about the status of Chinook salmon stocks. The Council noted that the preferred alternative established a limit on non-pollock Chinook PSC that was higher than the average over the period considered, but one that would have caused closures during some years if it had been in place. The Council noted that it was placing a potentially costly conservation burden on the

[61] https://www.gpo.gov/fdsys/pkg/FR-2014-12-02/pdf/2014-28096.pdf

trawl sector, and that additional management measures to help the trawl sector minimize its PSC more effectively would be developed. From 2013 to 2016 the Council considered a package that would provide the trawl fleet with cooperative management tools and allocations of groundfish and PSC species, but has not progressed with that issue since December 2016.

4.7.1.1 Effects on Non-Pollock Trawl CV Harvesters

The most obvious effect of a PSC limit on the GOA non-pollock trawl CV sector is the potential to close a fishery prematurely. An early closure affects vessel revenues and crew compensation in a manner that reverberates throughout stakeholder communities. Hard cap PSC limits are a blunt tool in terms of incentivizing participants to minimize Chinook salmon PSC at all times in the context of a competitive limited access fishery, where actions to avoid salmon – such as standing down, relocating, or employing a net excluder device – are individually costly but benefit the fleet as a whole by decreasing the likelihood of a closure. A sector-wide PSC limit does not, in and of itself, incentivize the fleet to achieve a level of Chinook PSC lower than the cap or – for the non-Rockfish Program CV sector – lower than the incentive buffer threshold.

The Council has set PSC hard caps with dual-objectives in mind: preventing PSC from exceeding established conservation goals and supporting the regulated fishery and its dependent stakeholders at historic levels of participation. An established conservation limit such as the 40,000 Chinook ITS represents an absolute maximum. The Council can select – and has selected – a lower target in order to promote positive outcomes for Chinook salmon, albeit indirectly. In selecting the status quo PSC limit for the fisheries affected by this action, the Council articulated that it intended to set a limit that supports the non-pollock trawl sector's historical PSC use over an average of years, but intentionally did not select a level that covered the highest years in order to incentivize bycatch minimization. Under that approach, historical average PSC use is a critical component of selecting the limit that best balances objectives. The purpose and need for this action (Section 1.1) notes that new information from observer coverage that was not in place during the years analyzed for Amendment 97 might indicate that estimated Chinook PSC for a subset of the GOA trawl fleet was lower than the actual rate that supported historical harvest levels. Though it is not possible to retrospectively prove or disprove that smaller trawl vessels were encountering more Chinook salmon than was estimated based on PSC rates extrapolated from larger Western and Central GOA trawl CVs, the marked increase in maximum estimated Chinook PSC for that sector post-restructuring warrants consideration (Table 74).

A hard cap PSC limits is also a blunt tool in terms of its ability to account for natural variations in fisheries (National Standard 6). A hard cap will become increasingly constraining over time if the intrinsic rate of PSC encounter increases due to changes in the environment or human-induced external factors. Information on the precise number and trend of Chinook salmon present in the times and areas that the non-pollock trawl fishery operates is not available, and thus the Council has attempted to set hard caps that account for uncertainty. However, the Council has considered, and may continue to consider, changes in observable factors that might contribute to the presence of Chinook in trawl areas, albeit to an unknown extent. Both the EA/RIR prepared for Amendment 97 (NPFMC 2014) and Section 3.3.7 in this document include data on hatchery releases of Chinook stocks that are known to occur in the GOA.

The trawl CV fleet's greatest motivation to minimize Chinook PSC at all times is uncertainty as to whether a "lightning strike" PSC event could close the fishery unexpectedly, and the seemingly natural annual variability in Chinook PSC encounter levels. In terms of unpredictable high-PSC events, the highest weekly estimated Chinook PSC level from 2007 through 2017 reached 1,302 salmon in the Central GOA, 920 Chinook in the Western GOA, and 899 Chinook in the Rockfish Program CV sector (Section 4.5.1.2). Table 74 in this document illustrates the annual variability in Chinook PSC levels. Since 2007, annual Central GOA non-Rockfish Program CV PSC has ranged from 412 (2016) to 4,529

(2013); Western GOA non-Rockfish Program CV PSC ranged from zero estimated Chinook in 2010 and one estimated Chinook in 2012 and 2014 to 1,686 (2017); the Rockfish Program CV sector ranged from 158 Chinook (2016) to 1,802 (2015). These peaks and valleys span the years before and after the implementation of the existing Chinook PSC limit (2015) and the expansion of observer coverage to smaller Western GOA trawl CVs (2013). The fact that estimated PSC levels have maintained a high variance throughout the range of analyzed years implies that any behavioral change effected by a hard cap does not result in reliably lower Chinook salmon bycatch. Given the potential economic impact of an early fishery closure – as described below in the context of the 2015 analysis for an emergency action to reopen the non-pollock trawl CV fishery – one might assume that fishery participants are operating with all reasonable caution in the context of the status quo management regime and yet still experiencing wide swings in PSC avoidance success.

The Amendment 97 analysis estimated the likelihood and the impact of an early fishery closure based on typical annual harvest, revenue, and estimated PSC patterns from 2007 through 2011. The quantitative estimates of maximum harvest and revenue effects in that analysis assumed no change in fleet behavior. Section 4.7.1.4.5 of the Amendment 97 RIR examined the maximum potential impact of a PSC limit that was apportioned by operational type (CV/CP) with a separate PSC limit for the Rockfish Program. The maximum potential impact on the non-Rockfish Program CV sector was associated with a closure in mid-April, completely closing the Pacific cod B season and the fall flatfish fisheries in the Central GOA. Moderate effects projected an October closure that precluded the latter portion of the Pacific cod B season and the fall flatfish fisheries in the Central GOA. Based on characteristic harvest and PSC patterns over the 2007 through 2011 period, a closure would have been projected in one out of five years.

In 2015 NMFS analyzed the potential impact of a May closure of the GOA non-pollock non-Rockfish Program CV trawl sector at nominal values of $4.6 million in ex-vessel revenues and $11.0 million in gross first wholesale revenues, in addition to indirect impacts on local employment, support service businesses, and public revenues.[62] Because the timing of the closure fell after the Pacific cod A season, those effects were deemed most impactful in Central GOA communities such as Kodiak.

This document builds upon those analyses using more recent years of data that reflect the non-pollock fishery as it operates under a PSC hard cap (2015) and increased observer coverage on smaller trawl CVs in the Western GOA (2013). Harvest patterns in more recent years should reflect any fleet behavior change as a result of the hard cap.[63] The monthly distribution of Chinook PSC presented in Table 77 should reflect any effect of expanding observer coverage to smaller trawl CVs in the Western GOA Pacific cod A season.

Based on historical PSC levels dating back to 2003, the existing hard cap is not expected to cause a PSC closure before the end of March. This means that direct harvest and revenue impacts on the non-pollock fishery would not occur in the Western GOA non-pollock CV sector. Note, however, that many Western GOA harvesters also participate in the Central GOA trawl fishery. From 2007 through 2017, 24 CVs made non-pollock landings in both areas.

[62] RIR for August 2015 Emergency Rule to provide 1,600 Chinook PSC to the non-pollock non-Rockfish Program CV trawl sector (80 FR 47864), available at https://www.gpo.gov/fdsys/pkg/FR-2015-08-10/pdf/2015-19428.pdf
[63] As with any retrospective analysis, harvest and PSC patterns from a small sample of previous years should be considered with the caveat that market and environmental conditions in the fishery are rarely the same from year to year. The 2015 through 2017 period is a small sample of time that includes the 2015 spring/summer closure as well as 2016 and 2017 fisheries that featured historically high pollock TACs, low Pacific cod catch per unit of effort, and relatively low product values on the world market due to a strong U.S. dollar. Nevertheless, these years of data represent the best available information on how the fishery operates under current management, and how it is estimated to perform in terms of PSC under the current observer deployment strategy.

In general, the impact of a PSC closure hinges on whether or not the Central GOA Pacific cod B season fishery and the late-year Central GOA flatfish fisheries can remain open. Those fisheries account for roughly 23% of harvest and 24% of ex-vessel revenues in the non-pollock non-Rockfish Program CV fisheries (see Table 67 and Figure 26, September through December). An exceptionally early closure occurring in April or May could preclude as much as 60% of average annual harvest and revenue. A closure that occurs during the summer months has a modest marginal impact relative to any other closure that falls after the Pacific cod A season, as only 10% of GOA non-pollock harvest and revenues are generated during June, July, and August.

Fishing year 2013 represents a recent high-Chinook event in which PSC would have closed the non-pollock non-Rockfish Program trawl CV sector in mid-season closure (4,544 Chinook). In that year, the 2,700 Chinook base PSC limit would have closed the fishery in May. Based on monthly average harvest and revenue distribution during the 2007 through 2017 period, such a closure would have precluded 37% of average annual ex-vessel revenues (approximately $5.9 million); the majority of that value would come from the Central GOA Pacific cod B season (Table 67). If the sector was operating under the incentive buffer PSC limit of 3,060 Chinook, the fishery would have closed in July, precluding approximately 32% of average ex-vessel revenues ($5.1 million). Presuming that a rollover of unused Rockfish Program Chinook PSC or a NMFS inseason PSC reallocation could be executed on October 1, the fishery could have reopened. During the analyzed period, roughly 13% of non-Rockfish Program ex-vessel value was generated after October 1, meaning that the sector might have recovered approximately $2.1 million (or more depending on whether Central GOA Pacific cod markets and catch rates can support a more intensive October harvest after the PSC constraint had been lifted).

The Rockfish Program CV sector has recorded more than its base limit of 1,200 Chinook salmon three times between 2007 and 2017, though the annual average is roughly 850 Chinook. The first two months of the season (May and June) account for 72% of Chinook PSC; that figure would be higher if a notable outlier in November 2015 data were excluded (Table 77). During the analyzed period, May and June activity account for 66% of Rockfish Program CV harvest by weight, and 63% of ex-vessel value (Table 68). Applying the highest single year total of estimated Rockfish Program CV PSC (1,802 Chinook) to the average monthly distribution of PSC over the analyzed period (Table 77), the fishery would have exceeded its PSC limit at the end of June. A July closure would preclude roughly 34% of average harvest (3,640 mt) and 37% of ex-vessel revenue ($2.3 million).

The simple exercise above gives a rough picture of the maximum potential direct effect of an early-season closure on the Rockfish Program CV sector based on the most recent available data; however, it clearly overstates what a likely outcome and impact would be. The Rockfish Program fishery is cooperatively managed and represents a smaller, more interconnected fleet when compared to the diverse set of non-Rockfish Program CVs that span the Central and Western GOA. Stand-downs or cooperative test-fishing to mitigate and adjust to unexpectedly high PSC rates are easier to coordinate within the Rockfish Program. Moreover, the Rockfish Program fleet carries 100% observer coverage, which lessens – but does not eliminate – the potential for episodic spikes in estimated PSC that sometimes occur when using basket sampling methods (refer to Section 4.5.1.1.1). The analysts suggest that it is not impossible for the Rockfish Program CV sector to reach its annual PSC limit of 1,200 Chinook, but it is highly improbable for that to occur so early in the season. Moreover, should an unexpected series of events close the Rockfish Program CV sector in June or July, the sector *could* receive up to 600 additional Chinook PSC through inseason reapportionment from another sector. A likely scenario in the event of an early season Rockfish CV closure is that NMFS would consider a reallocation from the pollock sector at some point during mid to late September after inseason managers have a sense of PSC rates in the pollock fishery.

It should be noted that this document does not focus entirely on retrospective estimates of forgone catch and revenue. The most valuable late-year GOA non-pollock fishery – Central GOA Pacific cod – is experiencing a dramatic 80% reduction in harvestable biomass that could persist into the medium term if not the long term. The reduced cod fishery will change the annual time-distribution of harvest and revenue from the fishery. Instead of looking backwards, the relative effects of maintaining status quo PSC limits versus increasing them should be viewed more broadly. The Council should weigh the likelihood that higher limits materially reduce the impact of unpredictable mid-year closures against a marginal increase in the maximum amount of annual Chinook salmon PSC that could possibly occur in a year. This is discussed further in Sections 4.7.2 and 4.7.3.

Finally, this analysis incorporates by reference the more extensive discussion in Section 4.7.3 of NPFMC 2014 about the monetary and non-monetary costs (other than forgone harvest) that harvesters incur when fishing under a PSC limit. The existence of a hard cap affects fishing behavior, but the magnitude of those effects varies from year to year and within a year depending on the perceived likelihood of reaching the limit. Individual participants will perceive the potential cost of a closure differently, depending on how much his or her business plan relies on harvest opportunities that occur later in the calendar year. Vessel operators and crew experience direct costs of salmon avoidance measures. Variable costs might increase as vessels spend time and fuel moving away from areas with high PSC rates. If trips are curtailed by PSC avoidance, vessel crews experience decreased labor productivity. Capital costs might also increase if a vessel makes investments in salmon excluding gear.[64]

4.7.1.2 Effects on Processors and Communities

In addition to any revenue loss associated with forgone non-pollock groundfish harvest, the processing sector might be impacted vis-à-vis its ability to anticipate the need for and utilization of labor, fixed processing costs per unit of production, loss of input supply products to value-added processors in other regions, and fulfillment of output supply contracts.

One of the greatest impacts of hard cap PSC limits on processors is uncertainty about the amount and/or timing of groundfish deliveries. Before the fishing season begins, processors estimate the number of workers that are needed to process expected deliveries. Because of the remote locations and the relatively small communities in which some processors operate, those processors are required to import labor from outside the local community. Processors with less diverse operations may experience greater impacts from Chinook salmon closures, as they have fewer alternative activities to which labor can be redirected during downtime in the groundfish fishery. For example, a plant that is not part of a Rockfish Program cooperative or that does not take a significant amount of halibut/sablefish IFQ deliveries might be more impacted by a non-pollock closure that precludes spring and fall flatfish fishing or the Central GOA Pacific cod B season. Processors that derive a greater portion of their revenue from other species such as pollock, salmon, or halibut might be relatively less impacted by a closure.

Processors in King Cove and Sand Point tend to have larger numbers of non-resident employees and may incur a greater cost from closures if they need to retain underutilized labor at their plants for an extended period of time between fisheries. By comparison, Kodiak plants tend to maintain a workforce that has a higher proportion of local residents. While plants with a resident workforce might incur fewer expenses related to housing and feeding employees, they would incur costs associated with keeping quality employees on the job and maintaining workforce morale. In either case – but especially in Kodiak – reduced wages and labor productivity will have negative local multiplier effects and might also lead to negative social outcomes.

Any alteration of delivery patterns throughout the fishing year can impact processor revenues, even if total deliveries are not reduced. An approaching Chinook PSC hard cap closure might create incentive for

[64] Note that salmon excluder gear has primarily been developed for the pollock trawl fishery, and effective use has typically been limited to larger trawl CVs that can tow at a relatively higher rate of speed.

fishermen who historically rely upon harvest from that area to intensify local fishing effort. As deliveries become concentrated into earlier parts of the year, processors could be forced to employ additional staff. Concentration of the limited access fishing season could also affect processors' ability to manage input flows in order to focus on higher value product forms. Processors that take more deliveries from vessels prosecuting state-managed fisheries such as salmon or fixed-gear cod might be relatively less exposed to Federal groundfish closures, depending on the timing of the closures.

Processing crews are also potentially affected by unpredictable fishery closures. Non-pollock fisheries such as flatfish often serve as a bridge season between the pollock/Pacific cod seasons and salmon processing in the summer. Those fisheries might also be the only source of wages in November and December, after the pollock, cod, and rockfish fisheries are closed by regulation.

4.7.1.3 Effects on Chinook Salmon Users

Limiting the amount of Chinook salmon PSC taken in non-pollock fisheries provides value to commercial Chinook salmon harvesters and processors, consumers, sport fishermen, charter operators, subsistence users, species that prey upon salmon (including ESA-listed species), and salmon stocks that are protected under the ESA and prioritized for conservation and recovery. Like the groundfish resource, the economic activity generated by salmon harvesting in commercial and non-commercial sectors creates employment and other socioeconomic benefit multipliers throughout coastal communities and the nation.

Chinook salmon are, arguably, the most prized of the five Pacific salmon species present off the west coast of North America. Chinook salmon contribute cultural, commercial, recreational, societal, subsistence, and ecological value in many forms, to a variety of users. Many of the benefits generated by these Chinook salmon user groups do not involve a market transaction. The lack of a market price makes comparing the value accruing to various users more difficult, but nonetheless important. As a result, value judgments are often based on the utility that individuals derive from Chinook salmon remaining in the ecosystem or being taken by a particular user group (e.g., Native Americans, subsistence-users, recreational fishermen) and not simply the market price of a fish. Society has invested heavily in the protection, recovery, and enhancement of Chinook salmon. Public and private entities have devoted expenditures to fish passageway, habitat recovery, migration assistance, and hatcheries; these investments are clear demonstrations of the value that society places on these fish.

The implementation of non-pollock fishery Chinook salmon PSC limits capped the maximum amount of salmon that can be taken in the trawl fishery. While this analysis recognizes that taking fewer Chinook in the trawl fishery represents a benefit to other users of the resource in aggregate, the direct effect of a marginal “saved” Chinook salmon is difficult to quantify with precision. Section 3.3.3.2 describes the use of adult equivalent (AEQ) models to understand the translation of Chinook taken as trawl PSC to reduced spawning potential, and Section 3.3.3.3 explores the correlation between trends in trawl PSC and gulf-wide abundance. Section 3.3.4 provides the best available information on the regional origins of the Chinook salmon that are taken as GOA trawl PSC, using genetic analysis and tagging studies. Taken together, the information in the EA is sufficient to identify that roughly 80% of the Chinook salmon taken in the GOA trawl fishery come from streams in British Columbia and the U.S. Pacific Northwest, and the other 20% originate in Southeast Alaska and the north coast of the GOA; impacts on Chinook stocks in western Alaska and trans-Pacific regions are negligible. However, the available information does not support the quantification of small scale impacts on individual stocks. Moreover, the size of Chinook PSC at the point of capture suggests that the salmon are distributed around the age-3 to age-5 range, meaning that some of the Chinook that are taken in the trawl fishery would have returned to spawn in their natal stream in the year of capture or in future years, but others would have experienced natural mortality in the absence of a trawl fishery.

While it is acknowledged that trawl PSC has a negative impact on Chinook salmon stocks, the reduction in spawning potential caused by a PSC removal is likely less than one-to-one. Overall, there is not sufficient evidence to conclude that the GOA trawl fishery's take of Chinook salmon is – or is not – causing escapement failures in Alaska rivers from the South Alaska Peninsula to the U.S. West Coast. The data limitations described in this document do not support an estimate of the specific impact of the GOA trawl fishery on ESA-listed salmon runs; as noted in Section 4.5.3.1 of this document, the most recent incidental take statements maintain that total Chinook PSC levels of fewer than 40,000 Chinook per year are not likely to jeopardize protected salmon runs.

4.7.1.4 Management Considerations

NMFS manages non-transferable Chinook PSC limits that are applied to a harvesting sector, in aggregate, using inseason assessments of estimated PSC levels, PSC rates, and projected fishing effort. If no PSC reallocation or rollover is available from another GOA trawl sector then NMFS issues a notice in the Federal Register to close directed fishing when a PSC limit is reached (or might be reached before NMFS could issue a closure). These closures apply to all vessels participating in the relevant directed fisheries. Any vessel fishing after the closure is in violation of regulations governing the closure. NMFS's ability to keep the directed fishery open and manage with inseason measures depends on the amount of available PSC remaining and the amount of effort in the fishery. In the EA/RIR for Amendment 97, NMFS noted that inseason managers would take a precautionary approach when remaining PSC is less than the highest weekly PSC level that has been observed in that sector. During the analyzed period, peak weekly PSC levels – which were outliers from average weekly PSC – were in the neighborhood of 1,000 Chinook salmon for both the non-Rockfish and Rockfish Program CV sectors.

Conservative management can be especially necessary in the non-pollock non-Rockfish Program fishery because it is a competitive limited access fishery that can display high pulses of effort. Furthermore, weekly PSC rate estimates that are derived from extrapolation of observers' at-sea samples onto unobserved fishing effort can have a high variance in the short-term, and might be revised during the course of the season as additional observer trips are debriefed. Beginning in 2017, NMFS has flexibility to make inseason reallocations of Chinook PSC to sectors that have a low remaining limit (GOA Amendment 103). As a result, NMFS is better able to avoid situations where extremely conservative closures are necessary. However, the availability of an inseason reallocation from another sector is not guaranteed. Reallocations would likely not be available during years in which PSC levels are high across all sectors (pollock and non-pollock), or early in a year when a sector with remaining PSC is expected to have a high level of effort in later months (e.g. the pollock C/D season).

NMFS works with harvesters and processors when they present plans for an industry-led stand down or a voluntary catch sharing agreement to harvest remaining TAC near the end of a seasonal quota or under a constraining PSC limit. Records of "PSC stand downs" are not available because NMFS does not track the reason for all inseason cessations in fishing. In some cases, a stand down does not last long enough for inseason managers to verify that it occurred. In other cases, it is not clear whether a stand down was the result of coordination to avoid PSC, weather, or a combination of factors. Anecdotally, however, NMFS noted that the Western GOA trawl fleet stood down for PSC during the week from February 19 through 25, 2017. Efforts to coordinate fishing plans with NMFS in the Central GOA are described in Section 4.5.1.2.1 of this document; most recent voluntary measures in that area occurred in the pollock fishery.

4.7.2 Alternative 2, Increase non-pollock non-Rockfish Program CV sector Chinook salmon PSC limit

Alternative 2 would modify the non-pollock non-Rockfish Program CV sector's annual Chinook salmon PSC limit. Options 1 through 3 would increase the base annual limit by 1,000 to 3,000 fish. The resulting base PSC limit would increase from 2,700 Chinook to 3,700, 4,700, or 5,700 fish. Option 4 would not increase the base PSC limit; rather, it would allow the sector to roll over a capped amount of unused PSC from one year to the next ("unused" would be assessed with regard to the existing base limit of 2,700 Chinook, irrespective of any rollover that the sector is carrying from a previous year). Options 1 through 3 would retain the existing incentive buffer mechanism, while Option 4 would replace it. Table 2 in Section 2.2 shows the maximum possible amount of PSC that could be taken by the sector in a single year, factoring in the application of the incentive buffer established under Amendment 97 and the maximum inseason reallocation from other GOA trawl sectors established under Amendment 103. The highest possible amount of PSC use would be 9,310 (Option 3). Table 3 shows the maximum amount of PSC available if incentive buffer and maximum reapportionment amounts are not affected by this action; the highest possible amount in that case would be 7,410 (Option 3).

It is important to note that the maximum possible single year PSC limits described in those tables overstate the real increase in potential annual Chinook PSC removals on an ongoing basis. Under Options 1 through 3, the incentive buffer would have to be earned each year by meeting or outperforming an avoidance threshold in the previous year that equals the size of the buffer. That structure ensures that the incentive buffer represents no increase in Chinook removals on a multiyear basis. Option 4 rolls over unused salmon from one year to the next on a one-to-one basis, but even that rollover is capped so that not every unused Chinook would be rolled over from a year of very low PSC. Inseason reallocations represent a net-zero increase in allowable Chinook PSC across all GOA trawl fisheries because the reallocated PSC must be taken from another sector. Moreover, NMFS is not obligated to make an inseason reallocation; that ability was established for the expressed purpose of building in flexibility to respond to unintended and unforeseen PSC events. It is possible that the agency would *not* make a reallocation to a sector that was displaying an atypically high Chinook PSC rate without evidence that the sector had a cause to continue fishing beyond its base PSC limit and a plan to minimize bycatch in accordance with the National Standards. In summary, Options 1 through 3 increase the maximum average annual GOA trawl PSC limit by only 1,000, 2,000, or 3,000 Chinook, depending on the option selected. Option 4 does not increase the maximum average annual PSC from the status quo level, but could increase PSC use in a particular year when the sector is carrying rolled-over PSC and fleet-wide Chinook encounter rates happen to be elevated. If one presumes that the trawl CV fleet's effort to minimize Chinook PSC is constant but results vary from year to year based on external factors, then the amount of PSC that the fleet can rollover in any given year is partly a function of chance. If a year in which the sector carries additional "rollover PSC" aligns with a year of high Chinook encounter rates, then the rollover option could result in higher PSC use relative to Alternative 1.

Similar to the effect of an inter-annual rollover (Option 4), PSC that is reallocated inseason likely represents an increase in the amount of Chinook that is caught in a particular year relative to what would have been caught in the absence of inter-sectoral transfers. Said otherwise, if NMFS is reallocating Chinook PSC from a sector where it is not projected to be needed to a sector where it is, then the likelihood that it will be used to cover Chinook removals increases in the latter sector. The Council weighed this issue when considering Amendment 103, and its rationale for action is described in the Final Rule (81 FR 62659; September 12, 2016).[65] The rationale focuses on providing the fleet and managers with flexibility to continue working towards National Standards 1 (optimum yield), 6 (account for variation), and 8 (minimize impacts on communities) in the context of highly variable annual PSC levels and the decision not to implement a cooperative allocation program for GOA trawl fisheries. The current cap on inseason reallocations to the non-pollock non-Rockfish Program CV sector is 1,350 Chinook PSC. This action could increase that amount to 1,850 (Option 1), 2,350 (Option 2), or 2,850 (Option 3); Option 4 would not modify the maximum inseason reallocation. If the Council determines that increasing the

[65] https://www.gpo.gov/fdsys/pkg/FR-2016-09-12/pdf/2016-21808.pdf

maximum possible reallocation to this sector by up to 1,500 Chinook salmon[66] substantially reduces the incentive to avoid Chinook during high-encounter years, then the Council could move forward considering Alternative 2 with the stipulation that maximum inseason reapportionments remain capped at their current level.

The non-pollock non-Rockfish Program CV sector was apportioned the smallest amount of “head room” in its base PSC limit (2,700) relative to its historical PSC use as analyzed when the Council took action on Amendment 97. PSC estimates for the sector in recent years suggest that the sector’s expected annual PSC encounter is even closer to the allotted hard cap of 2,700 Chinook salmon. Since the implementation of Amendment 97 in 2015, the sector has recorded Chinook PSC levels of 2,873, 425, and 2,244 (Table 74). Those widely varying totals, plus the acknowledged risk of a lightning strike PSC event of up to 1,000 estimated Chinook PSC in a week, illustrate the fact that the sector operates in an unstable setting. The Council has acknowledged this situation by implementing the Rockfish Program rollover provision and the incentive buffer as part of Amendment 97, as well as the flexibility measures provided by Amendment 103. Nevertheless, the possibility of closure before a rollover is available (October 1) or in a year when other sectors cannot afford to have PSC reallocated from their limits is a constant source of uncertainty.

Increasing the sector’s base PSC limit (Options 1 through 3) would reduce the likelihood of unpredictable closures, providing security to groundfish harvesters, processors, and communities. Allowing year-to-year rollovers of unused Chinook (Option 4) has a similar effect, but is contingent upon circumstances in the preceding year over which the fleet has only partial control. Reducing unpredictability may provide security could allow for better business planning, encourage investment in the affected fishery, stabilize the shoreside and at-sea workforce, and reduce uncertainty in an important source of public revenues. A higher PSC limit would reduce the number of years in which the limit is viewed as a looming constraint as the fishery progresses (i.e., years in which PSC levels in the Pacific cod A season and Central GOA spring flatfish fisheries are high). As noted in the previous section, vessels might modify their behavior and race for target species with less regard for PSC minimization when a mid-season closure is perceived as imminent and unavoidable. The benefits of reducing uncertainty and unpredictability in the frequency and timing of PSC closures are likely to be felt more strongly by stakeholders in the Central GOA fishery where harvest and revenues continue to accrue later in the calendar when closure is more likely.

Given the observed annual variability in Chinook PSC levels, this analysis does not forecast the number of annual closures in future years that would have occurred under the status quo PSC limit but would not occur under Alternative 2. Table 74 shows that the sector recorded PSC levels greater than 4,000 Chinook in two of the 11 years from 2007 through 2017 (2010 and 2013). The fishery also reached 3,500 Chinook in one historical year (2011), placing it within the margin of error for an expected PSC closure. That amount of PSC would have caused a closure under Alternative 2, Option 1, but not under Options 2 or 3. Under Option 4, a PSC total of 4,000 Chinook would certainly close the fishery if the year-to-year rollover is capped at 675 additional Chinook (Suboption 1), but might not close the fishery under Suboptions 2 and 3 *if* the sector had at least 1,300 unused Chinook PSC from the preceding year (PSC in the preceding year of less than 1,400). Based on the information provided in Table 77, a year with around 4,000 Chinook salmon and a typical monthly distribution of PSC accrual would have closed the fishery in October, curtailing part of the Central GOA Pacific cod B season and the late-year flatfish fishery.

If one accepts the premise that Chinook PSC was underestimated in the Western GOA non-pollock trawl CV fishery prior to observer program restructuring in 2013 – as discussed in Section 4.5.1.1 – it makes sense to revisit estimated PSC levels for earlier years and examine what they might have been if 2013

[66] 1,500 Chinook PSC is the difference between the maximum reallocation under Option 3 (2,850) and the status quo (1,350).

through 2017 levels are a truer reflection of expected PSC in the Western GOA Pacific cod A season. The purpose of this thought exercise is to assess whether the Council achieved its objective of providing the sector with a limit that reflects historical use of Chinook PSC when it crafted Amendment 97. Average PSC in the Western GOA from 2013 through 2017 was 554 Chinook; three of those five years recorded fewer than 15 salmon, while the other two years were over 1,000 salmon (1,056 in 2015 and 1,686 in 2017). For the sake of illustration, consider the total GOA non-pollock non-Rockfish Program CV sector PSC levels that would have occurred from 2007 through 2012 if the Western GOA PSC was 1,000 Chinook instead of the negligible amounts reported in Table 74 (maximum of 107 Chinook in 2008). Average GOA non-pollock non-Rockfish Program PSC would have averaged 3,193 Chinook from 2007 through 2012 (range of 1,749 to 5,161) instead of 2,230 (range of 856 to 4,161). If average PSC from 2007 through 2012 is assumed to be 3,193 and average PSC from 2013 through 2017 is taken at the amounts shown in Table 74, the sector's average PSC for the entire period would have been 2,789. The preceding exercise is not put forth as a model, and the analysts do not mean to imply that PSC estimation for the Western GOA Pacific cod A season fishery was low by 900 to 1,000 fish in every year. Nevertheless, the notion that expected annual PSC in the non-pollock non-Rockfish Program sector might be higher than what was reflected in historical catch accounting data warrants some consideration. If that notion holds some validity, then it follows that the probability of a PSC closure in this sector is higher than what was assumed when the existing hard cap was defined.

As noted in the previous section (Alternative 1), this analysis should also look ahead to the foreseeable future. Based on information available in the GOA Groundfish SAFE, harvest and PSC levels in the non-pollock non-Rockfish Program CV trawl sector will likely look different in 2018 and 2019 due to a significant reduction in available Pacific cod TAC. It is possible that reduced effort in the fishery will depress expected PSC levels as a function of rates. On the other hand, vessels that would normally focus on Pacific cod might increase their participation in flatfish fisheries, which are observed to have higher Chinook PSC rates (Section 4.5.3.3). The extent to which that target substitution will occur is not forecast in this analysis. The analysts suspect, however, that flatfish will not replace Pacific cod harvest on a pound-for-pound basis due to the lower value and marginal profit in the fishery. Moreover, substituting flatfish effort for Pacific cod effort could result in higher halibut PSC, which could also close the fishery prematurely. As a result, near-term Chinook PSC levels might be deflated relative to expectations based on the past. Nevertheless, the Council may wish to consider this action based on potential benefits and costs over the medium- to long-term, at which point there is a non-zero chance that Pacific cod stocks will rebound and restore effort to the levels on which the previous retrospective analyses were based.

The Council should weigh the potential benefits to the trawl sector and its stakeholders against the possibility that higher PSC limits in all years (Options 1 through 3) or in some years (Option 4) could decrease incentives to avoid Chinook PSC and result in higher bycatch levels relative to the No Action alternative. The amount and distribution of benefits to particular Chinook salmon stocks that result from lower PSC cannot be quantified with the information available, but research on stock of origin identification indicates that effects would be relatively tilted towards British Columbia and U.S. west coast stocks. Nevertheless, it should be acknowledged that Chinook salmon provide direct and indirect benefits to a wide range of consumptive and non-consumptive user groups, and that actions that increase Chinook removals represent a marginal adverse impact on those stakeholders.

4.7.3 Alternative 3, Increase Rockfish Program CV sector Chinook salmon PSC limit

Alternative 3 would modify the Rockfish Program CV sector's annual Chinook salmon PSC limit. Options 1 through 3 would increase the base annual limit by 300 to 900 fish. The resulting base PSC limit would increase from 1,200 Chinook to 1,500, 1,800, or 2,100 fish. Option 4 would allow the sector to roll over a capped amount of unused PSC from one year to the next ("unused" would be assessed with regard to the existing base PSC limit of 1,200 Chinook, irrespective of any rollover that the sector is carrying from a previous year). Table 6 in Section 2.3 shows the maximum possible amount of PSC that could be taken in the sector in a single year, factoring in the application of the maximum inseason reallocation from other GOA trawl sectors established by Amendment 103. Depending on whether an increase in the sector's base PSC limit (Options 1 through 3) would affect its maximum inseason reapportionment, the highest possible amount of PSC use in the fishery would be 2,700 or 3,150 Chinook (Option 3). As noted under Alternative 2, these maximum use cases are very unlikely given the purpose and rationale for implementing Amendment 103.

The Rockfish Program fishery operates under 100% observer coverage. As a result, the variance in PSC estimation is expected to be low, and the annual PSC levels reported in Table 74 are a strong indicator of annual average PSC levels that can be expected in the future. Average Chinook PSC from 2007 through 2017 was 848 fish, with a low of 158 (2016) and a high of 1,802 (2015). The fact that the highest and lowest PSC levels occurred in consecutive years reflects the supposition that Chinook PSC is unpredictable and that hard caps should account for expected variability, even in cooperatively managed fisheries with secure groundfish species allocations that remove the incentive to race for fish. The sector recorded Chinook PSC levels higher than the status quo PSC limit in three of the 11 years since the Pilot Program was implemented in 2007. Moreover, even in the context of a full observer coverage fishery, lightning strike PSC events have occurred (albeit in singular end-of-season circumstances described in Section 4.5.3.3).

The estimated maximum potential impacts of a fishery closure under the status quo PSC limit is identified in Section 4.7.1.1. The sector operates under a PSC limit that is high relative to its historical average use, and it has the operational advantages conferred by cooperative management. As a result, the most likely impact of increasing the sector's PSC limit is that the probability of a PSC closure will marginally decrease while the expected amount of the October 1 PSC rollover to the non-Rockfish sector will increase. Because the marginal PSC limit increases or rollovers under consideration (300 to 900 Chinook) are not larger than the sector's highest recorded weekly PSC level (899), it is not possible to conclude that raising the Rockfish Program CV PSC limit will reduce the probability of a PSC closure to zero. Increasing the expected October 1 rollover to the non-Rockfish CV sector is in accordance with the Council's original intent for apportioning the Rockfish sector with a base PSC limit that exceeded its historical average use. As noted in Section 4.5.2.1, an average of 87% of Rockfish CVs participate in Central GOA Pacific cod and/or flatfish fisheries after October 1 on an annual basis.

As noted in the preceding sections, an action that increases the amount of Chinook PSC available for use in a given year entails potential adverse impacts on direct and indirect users of the Chinook salmon resource. The level and distribution of those impacts at the individual stock-level are not quantifiable with available information.

4.8 Affected Small Entities

Section 603 of the Regulatory Flexibility Act (RFA) requires that an initial regulatory flexibility analysis (IRFA) be prepared to identify if a proposed action will result in a disproportionate and/or significant adverse economic impact on the directly regulated small entities, and to consider any alternatives that would lessen this adverse economic impact to those small entities. As of January 2017, NMFS Alaska Region will prepare the IRFA in the classification section of the proposed rule for an action. Therefore, the preparation of a separate IRFA is not necessary for the Council to recommend a preferred alternative. This section provides information that NMFS will use to prepare the IRFA for this action, namely a description and estimate of the number of small, directly regulated entities to which the proposed action will apply.

The entities that would be directly regulated under this action are catcher vessels that participate in the GOA trawl non-pollock groundfish fishery. Under the RFA, businesses classified as primarily engaged in commercial fishing are considered small entities if they have combined annual gross receipts not in excess of $11.0 million for all affiliated operations worldwide, regardless of the type of fishing operation (81 FR 4469; January 26, 2016). If a vessel has a known affiliation with other vessels – through a business ownership or through a cooperative – the vessel's gross receipts measured against the small entity threshold based on the total gross revenues of all affiliated vessels. Because public information on business ownership is incomplete, this analysis only considers affiliation in the form of membership in a fishing cooperative. AKFIN has provided data on GOA trawl CVs' total gross revenue across all activities, including fixed-gear and state-managed fisheries (e.g., Pacific cod and salmon). AKFIN applies combined gross revenues at the cooperative level for vessels that participate in the CGOA Rockfish Program, the Bering Sea AFA pollock fishery, or a crab cooperative.

Fifty-six GOA trawl CVs operated in 2016, which is the most recent year for which gross ex-vessel revenue data are available. Twenty-three of those vessels are classified as small entities. The average gross revenue for small entity CVs was $1.02 million, and the median was roughly $990,000. Two of the 23 small entity CVs were affiliated with cooperatives that accumulated a total gross revenue of less than $11 million during the year.

Thirty-three GOA trawl CVs are classified as large entities. No large-entity CV grossed more than $11 million dollars individually; the average revenue was $1.50 million and the median was $1.62 million. All of the large-entity CVs were affiliated with cooperatives that grossed more than $11 million. The lowest cooperative gross revenue was $11.05 million, and the highest was $257.67 million.

4.9 Summation of the Alternatives with Respect to Net Benefit to the Nation

A qualitative description of each alternative's likely net benefit compared to the No Action baseline will be further developed as the Council identifies a (preliminary) preferred alternative.

Neither the action alternatives nor the No Action alternative would allow annual Chinook salmon PSC levels in the GOA non-pollock trawl CV fisheries to contribute to exceeding a level of total GOA trawl PSC that would jeopardize protected species. Given that starting point, the Council must weigh the relative benefits of reducing the likelihood of unexpected trawl fishery closures against the likelihood that Chinook salmon PSC rises to levels that would not have been permitted under Alternative 1. The direct and indirect stakeholder groups that benefit from the groundfish trawl fishery and the Chinook salmon resource are broad, diverse, and, in some respects, overlapping.

Annual Chinook salmon PSC levels are shown to be highly unpredictable from year to year, and thus forecasts of future PSC levels are not part of this analysis. As a result, the likelihood of a PSC-closure under any of the proposed alternatives can only be quantified in terms of increasing or decreasing relative to the status quo. Alternatives 2 and 3 would reduce the likelihood of a fishery closure, though the probability would not fall to zero. The action alternatives also increase the maximum amount of Chinook salmon that could be taken as PSC in any given year, though historical performance has not indicated that actual PSC levels track at or just-below the imposed limit. Past performance suggests that PSC levels will continue to vary widely – near the limit in some years, and well below it in others. As such, the alternatives that increase the limit might allow for additional Chinook PSC relative to No Action in some years but would reduce uncertainty in achieving the full socioeconomic benefits of the trawl fishery in all years.

The purpose and need for this action defines an objective of setting a PSC limit that most appropriately balances harvest opportunities, community stability, and bycatch minimization in light of the known variability in PSC rates and the best information available (Section 1.1). The timing of a significant increase in estimated Chinook salmon PSC levels in non-pollock trawl fisheries coincided with an expansion of direct observer coverage in the fishery, which at least suggests the possibility that new information is available now compared to what was known when status quo PSC limits were established. As a result, this analysis suggests that the assessment of what constitutes an appropriate PSC limit may also have changed. The action alternatives provide a range of options for revising PSC limits to reflect expected use and dependence. Given the known variability in PSC encounter rates and the acknowledged imprecision of PSC hard caps as a management tool, the Council also included the objective of enhancing flexibility within existing limits; this objective is addressed through the consideration of Option 4 under Alternatives 2 and 3.

5 Magnuson-Stevens Act and FMP Considerations

5.1 Magnuson-Stevens Act National Standards

Below are the 10 National Standards as contained in the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). In recommending a preferred alternative, the Council must consider how to balance the national standards. After the Council completes an initial review of this analysis and potentially designates a preliminary preferred alternative, a brief discussion of how each alternative is consistent with the National Standards will be supplied.

National Standard 1 — Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

National Standard 2 — Conservation and management measures shall be based upon the best scientific information available.

National Standard 3 — To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

National Standard 4 — Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be; (A) fair and equitable to all such fishermen, (B) reasonably calculated to promote conservation, and (C) carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

National Standard 5 — Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources, except that no such measure shall have economic allocation as its sole purpose.

National Standard 6 — Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

National Standard 7 — Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

National Standard 8 — Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities by utilizing economic and social data that meet the requirements of National Standard 2, in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

National Standard 9 — Conservation and management measures shall, to the extent practicable, (A) minimize bycatch, and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

National Standard 10 — Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

The alternatives considered in this action, including the No Action alternative, do not directly or affect the safety of human life at sea. It is conceivable that increasing the Chinook PSC limit for the non-pollock non-Rockfish Program trawl CV fishery could reduce the likelihood that a vessel will operate in unsafe conditions in order to harvest additional groundfish in a competitive fishery before a constraining PSC hard cap is met (Alternative 2). That said, the status quo PSC hard cap (Alternative 1) will not necessarily be a constraint in every year. Increasing the Rockfish Program CV sector's Chinook PSC limit is not expected to affect decisions about when, where, and under what conditions to fish because Rockfish Program CVs operate in cooperatives that receive non-competitive allocations of target species; the perceived constraint of a hard cap in that fishery would not incentivize vessels to "race for fish" prior to a PSC-closure (Alternative 3).

5.2 Section 303(a)(9) Fisheries Impact Statement

Section 303(a)(9) of the Magnuson-Stevens Act requires that a fishery impact statement be prepared for each FMP amendment. A fishery impact statement is required to assess, specify, and analyze the likely effects, if any, including the cumulative conservation, economic, and social impacts, of the conservation and management measures on, and possible mitigation measures for (a) participants in the fisheries and fishing communities affected by the plan amendment; (b) participants in the fisheries conducted in adjacent areas under the authority of another Council; and (c) the safety of human life at sea, including whether and to what extent such measures may affect the safety of participants in the fishery.

The EA/RIR prepared for this plan amendment constitutes the fishery impact statement. The likely effects of the proposed action are analyzed and described throughout the EA/RIR. The effects on participants in the fisheries and fishing communities are analyzed in the RIR (Section 4). The effects of the proposed action on safety of human life at sea are evaluated under National Standard 10 in Section 5.1. Based on the information reported in this section, there is no need to update the Fishery Impact Statement included in the FMP.

The proposed action affects the groundfish fisheries in the EEZ off Alaska, which are under the jurisdiction of the North Pacific Fishery Management Council. Impacts on participants in fisheries conducted in adjacent areas under the jurisdiction of other Councils are not anticipated as a result of this action.

5.3 Council's Ecosystem Vision Statement

In February 2014, the Council adopted, as Council policy, the following:

Ecosystem Approach for the North Pacific Fishery Management Council

Value Statement

The Gulf of Alaska, Bering Sea, and Aleutian Islands are some of the most biologically productive and unique marine ecosystems in the world, supporting globally significant populations of marine mammals, seabirds, fish, and shellfish. This region produces over half the nation's seafood and supports robust fishing communities, recreational fisheries, and a subsistence way of life. The Arctic ecosystem is a dynamic environment that is experiencing an unprecedented rate of loss of sea ice and other effects of climate change, resulting in elevated levels of risk and uncertainty. The North Pacific Fishery Management Council has an important stewardship responsibility for these resources, their productivity, and their sustainability for future generations.

Vision Statement

The Council envisions sustainable fisheries that provide benefits for harvesters, processors, recreational and subsistence users, and fishing communities, which (1) are maintained by healthy, productive, biodiverse, resilient marine ecosystems that support a range of services; (2) support robust populations of marine species at all trophic levels, including marine mammals and seabirds; and (3) are managed using a precautionary, transparent, and inclusive process that allows for analyses of tradeoffs, accounts for changing conditions, and mitigates threats.

Implementation Strategy

The Council intends that fishery management explicitly take into account environmental variability and uncertainty, changes and trends in climate and oceanographic conditions, fluctuations in productivity for managed species and associated ecosystem components, such as habitats and non-managed species, and relationships between marine species. Implementation will be responsive to changes in the ecosystem and our understanding of those dynamics, incorporate the best available science (including local and traditional knowledge), and engage scientists, managers, and the public.

The vision statement shall be given effect through all of the Council's work, including long-term planning initiatives, fishery management actions, and science planning to support ecosystem-based fishery management.

In considering this action, the Council is being consistent with its ecosystem approach policy. The Council originally set Chinook salmon PSC limits as a conservation measure to prevent the impact of groundfish fishing on non-target species from reaching scientifically determined thresholds that could jeopardize protected stocks. In doing so, the Council used the best information available at the time to set PSC limits at levels that allowed for groundfish harvest to continue at or near the historical levels that support coastal communities and stakeholders throughout the nation. This action reconsiders the particulars of those limits in light of improved information regarding historical Chinook PSC encounters in the trawl fishery, and the genetic stock composition of Chinook salmon that are encountered in GOA trawl fisheries. Any revision to existing management measures would maintain the Council's precautionary approach to non-managed species as Chinook salmon PSC limits would not be allowed to exceed critical scientifically determined thresholds and would enhance the benefit that direct and indirect stakeholders in the groundfish fishery are able to receive.

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