Analysis of West Coast Groundfish Fisheries for the 2017 Biological Opinion on Endangered Species Act-listed Salmon

Sean E. Matson and Daniel L. Erickson

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

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Executive Summary

This analysis addresses the groundfish trawl and non-trawl sectors and their impacts on salmon bycatch, in support of the Endangered Species Act (ESA) salmon consultation for the groundfish fishery. While effects on Chinook salmon bycatch by the non-whiting trawl sector are emphasized, impacts on salmon (e.g., coho salmon and Chinook salmon) are also analyzed for the non-trawl groundfish sectors (both recreational and commercial) and the whiting trawl sector.

The assumed fishery conditions were described in the April 2017 Pacific Fishery Management Council (Council, PFMC) motion for the recommended proposed action for consultation (**Table ES-1**), which specified expected future groundfish attainment by species and sector, either as functions of recent attainment (e.g., 75 percent or more of its allocations from 2014 to 2016 would be achieved) or recent catch (e.g., 2014 to 2016 harvest levels in trawl fisheries would likely continue). We examined the Chinook salmon bycatch associated with the proposed action and additional scenarios to provide further context in assessing the results of implementing the Council motion. As part of the Council's motion, the Council recommended evaluating projected Chinook salmon bycatch relative to an annual guideline of 5,500 fish, or the sum of that guideline, plus a reserve (3,500 fish), for a total of 9,000 fish. Access to the reserve may be available to any sector that exceeds its recommended guideline, so there is no guarantee that a specific sector would be granted access to any or all of the reserve during a given year (e.g., the reserve could be taken by a different sector).

Under the proposed action, Chinook salmon projections were made under assumptions of increased groundfish attainment and removal of the trawl Rockfish Conservation Areas (RCAs) in waters off Oregon and California (**Table ES-1**). The proposed action for non-whiting fisheries was based on Alternative 2B(1) of the March 2017 Alternatives Document (NMFS 2017), with some modifications. Assumptions about future attainment of groundfish harvest in the proposed action (**Table ES-1** and **Table ES-2**) is optimistic compared with recent catches. Such optimistic projections could lead to overestimating Chinook salmon bycatch should future groundfish catch numbers decline.

Table ES-1. Summary of Council motion from April 2017 PFMC meeting (Agenda Item F.3, Council Action, April 2017). Alternatives 1A and 2B(1) were provided at the March 2017 PFMC meeting (NMFS 2017).

Description of fisheries	Whiting: Alternative 1A (NMFS 2017)	• Recent conditions will continue, including historical geographic footprint of the fisheries. • Includes a more substantial tribal fishery than observed in recent years with broader participation.
	Non-Whiting: Alternative 2B(1) (NMFS 2017)	• RCA is open to trawl fishing (see RCA definition below). • Geographic distribution of the fleet/harvest is similar to that prior to trawl rationalization and reflects recent bycatch rates. • Midwater yellowtail/widow rockfish fishery conducted in a manner similar to historical patterns when such a fishery took place. • Retain Selective Flatfish Trawl Gear (SFFT) requirements shoreward of the RCA in 2017.
RCA	Consistent with the Council's PPA (November 2016 Council Meeting; see Geographic Extent in Overview).	
Estimated Harvest Level/Model Threshold	Whiting: Entire United States total allowable catch (TAC) achieved; up to 500k metric tons (mt) of TAC into the future	
	At-sea total allocations and set-aside harvested.	
	IFQ allocations for sablefish, petrale, lingcod, shortspine and longspine, and overfished rockfish species fully harvested.	
	IFQ of other stocks which had 75 percent or more attainment in 2014 to 2016 will be achieved.	
Estimated Harvest Levels	IFQ of 2014 to 2016 harvest levels for canary rockfish, widow rockfish, yellowtail rockfish, and chilipepper rockfish will be taken by shoreside whiting and bottom trawl; remainder will be harvested in the midwater non-whiting trawl.	
	IFQ: All other groundfish stocks, harvest levels for 2014 to 2916 will continue.	
	Limited entry fixed gear (LEFG), open access fixed gear (OAFG), recreational fishery allocations, harvest guidelines, and harvest levels will likely continue.	
Chinook Bycatch Management Guidelines	Whiting: 11,000 Chinook salmon	Bottom trawl, mid-water non-whiting, LEFG, OAFG, and recreational: 5,500 Chinook salmon
Chinook Bycatch Reserve	3,500 Chinook bycatch Assess three possible scenarios of maximum effect to analyze the impact of the reserve on listed salmon: a) Assume reserve taken entirely by whiting. b) Assume reserve taken entirely by non-whiting bottom trawl. c) Assume reserve taken entirely by non-whiting midwater trawl.	
Exempted Fishing Permit	*2017:* • Bottom trawl[1] north of 42 N. latitude • No minimum mesh size requirement for bottom trawl vessels • SFFT gear not required shoreward of the RCA. • Chinook salmon bycatch harvest guideline of 3,500 fish (counted toward the 5,500 Chinook salmon threshold above) EFP terminated if 3,500 Chinook salmon harvest guideline (or 800 Chinook salmon prior to May 15th) attained so that participating vessels would have to comply with the SFFT gear requirement.	
	2018: Considered the advisory body comments, reports, and discussions occurring on this issue in April 2017 (see **Appendix C**).	

[1] The motion refers to a mid-water non-whiting trawl fishery EFP, but the description actually refers to the EFP in place at the time for bottom-trawl vessels only. The EFP also includes a sub-guideline of 800 Chinook salmon only allowed to be taken prior to May 15th.

Table ES-2. Components of groundfish catch conditions used in the model (retained mt) by species, IFQ gear type and target, their calculation and relevant assumptions, under the April 2017 Council motion. Projected landings and relevant assumptions are shown (agg.= aggregated (NW bottom and mid-water trawl); avg.=average; NW=non-whiting; attain=attainment). Catch and landings (retained catch) are expressed in metric tons.

IFQ species category	Area	2018 SB trawl allocation	Assumption	Avg. 2014-2016 IFQ attain.	Council assumed 2018 catch	Agg. 2014-2016 NW reten rate	Council assumed 2018 landings	2016 p (IFQ trawl)		Projected landings	
								Bottom trawl proportion landed	Mid-water NW proportion landed	Bottom trawl	Mid-water NW
Arrowtooth flounder	Coastwide	10,992.6	Avg. 2014-2016 attain.	0.497	5464.2	0.757	4,136.4	0.989	0.000	4,092.40	0.17
Bocaccio rockfish	South of 40°10' N. lat.	283.3	100% attainment	0.365	283.3	0.986	279.4	1.000	0.000	279.44	0.00
Canary rockfish	Coastwide	1,014.1	100% attainment	0.592	1014.1	0.996	1,009.8	0.383	0.289	386.48	292.03
Chilipepper rockfish	South of 40°10' N. lat.	1,845.8	100% attainment	0.171	1845.8	0.929	1,714.7	1.000	0.000	1,714.75	0.00
Cowcod	South of 40°10' N. lat.	1.4	100% attainment	0.222	1.4	0.995	1.4	1.000	0.000	1.39	0.00
Darkblotched rockfish	Coastwide	518.4	100% attainment	0.400	518.4	0.949	491.9	0.869	0.000	427.12	0.01
Dover sole	Coastwide	45,981.0	Avg. 2014-2016 attain.	0.195	8955.4	0.990	8,863.0	1.000	0.000	8,862.30	0.00
English sole	Coastwide	6,953.0	Avg. 2014-2016 attain.	0.046	319.8	0.772	246.9	1.000	0.000	246.88	0.02
Lingcod	North of 40°10' N. lat.	1,259.3	100% attainment	0.204	1259.3	0.924	1,163.4	0.967	0.002	1,067.61	2.13
Lingcod	South of 40°10' N. lat.	510.8	100% attainment	0.056	510.8	0.762	389.1	1.000	0.000	388.99	0.00
Longspine thornyhead	North of 34°27' N. lat.	2,560.2	Avg. 2014-2016 attain.	0.330	844.7	0.968	817.9	1.000	0.000	817.84	0.00
Minor Shelf Rockfish	North of 40°10' N. lat.	1,146.8	Avg. 2014-2016 attain.	0.043	49.3	0.675	33.3	0.715	0.050	23.80	1.67
Minor Shelf Rockfish	South of 40°10' N. lat.	192.4	Avg. 2014-2016 attain.	0.063	12.1	0.218	2.7	1.000	0.000	2.65	0.00
Minor Slope Rockfish	North of 40°10' N. lat.	1,268.0	Avg. 2014-2016 attain.	0.184	232.7	0.896	208.5	0.675	0.000	139.90	0.00
Minor Slope Rockfish	South of 40°10' N. lat.	433.9	Avg. 2014-2016 attain.	0.181	78.5	0.968	76.0	1.000	0.000	74.71	0.00
Other Flatfish	Coastwide	6,349.3	Avg. 2014-2016 attain.	0.148	941.5	0.781	735.4	0.992	0.000	729.44	0.02
Pacific cod	Coastwide	1,031.4	Avg. 2014-2016 attain.	0.295	304.7	0.998	304.2	1.000	0.000	304.10	0.01
Pacific ocean perch	North of 40°10' N. lat.	198.3	100% attainment	0.407	198.3	0.982	194.6	0.486	0.000	94.56	0.01
Pacific whiting	Coastwide	NA	Avg. 2014-2016 landed	NA	NA	0.992	NA	0.000	0.001	44.75	50.51
Petrale sole	Coastwide	2,628.5	100% attainment	0.969	2628.5	0.992	2,608.2	1.000	0.000	2,608.09	0.01
Sablefish	North of 36° N. lat.	2,521.9	100% attainment	0.968	2521.9	0.983	2,479.8	0.996	0.000	1,799.43	0.07

IFQ species category	Area	2018 SB trawl allocation	Assumption	Avg. 2014-2016 IFQ attain.	Council assumed 2018 catch	Agg. 2014-2016 NW reten rate	Council assumed 2018 landings	2016 p (IFQ trawl)		Projected landings	
								Bottom trawl proportion landed	Mid-water NW proportion landed	Bottom trawl	Mid-water NW
Sablefish	South of 36° N. lat.	814.4	Avg. 2014-2016 attain.	0.270	219.8	0.968	212.8	1.000	0.000	17.29	0.00
Shortspine thornyhead	North of 34°27' N. lat.	1,537.0	100% attainment	0.477	1537.0	0.987	1,517.8	0.984	0.000	1,492.18	0.00
Shortspine thornyhead	South of 34°27' N. lat.	50.0	100% attainment	0.037	50.0	0.896	44.8	0.000	0.000	0.00	0.00
Splitnose rockfish	South of 40°10' N. lat.	1,662.8	Avg. 2014-2016 attain.	0.023	37.6	0.204	7.7	1.000	0.000	7.66	0.00
Starry flounder	Coastwide	630.9	Avg. 2014-2016 attain.	0.015	9.4	0.921	8.7	1.000	0.000	8.65	0.00
Widow rockfish	Coastwide	10,661.5	100% attainment	0.607	10661.5	0.994	10,601.8	0.008	0.707	80.57	7,493.02
Yelloweye rockfish	Coastwide	1.1	Avg. 2014-2016 attain.	0.046	0.1	0.987	0.0	1.000	0.000	0.04	0.00
Yellowtail rockfish	North of 40°10' N. lat.	4,075.4	100% attainment	0.324	4075.4	0.999	4,072.7	0.095	0.478	386.03	1,945.33
Sum IFQ species	NA	NA	NA	NA	NA	NA	NA	NA	NA	26,099.07	9,785.02
Non-IFQ groundfish	NA	NA	Avg. 2014-2016 landed	NA	NA	NA	NA	NA	NA	786.76	19.12
Sum all groundfish	NA	NA	NA	NA	NA	NA	NA	NA	NA	**26,885.83**	**9,804.14**

Since few data exist that directly reflect the proposed action (e.g., the observer program started the same year that darkblotched conservation areas were implemented and one year before initiation of RCA), we analyzed two historical datasets from the 1980s and 1990s to explore the uncertainty of catch that may accrue should RCAs become open. However, we affirmed that using the current information represented in Alternative 2B(1), which is consistent with the Council action, would better reflect operation of the fishery going forward. Although the historical datasets provide some direct observations of Chinook salmon bycatch within the portion of the current RCA to be removed, there is substantial uncertainty in the bycatch projections using data from 1980s and 1990s (or early 2000s), due to substantial changes within the fishery since that period. As such, analyses using historical data were included only to explore uncertainty and interannual variation. This information is detailed in **Appendix A**.

For the proposed action, which includes the Council's PPA of opening the RCA south of Washington (Agenda Item F.4, Council Action, November 2016), we concluded that the current individual fishing quota (IFQ) management system, management tools, bycatch avoidance incentives, and near-real time catch data would likely result in larger groundfish catches but lower salmon bycatch rates, which is consistent with the assumptions in Alternative 2B(1). Under this assumption, recent West Coast Groundfish Observer Program (WCGOP) bycatch rates would remain similar, whether the RCA off Oregon and California would remain in place or would be removed. Incentives and improved efficiencies associated with the catch share program, along with near-real-time, 100 percent monitoring and data reporting, would enable IFQ fishermen to make selective choices regarding where, when, and how to fish to increase catch of target species while minimizing bycatch. In addition, the Council could reimplement the boundaries of the trawl RCA or institute block closures in specific areas to reduce impacts on salmon if bycatch rates were to become noticeably high. These tools were not available to managers or fishermen in the 1980s and 1990s. Finally, the catch share program and the vessel buyback program have resulted in significant fleet consolidation. These programs, combined with improved efficiencies, have resulted in increased catch per unit of effort of groundfish species with fewer trips and tows, which may in turn reduce salmon encounters.

We evaluated the 80th percentile of the distribution of simulated catches using WCGOP data from 2012 to 2016. For ESA-listed species, our goal was to assess the range of bycatch that would occur in most circumstances. Our analysis indicates the bycatch associated with the 80th percentile would encompass the range of bycatch that would occur under most situations, except those generally associated with uncommon extreme catch events (ECEs). The estimates reflect the pattern in the data for most hauls to catch either zero or a handful of Chinook salmon, while a few of those hauls would catch an intermediate amount. Finally, a very small number of hauls and vessels would catch a comparatively very large amount of Chinook, on the order of 100 or more fish, and these ECEs would tend to occur as “lightning strikes,” once to a few times per year. Model projections indicate that, based on the description of the fisheries in the Council’s proposed action, 80 percent of the time, Chinook salmon bycatch by non-whiting midwater and bottom trawl vessels would equal fewer than 4,580 fish (**Table ES-3**). These projections are lower than the Council’s recommended guideline for the non-whiting fishery of 5,500 fish, they consider the Council’s PPA of opening the RCA off the coast of Oregon and California, and they assume increased groundfish landings (i.e., higher attainment than currently observed). Use of the 80th percentile itself was requested by the consultation team after review of the analytical results. Use of risk-averse quantiles and probabilities for marine fisheries and conservation is established in the literature (Gerrodette et al. 2002; Wade 1998; Crowder and Murowski 1998; Stohs 2015), the choice of which quantile is informed by the data itself and amount of risk tolerance for the taxon at hand.

Table ES-3. Quantiles for predicted distributions of annual Chinook salmon bycatch (number) by commercial non-whiting trawl gear types (bottom and mid-water), assuming groundfish harvest levels (= model thresholds; Table 1-2) and fishery conditions (Table 1-1) under the Council’s proposed action. Mean values were provided for comparison. Bycatch projections were rounded. Note: 404 Chinook salmon were also projected for non-trawl groundfish fisheries (commercial and recreational; see Section 3.1.3). Source: West Coast Groundfish Observer Program data.

	Chinook salmon projected bycatch (number)		
Quantiles	**Bottom trawl[a/]**	**Midwater trawl**	**Bottom and midwater trawl (total)**
Min	73	289	362
0.01	165	331	496
0.05	307	355	662
0.25	483	1,155	1,637
0.50	638	1,722	2,360
0.75	1,555	2,684	4,238
0.80	**1,642**	**2,938**	**4,580**
0.85	1,726	8,149	9,875
0.95	1,971	9,085	11,056
0.99	2,339	9,777	12,116
Max	3,290	11,184	14,474
Mean	960	2,898	3,858

[a/]Bottom trawl (0.80th quantile) + non-trawl bycatch (404) = 2,046 Chinook salmon

The non-whiting midwater trawl gear shows a stronger potential than bottom trawl gear to take higher bycatch and to exhibit higher uncertainty on the low and high ends of the salmon bycatch. This is shown by the uncertainty generated by the model. Although the data show strong year effects in Chinook salmon bycatch for both gear types, non-whiting midwater trawl shows the most disparate distribution of predicted bycatch for the same quantiles and the highest bycatch rates of the two gear types.

Based on results of the simulation analysis, it is possible (but unlikely) that the non-whiting trawl fishery may periodically have to use the reserve in the case of ECEs or if the bycatch rates are higher than anticipated. Nearshore fixed gear is the primary commercial non-trawl fishery that encounters salmon (primarily Chinook salmon).

The nearshore, fixed gear bycatch of salmon was considered negligible in previous biological opinions, and we reassess in this document. Although ocean recreational bottomfish (groundfish) fisheries encounter salmon, mortality of these salmon are included as part of the preseason salmon package. They also count in modeling (for salmon) if caught during the recreational salmon season. These fish have been included in biological opinions on the salmon fisheries and, therefore, are not included as part of this analysis. However, salmon caught (and released) outside of the salmon season are not included as part of the impacts associated with salmon fisheries and are unaddressed by other biological opinions; this mortality is evaluated in this document. In addition, a long-leader, midwater recreational groundfish fishery at depths greater than 40 fathoms may take place off Oregon from April through September in 2018. Potential salmon bycatch within this long-leader fishery is described and included in the estimates of overall non-trawl bycatch.

The Council requested an analysis of potential use of the Chinook salmon bycatch reserve (3,500 Chinook salmon) that could be provided to any sector, if needed. This reserve would be available to either the whiting or non-whiting sector, in addition to the proposed action that would set guidelines of 5,500 Chinook salmon for the non-whiting trawl sector and 11,000 Chinook salmon for the whiting sectors (**Appendix B**).

We explored the idea of producing model-based estimates across all sectors to assess the probability of multiple sectors needing to access the reserve at the same time, but some issues made this approach unfeasible. In addition, there were no apparent or significant relationships in bycatch of Chinook salmon between whiting and non-whiting sectors. The only significant correlation occurred within each sector type, based on fishing target (e.g., between shorebased whiting and at-sea whiting, and between non-whiting midwater trawl and bottom trawl). Although the reserve analysis could not be formally modeled using bootstrap simulations, comparisons of results were possible based on the projections and associated quantiles produced by simulations shown in this paper for the non-whiting trawl sector and in **Appendix**

B, from the April 2017 Meeting, for whiting sectors. Under the assumption that the at-sea whiting fleet fishes mostly in the northern areas (**Appendix B**, from the April 2017 Meeting), results demonstrate that the whiting sector or the non-whiting sector would be unlikely to exceed its Chinook salmon guideline (with or without a reserve) at the 80th percentile. In other words, for the northern distribution of the at-sea whiting fleet, if one sector had to use its reserve, the other sector would most likely not be impacted. However, if the at-sea whiting sectors shifted their distribution to more southern areas, where Chinook salmon bycatch is highest, then there would be a much higher likelihood that whiting sectors could surpass both their guideline and the reserve without management actions to address the Chinook bycatch under provisions of the proposed action.

In five of six scenarios examined where the at-sea whiting fleet fished solely in the southern area, the whiting and non-whiting sectors combined could exceed the 20,000 Chinook salmon guideline, plus the reserve for the whole trawl fishery. This could occur even though the non-whiting trawl fleet would likely remain within its 5,500 Chinook guideline (under the 80th percentile).

Although both the whiting and non-whiting sectors show the potential for periodic high bycatch years, they have shown a pattern of doing so in either the whiting sector or the non-whiting sector, but not both at the same time, over the relatively long period from 2002 to 2016. Continuation of this historical pattern would make management of Chinook salmon bycatch remaining within the reserve capacity more likely. To evaluate these potential outcomes, consistent with the Council's proposed action, we assessed the anticipated overall bycatch if the whiting fleet were to use the full reserve, the bottom-trawl sector were to use the full reserve and, finally, if the mid-water non-whiting sector were to use the full reserve.

Also included in the proposed action is an exempted fishing permit (EFP) being considered for 2018 that would lift various trawl gear restrictions (**Appendix C**). The Council recommended that the 2018 EFP would include the following:

1. An exemption to the requirement to use selective flatfish trawl gear shoreward of the RCA and north of 42° N. latitude
2. An exemption to the minimum mesh size requirements for both bottom trawl and midwater trawl gear
3. An exemption to the prohibition on non-whiting midwater trawling prior to May 15th in all areas (seaward, within, and shoreward of the RCA) north of 40°10' N. latitude
4. An exemption to the prohibition on midwater trawling within the RCA south of 40°10' N. latitude

Additional exemptions are shown in **Appendix C**, Considerations for the 2017 and 2018 Trawl Gear Exempted Fishing Permits. The Chinook salmon bycatch from the EFP would accrue to the 5,500-fish guideline for the non-whiting fishery (i.e., is part of that guideline, and not in addition to it).

In 2017, the National Marine Fisheries Service (NMFS) initiated a trawl gear EFP for bottom trawl vessels. The 2017 EFP is operating with fewer exemptions than the Council recommended for the 2018 EFP (**Appendix D**). Preliminary catch and bycatch results from the 2017 trawl gear EFP are shown in **Appendix C**. Considerations for the 2017 and 2018 Trawl Gear Exempted Fishing Permits. The purpose of these EFPs (2017 and 2018) is to evaluate and better understand bycatch associated with lifting certain trawl restrictions while allowing vessels to increase efficiency (and increase catch) when targeting rebuilt species (e.g., widow rockfish, yellowtail rockfish, and chilipepper rockfish).

Various Chinook salmon bycatch harvest guidelines are included in the 2017 trawl gear EFP and the proposed 2018 trawl gear EFP to keep bycatch within Council-recommended harvest guidelines and to minimize impacts on southern Chinook and coho salmon ESUs. Conclusions shown in **Appendix C**. Considerations for the 2017 and 2018 Trawl Gear Exempted Fishing Permits are as follows:

1. Future EFP salmon bycatch will likely remain within the general non-whiting projections and are not in addition to them.
2. The EFP has harvest guidelines that would limit potential impacts on Chinook salmon.
3. Non-whiting mid-water trawl effort within the trawl RCA would likely occur south of 42° N latitude prior to May 15th (it is already permitted after May 15th) and south of 40°10' N latitude before and after May 15th (within the current boundaries of the trawl RCA), but the proportion of effort relative to northern mid-water trawling effort would likely be lower than historically observed.

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Acronyms and Abbreviations

ACL	Annual catch limit
BSIA	Best scientific information available
CDFW	California Department of Fish and Wildlife
ECE	Extreme catch event
EDCP	Enhanced Data Collection Project
EEZ	Exclusive Economic Zone
EFH	Essential fish habitat
EFHCA	EFH conservation areas
EM	Electronic monitoring
ESA	Endangered Species Act
ESU	Evolutionarily significant units
EFP	Exempted fishing permit
GAP	Groundfish Advisory Panel
GMT	Groundfish Management Team
IFQ	Individual fishing quota
LEFG	Limited entry fixed gear
mt	metric ton
MSC	Marine Stewardship Council
NMFS	National Marine Fisheries Service
NWFSC	Northwest Fisheries Science Center
OAFG	Open access fixed gear
ODFW	Oregon Department of Fish and Wildlife
PacFIN	Pacific Fisheries Information Network
PFMC	Pacific Fishery Management Council
POP	Pacific Ocean perch
PPA	Preliminary preferred alternative
RCA	Rockfish conservation area
SFFT	Selective flatfish trawl
SSC	Scientific and Statistical Committee
TAC	Total allowable catch
VMS	Vessel monitoring system
WCGOP	West Coast Groundfish Observer Program
WDFW	Washington Department of Fish and Wildlife

1 INTRODUCTION

This paper provides projected salmon bycatch estimates for all sectors within the Pacific Coast groundfish fishery, but it focuses primarily on Chinook salmon bycatch in the non-whiting trawl sector. Although this paper focuses on Chinook salmon bycatch in the non-whiting trawl sector, additional information and analyses are provided for salmon bycatch in the whiting trawl sectors, as well as salmon bycatch in non-trawl sectors (commercial and recreational). These salmon bycatch projections are a component of the effects analysis for the Biological Opinion (BiOp) on listed salmon's Evolutionarily Significant Units (ESUs) affected by the proposed action under the Endangered Species Act (ESA).

We evaluated impacts on Chinook salmon in the non-whiting groundfish fisheries, based upon the motion recommended by the Pacific Fishery Management Council (PFMC) at the April 2017 meeting (Agenda Item F.3, Council Action, April 2017), which described the final proposed action for the consultation. Our analysis also considers input from the Groundfish Management Team (GMT) reports presented at the April 2017 Council meeting (Agenda Item F.3.a, Supplemental GMT Report 1, April 2017), the Scientific and Statistical Committee (SSC) report from the March Council 2017 meeting (Agenda Item I.1.a, Supplemental SSC Report, March 2017), follow-up conversations with members of the SSC and Northwest Fisheries Science Center (NWFSC), and from a working subgroup of commercial fishery specialists from the Groundfish Management Team (GMT).[2]

For the non-whiting groundfish trawl sector, the proposed action is based largely on Alternative 2B(1) from "Alternatives for Salmon Bycatch Management in the Pacific Coast Groundfish Fisheries," presented at the March 2017 Council meeting (NMFS 2017), with additional conditions recommended by the Council at its April 2017 meeting (Agenda Item F.3, Council Action, April 2017). Those conditions are based on recent bycatch rates (2012 to 2016) encompassed in Alternative 2B(1) (Table 1-1). The Council further specified catch distributions among sectors and groundfish species for the near future (Table 1-2).

[2] Jessi Doerpinghaus, Washington Department of Fish and Wildlife and Patrick Mirick, Oregon Department of Fish and Wildlife.

Table 1-1. Summary of Council motion from April 2017 PFMC meeting (Agenda Item F.3, Council Action, April 2017). Alternatives 1A and 2B(1) were provided at the March 2017 PFMC meeting (NMFS 2017).

Description of fisheries	Whiting: Alternative 1A (NMFS 2017)	• Recent conditions will continue, including historical geographic footprint of the fisheries. • Includes a more substantial tribal fishery than observed in recent years with broader participation.
	Non-Whiting: Alternative 2B(1) (NMFS 2017)	• Rockfish Conservation Area is open to trawl fishing (see RCA definition below). • Geographic distribution of the fleet/harvest is similar to that prior to trawl rationalization and reflects recent bycatch rates. • Midwater yellowtail/widow rockfish fishery conducted in a manner similar to historical patterns when such a fishery took place. • Retain Selective Flatfish Trawl Gear (SFFT) requirements shoreward of the RCA in 2017.
RCA	Consistent with the Council's PPA (November 2016 Council Meeting; see Geographic Extent in Overview).	
Estimated Harvest Level/Model Threshold	Whiting: Entire United States total allowable catch (TAC) achieved; up to 500k metric tons (mt) of TAC into the future	
	At-sea total allocations and set-aside harvested.	
	IFQ allocations for sablefish, petrale, lingcod, shortspine and longspine, and overfished rockfish species fully harvested.	
	IFQ of other stocks which had 75 percent or more attainment in 2014 to 2016 will be achieved.	
Estimated Harvest Levels	IFQ of 2014 to 2016 harvest levels for canary rockfish, widow rockfish, yellowtail rockfish, and chilipepper rockfish will be taken by shoreside whiting and bottom trawl; remainder will be harvested in the midwater non-whiting trawl.	
	IFQ: All other groundfish stocks, harvest levels for 2014 to 2916 will continue.	
	Limited entry fixed gear (LEFG), open access fixed gear (OAFG), recreational fishery allocations, harvest guidelines, and harvest levels will likely continue.	
Chinook Bycatch Management Guidelines	Whiting: 11,000 Chinook salmon	Bottom trawl, mid-water non-whiting, LEFG, OAFG, and recreational: 5,500 Chinook salmon
Chinook Bycatch Reserve	3,500 Chinook bycatch Assess three possible scenarios of maximum effect to analyze the impact of the reserve on listed salmon: a) Assume reserve taken entirely by whiting. b) Assume reserve taken entirely by non-whiting bottom trawl. c) Assume reserve taken entirely by non-whiting midwater trawl.	
Exempted Fishing Permit	*2017:* • Bottom trawl[3] north of 42 N. latitude • No minimum mesh size requirement for bottom trawl vessels • SFFT gear not required shoreward of the RCA. • Chinook salmon bycatch harvest guideline of 3,500 fish (counted toward the 5,500 Chinook salmon threshold above) EFP terminated if 3,500 Chinook salmon harvest guideline (or 800 Chinook salmon prior to May 15th) attained so that participating vessels would have to comply with the SFFT gear requirement.	
	2018: Considered the advisory body comments, reports, and discussions occurring on this issue in April 2017 (see **Appendix C**).	

[3] The motion refers to a mid-water non-whiting trawl fishery EFP, but the description actually refers to the EFP for bottom-trawl vessels only in place at the time. The EFP also includes a sub-guideline of 800 Chinook salmon only allowed to be taken prior to May 15th.

Table 1-2. Components of groundfish catch conditions used in the model (retained mt) by species, IFQ gear type and target, their calculation and relevant assumptions, under the April 2017 Council motion. Projected landings and relevant assumptions are shown (p=proportion; agg.=aggregate; avg.=average; NW=non-whiting; ret.=retention; attain=attainment).

								2016 p (IFQ trawl)		Projected landings	
IFQ species category	**Area**	**2018 SB trawl allocation**	**Assumption**	**Avg. 2014-2016 IFQ attain.**	**Council assumed 2018 catch**	**Agg. 2014-2016 ret. rate**	**Council assumed 2018 ret. rate**	**Bottom trawl p (landed)**	**Mid-water NW p (landed)**	**Bottom trawl**	**Mid-water NW**
Arrowtooth flounder	Coastwide	10,992.6	Avg. 2014-2016 attain.	0.497	5464.2	0.757	4,136.4	0.989	0.000	4,092.40	0.17
Bocaccio rockfish	South of 40°10' N. lat.	283.3	100% attainment	0.365	283.3	0.986	279.4	1.000	0.000	279.44	0.00
Canary rockfish	Coastwide	1,014.1	100% attainment	0.592	1014.1	0.996	1,009.8	0.383	0.289	386.48	292.03
Chilipepper rockfish	South of 40°10' N. lat.	1,845.8	100% attainment	0.171	1845.8	0.929	1,714.7	1.000	0.000	1,714.75	0.00
Cowcod	South of 40°10' N. lat.	1.4	100% attainment	0.222	1.4	0.995	1.4	1.000	0.000	1.39	0.00
Darkblotched rockfish	Coastwide	518.4	100% attainment	0.400	518.4	0.949	491.9	0.869	0.000	427.12	0.01
Dover sole	Coastwide	45,981.0	Avg. 2014-2016 attain.	0.195	8955.4	0.990	8,863.0	1.000	0.000	8,862.30	0.00
English sole	Coastwide	6,953.0	Avg. 2014-2016 attain.	0.046	319.8	0.772	246.9	1.000	0.000	246.88	0.02
Lingcod	North of 40°10' N. lat.	1,259.3	100% attainment	0.204	1259.3	0.924	1,163.4	0.967	0.002	1,067.61	2.13
Lingcod	South of 40°10' N. lat.	510.8	100% attainment	0.056	510.8	0.762	389.1	1.000	0.000	388.99	0.00
Longspine thornyhead	North of 34°27' N. lat.	2,560.2	Avg. 2014-2016 attain.	0.330	844.7	0.968	817.9	1.000	0.000	817.84	0.00
Minor Shelf Rockfish	North of 40°10' N. lat.	1,146.8	Avg. 2014-2016 attain.	0.043	49.3	0.675	33.3	0.715	0.050	23.80	1.67
Minor Shelf Rockfish	South of 40°10' N. lat.	192.4	Avg. 2014-2016 attain.	0.063	12.1	0.218	2.7	1.000	0.000	2.65	0.00
Minor Slope Rockfish	North of 40°10' N. lat.	1,268.0	Avg. 2014-2016 attain.	0.184	232.7	0.896	208.5	0.675	0.000	139.90	0.00
Minor Slope Rockfish	South of 40°10' N. lat.	433.9	Avg. 2014-2016 attain.	0.181	78.5	0.968	76.0	1.000	0.000	74.71	0.00
Other Flatfish	Coastwide	6,349.3	Avg. 2014-2016 attain.	0.148	941.5	0.781	735.4	0.992	0.000	729.44	0.02
Pacific cod	Coastwide	1,031.4	Avg. 2014-2016 attain.	0.295	304.7	0.998	304.2	1.000	0.000	304.10	0.01
Pacific ocean perch	North of 40°10' N. lat.	198.3	100% attainment	0.407	198.3	0.982	194.6	0.486	0.000	94.56	0.01
Pacific whiting	Coastwide	NA	Avg. 2014-2016 landed	NA	NA	0.992	NA	0.000	0.001	44.75	50.51
Petrale sole	Coastwide	2,628.5	100% attainment	0.969	2628.5	0.992	2,608.2	1.000	0.000	2,608.09	0.01
Sablefish	North of 36° N. lat.	2,521.9	100% attainment	0.968	2521.9	0.983	2,479.8	0.996	0.000	1,799.43	0.07
Sablefish	South of 36° N. lat.	814.4	Avg. 2014-2016 attain.	0.270	219.8	0.968	212.8	1.000	0.000	17.29	0.00

IFQ species category	Area	2018 SB trawl allocation	Assumption	Avg. 2014-2016 IFQ attain.	Council assumed 2018 catch	Agg. 2014-2016 ret. rate	Council assumed 2018 ret. rate	2016 p (IFQ trawl)		Projected landings	
								Bottom trawl p (landed)	Mid-water NW p (landed)	Bottom trawl	Mid-water NW
Shortspine thornyhead	North of 34°27' N. lat.	1,537.0	100% attainment	0.477	1537.0	0.987	1,517.8	0.984	0.000	1,492.18	0.00
Shortspine thornyhead	South of 34°27' N. lat.	50.0	100% attainment	0.037	50.0	0.896	44.8	0.000	0.000	0.00	0.00
Splitnose rockfish	South of 40°10' N. lat.	1,662.8	Avg. 2014-2016 attain.	0.023	37.6	0.204	7.7	1.000	0.000	7.66	0.00
Starry flounder	Coastwide	630.9	Avg. 2014-2016 attain.	0.015	9.4	0.921	8.7	1.000	0.000	8.65	0.00
Widow rockfish	Coastwide	10,661.5	100% attainment	0.607	10661.5	0.994	10,601.8	0.008	0.707	80.57	7,493.02
Yelloweye rockfish	Coastwide	1.1	Avg. 2014-2016 attain.	0.046	0.1	0.987	0.0	1.000	0.000	0.04	0.00
Yellowtail rockfish	North of 40°10' N. lat.	4,075.4	100% attainment	0.324	4075.4	0.999	4,072.7	0.095	0.478	386.03	1,945.33
Sum IFQ species	NA	NA	NA	NA	NA	NA	NA	NA	NA	26,099.07	9,785.02
Non-IFQ groundfish	NA	NA	Avg. 2014-2016 landed	NA	NA	NA	NA	NA	NA	786.76	19.12
Sum all groundfish	NA	NA	NA	NA	NA	NA	NA	NA	NA	**26,885.83**	**9,804.14**

More detailed information regarding these conditions can be found in Table 1-1 and Table 1-2, as well as in the Council's motion (Agenda Item F.3, Council Action, April 2017).

Some conditions and assumptions that the Council recommended at its April 2017 meeting (Table 1-1) differ from the original conditions and assumptions in Alternative 2B(1) and Table 14 of the March 2017 Alternatives Document (NMFS 2017) (e.g., level of groundfish catch). The Council proposed these differences based on its expectations for the future of the groundfish fishery, as well as on recommendations by the SSC (Agenda Item I.1.a, Supplemental SSC Report, March 2017) and the GMT (Agenda Item F.3.a, Supplemental GMT Report 1, April 2017) during the March and April 2017 Council meetings. Additionally, the analysis was updated, as recommended by the GMT, to include more recent data (2012 to 2016) from the West Coast Groundfish Observer Program (WCGOP) than were available for the Alternatives Document (NMFS 2017). The statistical method used to generate the predictions in the analysis was changed, based on recommendations from the SSC (see Methods, Section 2). Catch assumptions the Council proposed (summarized in Table 1-1) were used, together with its recommended distribution among the two non-whiting trawl gear types (bottom and midwater trawl), and the catch assumptions were expressed as landings (Table 1-2). Finally, future fishery and management conditions under the proposed action would include higher attainment rates for groundfish species relative to current attainment rates and removal of the trawl RCAs off Oregon and California (Table 1-2).

We assessed the Council's proposed action for the non-whiting trawl sector (Table 1-1). However, there were limited data to inform what might occur if fishing were allowed, as envisioned in the proposed action, within the area previously closed by the trawl RCA. The WCGOP began collecting at-sea data in 2002, which was the first year that darkblotched conservation areas were implemented, and one year before implementation of RCAs (NMFS 2014). Therefore, WCGOP data are limited prior to RCA implementation.

We used two sources of data from the 1980s (Pikitch et al. 1988)[4] and 1990s (Sampson 2002) from studies that included bottom trawl catches within the area of the current RCA to explore the potential uncertainty of bycatch in our analysis. However, bycatch projections using data from 1980s and 1990s should be viewed with caution; much of the uncertainty relates to the applicability of using historical data to project bycatch for current or future fisheries.

Significant changes have occurred over the past 20 to 30 years, and they may have reduced bycatch and bycatch rates substantially. These changes include the following:

[4] Erickson and Pikitch (1994) provided caution against using their results to project salmon bycatch for years beyond 1990.

- The vessel buyback program, which resulted in significant fleet consolidation, implementation of the catch shares program and a reduction in the number of species managed with trips limits
- Improved technologies, such as vessel monitoring systems (VMS)
- Enhanced incentives to avoid and reduce bycatch
- Improved and timely at-sea and shoreside catch monitoring (NMFS and PFMC 2017), including 100 percent monitoring of all individual fishing quota (IFQ) species

As part of its November 2016 motion (Agenda Item F.4, Council Action, November 2016), the Council defined the PPA for modifications to the RCA and essential fish habitat (EFH) conservation areas (EFHCAs); that recommendation included removing the RCA in waters off Oregon and California. The EFH/RCA action alternative, described in the Agenda Item F.4.a, Project Team Report, identifies block closures as an accountability measure to limit the impacts on prohibited and protected species, including Chinook salmon. The availability of these measures, together with the reasons described in the previous paragraph, support the Council's basis for choosing Alternative 2B(1).

In addition to management measures (e.g., block closures) and incentives that may reduce bycatch of IFQ species through implementation of the catch shares program (PFMC 2010), the trawl industry has the additional incentive of reducing bycatch of all species to remain certified by the Marine Stewardship Council (MSC) (NMFS and PFMC 2017). The MSC certified the West Coast limited entry groundfish trawl fishery as sustainable in 2014 (MSC.org). Finally, it is unlikely that fishing strategies will change dramatically throughout the Exclusive Economic Zone (EEZ), due to reasons shown above, and any changes in distribution of effort and gear type could be strategic (i.e., to improve efficiency and maintain or reduce bycatch levels (see NMFS and PFMC 2017; see Agenda Item G.8 Attachment, March 2016). For example, fishing strategies and resulting bycatch rates for non-whiting midwater trawl (within, seaward, and shoreward of the trawl RCA) and for bottom trawl seaward of the RCA (e.g., targeting the Dover-sablefish-thornyhead complex) are not expected to change relative to current conditions; locations, gear, and strategies will likely be similar to current fishing methods. Although distribution of fishing effort may change for bottom trawl in the near future (e.g., new bottom trawl effort within what is currently the boundaries of the trawl RCA), fishermen may opt to use the selective flatfish trawl (SFFT) while targeting flatfish, whether within or shoreward of the RCA to avoid salmon, Pacific whiting, or other unwanted semi-pelagic species. Fishermen who target pelagic or semi-pelagic rockfish within the RCA or shoreward of the RCA may choose to do so with high-rise, hooded nets in the future, but they may also opt to install salmon excluder devices or select areas and times where Chinook salmon bycatch may be low. The increased incentives (e.g., retaining MSC certification) combined with advancements in management, monitoring, and technology, would result in Chinook salmon bycatch and bycatch rates consistent with those under the proposed action.

Exempted Fishing Permits: The Council's description of the future of the groundfish fishery under the proposed action (Table 1-1) included EFPs in 2017 and 2018 (Agenda Item F.3, Council Action, April 2017). The purpose of these EFPs is to allow vessels to target rockfish stocks more effectively on a pilot basis, while also gathering data and information that will help NMFS assess potential impacts of the Council's recommended changes to the current trawl gear restrictions. A description of these EFPs, a summary of catch and bycatch for the 2017 EFP, and an analysis of potential impacts on salmon that may occur through implementation of the 2018 non-whiting midwater trawl EFP (allowing year-round and coastwide midwater trawling) are provided in **Appendix C**. Chinook salmon catch occurring in the EFPs is counted toward the 5,500 non-whiting guideline, as recommended by the Council under the proposed action.

Reserves: In April 2017, during discussion of the Council's motion for the proposed action, Council members discussed the concept of a reserve to address concerns with one sector exceeding its guideline of Chinook salmon bycatch. The reserve is a specific amount of Chinook salmon bycatch that could be used by either the whiting or non-whiting sectors if they were to exceed their sector's recommended guideline. The Council's proposed action described a 3,500 Chinook salmon bycatch reserve (i.e., 3,500 Chinook salmon may be available to one or both fleets combined during a single year, not 3,500 Chinook salmon to each fleet during the same year). As emphasized in the Council motion, the reserve would not be an entitlement or a *de facto* increase in the guidelines, but a safety net to minimize disruption to the fishery where actions that were already actively being taken to reduce bycatch were insufficient.

In this analysis, we examined two questions regarding projected Chinook salmon bycatch under the proposed action. First, we examined the potential for the non-whiting trawl sector to meet the Council's recommended guideline (5,500 Chinook salmon) or exceed the sum of that guideline plus the reserve (3,500 Chinook salmon, for a total of 9,000 Chinook salmon). The second was to examine impacts under the assumption that the entire reserve would be taken by a single sector (i.e., whiting or non-whiting) or a single gear type within a sector (i.e., non-whiting midwater trawl or bottom trawl). We also examined the potential for multiple sectors needing access to the reserve within the same year.

2 METHODS

Detailed methods for the non-trawl data sources are shown in Section 2.1. Section 2.2, Section 2.3, and Section 2.4 focus on methods to project salmon bycatch in the non-whiting trawl fishery using the assumptions specified in the Council's proposed action and described in Chapter 2 of this document. However, as noted above, to explore uncertainty in the non-whiting trawl estimates, we also estimated future salmon bycatch using historical trawl data from the 1980s and 1990s in **Appendix A**. Methods that are shared between the analyses (e.g., analytical procedure) are provided within this section, whereas methods specific only to the historical databases are described in **Appendix A**.

2.1 Salmon bycatch by non-trawl groundfish fisheries

Projected salmon bycatch by non-trawl groundfish fisheries is based on estimates from three sources:

1. WCGOP bycatch tables for commercial fisheries during the period 2002-2015 (NWFSC 2017)
2. Washington, Oregon, and California state agency queries for recreational groundfish trips
3. A draft environmental assessment (EA) that provided estimates of potential bycatch from a long-leader "midwater" recreational groundfish fishery that may occur off Oregon beginning in 2018 (NMFS 2016c)

2.1.1 WCGOP commercial data

The WCGOP data (NWFSC 2017) used in this paper have been updated since the Salmon Bycatch Report (NMFS 2016b) was presented to the Council at the March 2017 meeting. Table 10 in that report was based on fewer years of data than were provided by the NWFSC (NWFSC 2017). The updated WCGOP data (NWFSC 2017) include some corrections relative to previous WCGOP bycatch reports and relative to Table 10 in NMFS 2016b. The WCGOP assumes salmon discard mortality to be 100 percent. Observer coverage for the non-trawl groundfish fisheries ranged from 5 percent to 8 percent for nearshore fixed gear, from 8 percent to 42 percent for sablefish-endorsed LEFG, from 1 percent to 13 percent for non-sablefish-endorsed LEFG, and from 1 percent to 7 percent for OAFG (Somers et al. 2016). Because salmon bycatch is sporadic, and sampling coverage is low for these fixed gear fisheries, non-retention mortality is difficult to estimate. A buffer was added to the final estimate of maximum salmon mortality projections for the non-trawl groundfish fisheries to account for this uncertainty.

2.1.2 State ocean recreational groundfish data

State agencies report and account for salmon mortality occurring in ocean recreational groundfish fisheries during the open salmon season in pre-season salmon modeling for ocean salmon management, as well as in biological opinions on salmon fisheries. This salmon mortality is not shown here to avoid double-counting. Salmon caught and released by ocean groundfish recreational fisheries outside of the salmon season are included in the analysis of non-trawl impacts in this document because this mortality is not accounted for in salmon fisheries or their associated biological opinions. The mortality is, therefore, a direct result of fisheries that are part of the proposed action.

The California Department of Fish and Wildlife's (CDFW's) Ocean Salmon Project provided salmon bycatch estimates for a recreational skiff fishery, which takes place outside of the salmon season. Other encounters of salmon by California ocean groundfish recreational fisheries are rare (Jennifer Simon, CDFW, personal communication). Preliminary estimates of salmon encounters by ocean recreational bottomfish fisheries outside of the salmon season were also provided by the Oregon Department of Fish and Wildlife (ODFW) and the Washington Department of Fish and Wildlife (WDFW). Our data requests were submitted recently, providing little time for thorough quality assurance and quality control for these data queries. In addition, recreational sampling outside of the salmon season (i.e., during winter) is sporadic and covers fewer ports than summer sampling. As such, a buffer was included in the total non-trawl mortality estimates to account for this uncertainty.

A basic description of methods used to estimate salmon bycatch mortality by recreational groundfish fisheries is included for reference. Although regulations may vary by state, all have specific salmon retention requirements for ocean recreational groundfish fisheries, while salmon season is open. Under federal salmon regulations, any retained salmon must be caught on legal salmon sport gear for ocean salmon, must be caught during the salmon season, and gear must include no more than two single-point barbless hooks. Salmon incidentally caught with groundfish gear (e.g., barbed hooks) must be returned (discarded) unharmed whether during or outside of the salmon season. Once legally caught salmon are retained onboard a vessel during recreational groundfish trips, only legal salmon gear can be used on that vessel for the remainder of the trip. Some private anglers may use salmon-legal gear when fishing groundfish; if a salmon is caught using this gear, they can keep it and continue using only salmon-legal gear thereafter. Charter vessels may initially fish groundfish using legal groundfish gear. They can, however, opt to switch to salmon-legal gear and begin targeting salmon later in the trip if groundfish limits are attained, or if groundfish catch is poor, and they are in an area open to salmon angling.

Total salmon mortality calculations include different mortality rates applied to fish that are retained (i.e., 100 percent), fish that are brought onboard but released (i.e., discard mortality), and fish that are hooked but not brought onboard the vessel (i.e., drop off mortality). Release mortality and drop-off mortality rates were derived after discussions with state groundfish and salmon managers/biologists and federal salmon biologists. These rates may differ from those the Council's Salmon Technical Team used when modeling mortality for the directed recreational salmon fishery.

For ocean groundfish recreational fisheries, we applied a 30 percent mortality rate to released salmon in waters off Oregon and Washington. For California, however, we applied a 59 percent mortality rate to released salmon, based on results shown by Grover et al. (2000) for "J" hook discard mortality. Drop-off mortality was estimated as five percent of all retained salmon during bottomfish-identified trips off Washington and Oregon. For California, drop-off mortality was estimated as five percent of landed and released salmon.

2.1.3 Long-leader midwater recreational groundfish data

NMFS (2016c) provided an analysis of alternatives regarding a proposed action to authorize a midwater long-leader recreational fishery for healthy midwater rockfish species (e.g., yellowtail rockfish, *Sebastes flavidus)* in waters seaward of approximately 40 fathoms off the coast of Oregon (42°00' N. latitude to 46°18' N. latitude) (NMFS 2016c). The proposed action would take place during the established Oregon recreational groundfish fishery, open from April to September, managed under the seasonal depth restriction framework. This proposed action is being considered for the 2018 recreational fishing season. The time/area block for this fishery is new. Therefore, salmon mortality in this proposed fishery is estimated in addition to mortality in the traditional Oregon recreational groundfish fishery; that mortality is already accounted for in pre-season salmon models.

Bycatch rates that may be applied to this proposed long-leader fishery were developed through EFPs that took place off Oregon between 2009 and 2011 (NMFS 2016c). Average bycatch rates for these EFPs were 0.0026 Chinook salmon per angler trip and 0.0289 coho salmon per angler trip (Lynn Mattes, ODFW, personal communication). NMFS projected that as many as 25,000 to 50,000 angler trips could be attained by this proposed fishery (NMFS 2016c). The maximum traditional recreational bottomfish trips off Oregon during recent years is approximately 100,000 (NMFS 2016c). Discussions between NMFS and ODFW staff concluded that 25,000 to 50,000 additional trips would likely be too high, given that fishermen would have to travel farther and use unfamiliar gear relative to the traditional recreational groundfish fishery. We concluded that approximately 15,000 annual long-leader trips, or 15 percent of the maximum traditional groundfish trips, would be a more likely maximum value for this analysis.

2.2 Methods used to project non-whiting trawl bycatch of Chinook salmon under future fishery and management conditions

The WCGOP provided data that included both total Chinook salmon counts and total combined retained groundfish weights (round, mt) from 2012 to 2016. Data from 2015 and 2016 were combined from both observed and electronically monitored (EM) trips. We use retained catch as a currency in the analysis because of its broad availability in historical data as landings on tickets, and in logbooks to help apportion effort between areas. It also enabled direct comparisons with analytical assumptions from the Alternatives Document (NMFS 2017) and the bycatch reports (e.g., NMFS 2016b) that were provided at the March 2017 Council meeting.

We used the bootstrap method to project Chinook salmon bycatch under the Council's proposed future conditions shown in Table 1-1 and Table 1-2. This method is a non-parametric simulation approach that builds empirical distributions of one or more specified statistics by resampling actual data within stated parameters. The Council has used this approach previously to estimate probabilities of exceeding bycatch harvest guidelines, to manage bycatch in the drift gill net fishery for swordfish, and to manage bycatch of rockfish in the whiting fishery (e.g., Agenda Item F.7.a, WDFW Report, September 2016). This method circumvents shortcomings of parametric simulation approaches (such as Monte Carlo) that result from non-standard distributions typically seen in fishery data. Forcing an assumption of a particular distribution upon an analysis that does not fit the data well can introduce error (not easily predicted or corrected), which can have important consequences on analytical conclusions and downstream decision making.

This analysis was conducted to evaluate likely Chinook salmon impacts compared to the 5,500 Chinook salmon bycatch guideline for the non-whiting sector (midwater and bottom trawls separately and combined), as well as an additional 3,500 fish reserve, for a total of 9,000 fish. These guidelines were part of the Council motion of the proposed action to manage Chinook salmon bycatch in the groundfish fishery (Table 1-2).

We simulated thousands of fishing seasons, then randomly drawing many bottom trawl hauls with replacement, or randomly drawing non-whiting midwater trawl hauls without replacement. Year effects were explicitly considered in the model conditions (in agreement with SSC recommendations) by randomly selecting a year first, before drawing hauls from within that year, when simulating a season. We built cumulative tallies of target species (retained groundfish) versus bycatch (counts of Chinook salmon), and we evaluated those tallies against the Council's proposed guidelines. We repeated this process 10,000 times (for 10,000 simulated seasons) for each non-whiting trawl gear type. We compiled the results into distributions and calculated quantiles and measures of central tendency from those distributions. The quantiles can be used as reasonable approximations of probabilities under the implicit and explicit conditions and assumptions of a particular model run, and the input data that are resampled.

We made projections separately for each gear type in the non-whiting fishery (i.e., bottom trawl and midwater trawl). We calculated the quantiles of the predicted distributions for each gear type, and then we summed those same quantiles across gear types to generate aggregate prediction statistics for the commercial non-whiting fishery.

2.3 Metrics applied to the trawl estimates of Chinook salmon bycatch

To assess impacts on listed species under ESA, we used the 80th percentile (= 0.80th quantile) for which Chinook salmon bycatch would be lower than or equal to in 80 percent of simulations (i.e., 80 percent of the time). Our goal was to assess the range of bycatch that would occur in most circumstances. The analysis indicates bycatch associated with the 80th percentile would encompass the range of bycatch that would occur under most situations, except those generally associated with uncommon extreme catch events (ECEs). Based on the available information under the proposed action, we would expect Chinook salmon bycatch to be lower than this amount in almost all cases except for ECEs. For the purposes of ESA consultation, we wanted to assess what we could reasonably expect to occur in future years. At lower quantiles, the likelihood of exceeding the authorized take of listed salmon would increase substantially, which would not adequately describe the range of bycatch likely to occur under the proposed action, but would, therefore, likely require more frequent reinitiation of consultation and potential undue disruption of the fishery. Use of the 80th percentile itself was requested by the consultation team after review of the analytical results. Use of risk-averse quantiles and probabilities for marine fisheries and conservation is established in the literature (Gerrodette et al. 2002; Wade 1998; Crowder and Murowski 1998; Stohs 2015), the choice of which quantile is informed by the data itself and amount risk tolerance for the taxon at hand.

We also report the median and other typically used quantiles, as well as the mean of the distribution of; while this information is still useful in this analysis, the mean does not have a probability associated with it. However, the distance between the median[5] (0.5 quantile) and the mean is useful for demonstrating the amount of skewness in a distribution. This comparison is useful for illustrating variance and the difference between potential outcomes. If the mean is far from the median, then there may be both very low and very high modes within the predicted distribution of bycatch. This would illustrate a strong year effect in the model input data and the potential for both low and high bycatch outcomes in the future, relative to normal distributions.

[5] The median is frequently used in groundfish management as a risk-neutral point of reference, and it is defined as value or quantity lying at the midpoint of a frequency distribution of observed values or quantities, such that there is an equal probability of falling above or below it. It is provided here for the purpose of providing orientation to those familiar with its use in the groundfish fishery.

2.4 Trawl model conditions, parameters, and assumptions

We used the species- and gear-specific assumptions the Council recommended at the April 2017 meeting (Agenda Item F.3, Council Action, April 2017) to calculate model harvest guidelines for groundfish species, including IFQ and non-IFQ species. They reflect a mix of 100 percent attainment, average attainment over 2014 to 2016 for IFQ species categories, and average catch for Pacific whiting bycatch and non-IFQ species (Table 1-2). We applied those Council assumptions to 2018 IFQ sector allocations. We found that in aggregate, the Council-recommended assumptions about the future attainment of groundfish catch (Table 1-2) were similar to the model-based projections (Matson et al. 2017) for the Pacific Coast Individual Fishing Quota Program (IFQ) species categories in the 2017 to 2018 groundfish harvest specifications (aggregate amounts within less than one percent). Although the original motion described nearly identical assumptions to be applied both to 2017 and 2018 allocations, we limited our analysis to 2018 allocations because this ESA salmon consultation was targeted for completion near the end of 2017. Because our goal was to project bycatch counts of Chinook salmon and their latitudinal distributions, coincident with simulated seasons with defined amounts of groundfish retained catch, and assess those projections against the proposed thresholds, we did not impose bounds on the amount of Chinook salmon bycatch itself.

The confirmed intent of the Council was to use Alternative 2B(1), described in the March 2017 Alternatives Document (NMFS 2017), and Table 1 of a GMT report submitted at the April 2017 Council meeting (Agenda Item F.3.a, Supplemental GMT Report 2, April 2017) (i.e., recent bycatch rates, historical effort, and use of lower bycatch rates associated with use of SFFT gear), but to modify the fishery footprint to reflect the Council's PPA for the EFH/RCA action as described in November 2016 (Agenda Item F.4, Council Action, November 2016). The PPA was to retain the current RCA off Washington and to eliminate the RCA off Oregon and California, but to retain the ability to use block area closures in the future. Block area closures would use combinations of management lines and depth contours in regulation to create borders for the block closures, if needed. The rationale for using current bycatch rates, even if the RCA were removed for the duration of the calendar year, was discussed at length in the introduction. It was shown that under the current management framework, technology, and monitoring, trawl gear users and the Council can respond to reduce bycatch rates in a timely manner, if needed. In addition, the design of the catch share program provides incentives to keep bycatch low (PFMC 2010). It is also likely that any changes in distribution of effort and gear type could be strategic (i.e., to improve efficiency and to maintain or reduce bycatch (NMFS and PFMC 2017; see Agenda Item G.8 Attachment, March 2016).

Bycatch rates and distributional assumptions used to inform Alternative 2B(1) from the March 2017 Alternatives Document (NMFS 2017) were obtained from 2012 to 2014, which were the most recent available at that time (p. 63, March Alternatives Document). The GMT recommended adding more recent data that have since became available through 2016. Thus, the bottom trawl modeling for this exercise was designed based on the updated information used to inform Alternative 2B(1) from March. This adheres both to recommendations in the April Council motion (Agenda Item F.3, Council Action, April 2017) and to GMT recommendations. The non-whiting midwater trawl bycatch estimates from Alternative 2B(1) were informed by 2014 and 2015. We updated these years from Alternative 2B(1) to the most recent data available, 2012 through 2016, which aligned with recommendations from both the Council in its motion and from the GMT.

The data suggest that these are reasonable choices of data years based on groundfish harvest levels and Chinook salmon bycatch for bottom trawl and midwater trawl. For bottom trawl, 2012 to 2016 data provide a fairly balanced picture of Chinook salmon bycatch across the range from high to low, with two high years and three low years (Table 2-1). High Chinook salmon bycatch years (in this case three times more bycatch than the low years) occur less frequently than low bycatch years. Effort and landings in the non-whiting midwater fishery have been trending upward over the past few years. For that reason, using only the most recent three years could be justified. However, addition of the most recent years indicated a different pattern. Using only the most recent years presents an imbalance with a bias toward high bycatch years in the input data for the model. The bycatch rates for 2014 and 2015 were quite high, but 2012 and 2013 were moderate and 2016 was low (Table 2-2). For this reason, we used the same data range as the bottom trawl (2012 to 2016), which is better analytically justified than the shorter time span and would avoid spurious results stemming from sampling too few years.

Table 2-1. Groundfish landed (mt), Chinook salmon count (number) and bycatch rate using bottom trawl gear from 2012 to 2016 observed data. Observed (WCGOP) and electronically monitored data are combined; 2016 data are preliminary.

Year	Groundfish landed (mt)	Chinook count (Number)	Bycatch rate
2012	17,026	305	0.0179
2013	18,715	323	0.0173
2014	15,876	984	0.0620
2015	15,942	996	0.0625
2016	16,456	371	0.0225

Table 2-2. Groundfish landed (mt), Chinook salmon count (number), and bycatch rate using midwater trawl gear, from 2012 to 2016 observer data. Observed (WCGOP) and electronically monitored data are combined; 2016 data are preliminary.

Year	Groundfish landed (mt)	Chinook count (Number)	Bycatch rate
2012	391	12	0.0307
2013	622	71	0.1142
2014	909	661	0.7272
2015	1,817	482	0.2653
2016	1,221	47	0.0385

2.5 Impacts among sectors and gear types given full utilization of the reserve by a single gear type or sector

A key component of the proposed action in assessing Chinook salmon bycatch was to evaluate the impacts of providing the entire reserve to a single sector (i.e., whiting versus non-whiting) or gear type (i.e., non-whiting midwater trawl versus bottom trawl) (Table 1-1). This was evaluated in two ways. First, correlations were evaluated among sectors and gear types to assess the likelihood that both sectors would need access to the reserve in the same year. Second, results from the bootstrap model runs were evaluated to shape the reserve scenarios in the Council's proposed action. Results of the bootstrap simulations for the non-whiting sectors are described in the body of this document; results for whiting sectors are reported in **Appendix B**.

Chinook salmon bycatch in the whiting sector depends on northern versus southern distributions of the at-sea whiting fleets and assumed whiting attainment rates (**Appendix B**). For this reserve analysis, we examined bycatch distribution under both full attainment (i.e., 100 percent attainment) and average annual attainment of whiting for at-sea and shoreside whiting fleets from 2008 to 2016 (**Appendix B**). We applied bootstrap modeling results showing (a) generally northern distribution of the at-sea whiting fleets for 2008 to 2010 data under full and average attainment (Table 3-5a and Table 3-5b) and (b) generally southern distribution of the at-sea whiting fleets during 2012 to 2016 under full and average attainment (Table 3-5c and Table 3-5d) (see **Appendix B** for more detail).

For this analysis, we applied the 0.80th quantile as the target reference point and evaluated whether projected catches at the 0.80th quantile would be equal to, less than, or higher than the guidelines (or guidelines plus reserve) shown under the Council's motion of the proposed action. For cases where the projected catch at the 0.80th quantile was lower than the level of the guideline plus reserve, the projected catch was increased to equal that level, and the associated quantile was reported, consistent with the direction provided in the proposed action. For example, if projected Chinook salmon catch for the whiting sector was 7,625 fish at the 0.80th quantile, then under the reserve scenario, the assumed catch would be increased to the guideline plus reserve (i.e., 14,500 Chinook) and the associated quantile would be applied (in this case a quantile much higher than 0.80). The catch-level for the remaining sectors (i.e., those sectors or gear types that would not receive the reserve) was reported at the 0.80th quantile. Likewise, for cases where the guideline plus reserve were assumed to be taken, if the projected catch at the 0.80th quantile was higher than the guideline plus reserve, then the projected catch at the 0.80 percentile was shown.

Distributing projected catch between gear types for the non-whiting sector was not straightforward, because the guidelines apply to the non-whiting sector as a whole. The method used to evaluate the projected catch of the non-whiting sector was similar to that of the whiting sector. However, distributing the catch between gear types within the non-whiting sector required an additional step when one gear type received the reserve, and the total projected catch of the non-whiting sector was lower than the Council proposed guideline plus reserve. The process for distributing this additional Chinook salmon was as follows:

- For the non-whiting sector, projected Chinook salmon catches at the 0.80th quantile were distributed to bottom trawl and midwater trawl per results of the bootstrap analysis.
- For cases where projected catches were lower than the guideline plus reserve, the amount remaining between (a) the guideline plus reserve (9,000 Chinook salmon) and (b) the sum of the projected catches at the 0.80th quartile for bottom trawl and midwater trawl combined was added to the non-whiting gear type that would receive the reserve. The associated quantile (or range of quantiles) was then provided for that higher total value.

As was done for the whiting sector, the values associated with the 0.80th quantile were shown when they were (a) lower than the guideline, (b) higher than the guideline, or (c) higher than the guideline plus the reserve.

3 RESULTS

Salmon bycatch in all commercial fisheries from 2002 to 2015 are shown in Table 3-1. These data were updated by WCGOP (NWFSC 2017) after the Salmon Bycatch Report (NMFS 2016b) was presented to the Council at the March 2017 meeting. Table 10 shown in NMFS 2016b was based on fewer years of data than are shown in Table 3-1.

Supplementary information is included in **Appendix A**, **Appendix B**, **Appendix C**, and **Appendix D**.**Appendix B** provides detailed analyses for projecting Chinook salmon bycatch for the whiting sector, and National Marine Fisheries Service (NMFS) (NMFS 2016b) provided information on salmon interactions relative to the operations of the Pacific Coast groundfish.

Table 3-1. Salmon mortality (number of fish) by species and fishing sector in the Pacific Coast Groundfish Fisheries, 2002 to 2015. Source: WCGOP (*NWFSC 2017*).

Fishery	Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
At-Sea whiting	Chinook	1,663	2,617	803	3,958	1,192	1,317	718	318	714	3,989	4,209	3,739	6,695	1,806
	Coho	146	3	1	86	28	226	21	12	0	5	17	6	104	4
	Chum	24	11	55	20	87	169	60	41	10	46	53	26	4	5
	Pink	0	17	0	48	0	34	0	2	0	12	22	37	0	23
	Sockeye	0	0	0	0	0	0	2	0	2	0	0	0	0	0
Shorebased whiting	Chinook	1,062	425	4,206	4,018	839	2,462	1,962	279	2,997	3,722	2,359	1,263	6,898	2,002
	Coho	0	0	0	0	0	141	10	37	16	136	16	33	167	9
	Chum	0	0	0	0	0	113	8	2	8	42	3	7	4	7
	Pink	0	0	0	0	0	47	7	26	0	6,113	0	2	0	0
	Sockeye	0	0	0	0	0	0	0	0	0	2	0	0	1	0
Tribal whiting a/	Chinook	1,004	3,413	3,743	3,980	1,931	2,400	696	2,145	678	828	17	1,014	45	3
	Coho	23	191	207	344	3	107	21	57	5	28	0	78	0	0
	Chum	51	9	11	2	24	8	11	11	1	23	0	5	0	0
	Pink	0	3747	0	383	0	513	9	129	0	1087	0	5	0	0
	Sockeye	0	0	0	0	0	0	0	0	0	2	0	1	0	0
Bottom trawl	Chinook	14,501	16,433	1,758	808	67	194	449	304	282	175	304	323	984	996
	Coho	24	32	66	5	0	13	0	0	31	19	27	49	18	3
	Chum	14	38	4	0	0	0	0	0	0	0	0	0	0	0
	Pink	0	0	0	0	0	0	0	2	0	0	2	0	2	0
	Sockeye	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Midwater non-whiting	Chinook	--	--	--	--	--	--	--	--	--	--	12	71	661	482
	Coho	--	--	--	--	--	--	--	--	--	--	0	0	12	7
	Chum	--	--	--	--	--	--	--	--	--	--	0	1	0	5
	Pink	--	--	--	--	--	--	--	--	--	--	0	0	0	0
	Sockeye	--	--	--	--	--	--	--	--	--	--	0	0	0	0
Non-trawl gear b/	Chinook	22	72	43	32	20	0	0	22	16	8	63	124	36	40
	Coho	0	3	45	3	0	15	42	71	42	63	16	19	106	32
	Chum	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pink	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sockeye	0	0	0	0	0	0	0	0	0	0	0	0	0	0

a/ Includes only the Pacific whiting fishery. Tribal non-whiting fishery values were not available

b/ Includes bycatch by vessels fishing under EFPs not already included in a sector count. The added Chinook bycatch by year under EFPs was 2002-22, 2003-51, 2004-3, 2014-1

3.1 Projections under future fishery and management conditions (Proposed Action)

3.1.1 Commercial non-trawl groundfish fisheries

Salmon bycatch by federally managed commercial groundfish non-trawl fisheries are shown in Table 3-1 and Table 3-2. Chinook salmon bycatch by these fisheries ranged from 0 to 124 fish per year.[6] All Chinook salmon bycatch in the federally managed commercial fixed gear fisheries were taken by the commercial nearshore fishery north of 40^{o}10' N. latitude (Somers et al. 2014; NWFSC 2017).

Coho salmon bycatch by commercial non-trawl groundfish fisheries ranged from 0 to 106 fish per year (Table 3-1; Table 3-2). Although most coho salmon were caught by the nearshore fixed gear fishery, some were also caught by LE sablefish hook and line and by catch share hook and line fisheries (NWFSC 2017). No other salmon species were caught by commercial non-trawl groundfish fisheries.

The maximum annual estimated mortality for Chinook and coho salmon is shown in Table 3-2 Observer coverage is low on commercial non-trawl groundfish trips, especially nearshore groundfish trips where most salmon are caught (Somers et al. 2016). A buffer of 250 Chinook salmon and 250 coho salmon mortality is also shown in Table 3-2 to account for this uncertainty (as well as uncertainty in mortality estimates provided for recreational groundfish fisheries; see below).

[6]Note that this maximum value was corrected since salmon bycatch was reported to the Council in March, 2017 (see above, NMFS 2016b)

Table 3-2. Chinook and coho salmon mortality in ocean recreational groundfish fisheries and commercial groundfish non-trawl fisheries.

Non-trawl groundfish fishery	Species: Chinook salmon (number)	Coho salmon (number)
Commercial non-trawl[a/]	124	106
OR long-leader recreational[b/]	12	130
CA recreational skiff fishery[c/]	18	8
WA ocean bottomfish fishery[d/]	NA	NA
OR ocean bottomfish fishery[d/]	NA	NA
CA ocean bottomfish fishery[d/]	NA	NA
Buffer[e/]	250	250
Total	404	494

a/Maxiumum catch from 2002-2015; 100% discard mortality assumed; Table 5.
b/Bycatch rates were calculated from 2009-2011 long-leader EFPs
c/Ocean recreational groundfish fisheries outside of salmon season; 2012-2016. Chinook salmon mortality ranged from 0 to 17.78 per year; Coho 0 to 5.7 per year
d/Salmon catch by WA, OR, and CA ocean recreational groundfish fisheries is already accounted for in salmon pre-season modeling. Not reported here.
e/Buffer to account for OR and WA ocean recreational fisheries outside of the salmon season and uncertainty associated with commercial non-trawl estimates.

3.1.2 Ocean recreational groundfish (bottomfish) fisheries

State agencies provided estimates of fishing-related salmon mortality associated with recreational groundfish fisheries. Salmon caught by California, Oregon, and Washington recreational groundfish fisheries during salmon seasons are accounted for in the assessment and recording of salmon impacts in salmon fisheries. Hence, we show “NA” for these ocean fisheries in Table 3-2.

The CDFW provided sampling data for ocean skiff recreational fisheries that take place outside of salmon seasons. Data were provided from 2012 to 2016. Mortality of discarded salmon by this fishery ranged from 0 to 17.78 Chinook salmon per year and from 0 to 5.7 coho salmon per year. The maximum annual estimate for Chinook and coho salmon (rounded) are shown in Table 3-2 for this California recreational fishery. The data for these recent years indicate that salmon contacts during California recreational groundfish fisheries are uncommon, likely due to distinct fishing locations and gear type.

Anglers frequently report targeting salmon and groundfish species during the same trip when the seasons overlap, but differences in the species’ catch location, depth, and gear suggest anglers target and catch one species group at a time. Furthermore, regulatory gear and depth restrictions relative to each fishery may reduce incidence of true bycatch (e.g., barbless hooks are required while targeting salmon or with salmon onboard; there are groundfish depth-based restrictions). Although data are only readily available since 2012 to estimate salmon bycatch outside the open salmon season, we expect the bycatch pattern and magnitude were similar throughout the 2000s as these factors would have been primary drivers of salmon bycatch in those earlier years as well.

Preliminary salmon mortality estimates were provided for Oregon and Washington recreational groundfish fisheries during closed salmon seasons (see Section 5.1.2, Methods). Sampling during this period (e.g., winter months) is sporadic and covers only a few ports. Hence, there is higher uncertainty for winter estimates than summer estimates. The level of salmon contacts by recreational groundfish anglers outside of the salmon seasons off Oregon and Washington is likely low. For example, over a 16-year period off Oregon (2001 to 2016), a preliminary query for the November to February window (i.e., closed salmon season) showed that on average 47 Chinook salmon, 23 coho salmon, 14 steelhead salmon, and 4 unidentified salmonids were caught and released per year. Salmon contacts by the ocean recreational groundfish fishery off Washington were higher than off Oregon. Over the same 16-year period in Washington, a query during the closed salmon season (October through May) showed on average fewer than 150 Chinook salmon and 20 coho salmon were encountered annually. Because salmon caught outside of the salmon season would be released, a 30 percent mortality rate would be applied to all encounters. A rough estimate of salmon release mortality off Oregon and Washington for the recreational groundfish fishery outside of the salmon season would therefore be 46 Chinook salmon, 1 coho salmon, 4 steelhead salmon, and 1 unidentified salmon. This potential salmon mortality is accounted for in the buffer shown in Table 3-2. Regulations for a long-leader recreational fishery seaward of 40 fathoms off Oregon for both charter and private vessels are being considered for 2018 (NMFS 2016c). Maximum estimated salmon bycatch mortality for this potential fishery is 12 Chinook salmon and 130 coho salmon (Table 3-2) (see Methods, Section 2).

3.1.3 Projected total salmon mortality in commercial and recreational non-trawl fisheries combined

The highest annual salmon mortality across non-trawl groundfish fisheries (recreational groundfish outside of salmon seasons and commercial non-trawl) was 404 Chinook salmon and 495 coho salmon per year (Table 3-2). A buffer was included in this estimate of maximum salmon mortality because salmon bycatch is sporadic, sampling coverage of commercial and recreational trips is low (i.e., not 100 percent), and we could not estimate salmon bycatch in recreational fisheries outside of the salmon season for all states.

3.1.4 Non-whiting trawl sector

Historical salmon bycatch in groundfish trawl fisheries is shown in Table 3-1. Among all salmon species, Chinook salmon catch numbers are highest in the trawl fisheries. Chinook salmon mortality was 901 to 19,475 fish for non-tribal trawl fisheries (whiting and non-whiting sectors) from 2002 to 2015. Coho and chum salmon were also caught annually by all trawl fisheries combined during from 2002 to 2015, but at much lower numbers (Table 3-1). Pink salmon were caught sporadically; pink salmon catch in non-tribal trawl fisheries was fewer than 100 fish per year, with the exception of 2011 when 6,125 pink salmon were caught by non-tribal groundfish trawl fisheries. Sockeye salmon are rarely caught by any of the trawl fisheries. Salmon bycatch by tribal whiting fisheries is also shown in Table 3-1. Projections of Chinook salmon bycatch (Table 3-3) were made using the conditions and assumptions in the proposed action (Agenda Item F.3, Council Action, April 2017), including assuming the current EFH area closures and other inherent characteristics of the IFQ fishery catch data between 2014 and 2016 (such as species composition) (Table 1-1; Table 1-2).

The results indicate that, under the proposed action, projected Chinook salmon bycatch would fall below the guideline of 5,500 Chinook salmon for the non-whiting fleet in most cases; the 0.80th quantile demonstrates that Chinook salmon bycatch would be less than or equal to 4,580 fish (Table 3-3). Other quantiles are provided in Table 3-3 for reference.

The potential need to access the non-whiting trawl reserve is indicated simply by the quantile associated with the Chinook salmon guideline (i.e., 5,500 fish). Under the proposed action (Table 1-1; Table 1-2), the approximate probability of exceeding the 5,500 Chinook salmon guideline in any one year by the bottom trawl and non-whiting midwater trawl together lies between the 0.80th and 0.81st quantiles (Table 3-3). This indicates that between 80 percent and 81 percent of the time, bycatch should be equal to or lie beneath the 5,500 Chinook salmon bycatch guideline. The probability that these two non-whiting gear types would meet or exceed 9,000 Chinook salmon (guideline plus reserve), also lies within these same quantiles. Specifically, both lie between the 0.80th and 0.81st quantiles (4,580 and 9,182 fish), due to the steep rise at the high end of the predicted bycatch distribution for the midwater trawl gear (and disparate bimodal distribution; Figure 3-1), as evidenced by the same quantiles given for each individual gear type (1,642 and 1,658 for bottom trawl, versus 2,938 and 7,525 for midwater trawl; Figure 3-1). This is due to high variance from strong year effects in the data for midwater trawl, particularly 2014 and 2015 versus other years in the range (Figure 3-1; Table 2-2). Therefore, the results indicate that most of the time, Chinook salmon bycatch in the non-whiting trawl fishery is expected to be below the 5,500 guideline, but bycatch could increase quickly, requiring access to the reserve and potential additional actions such that bycatch would not exceed the combined guideline and reserve.

The underlying distributions for the two non-whiting gear types are both multimodal due to strong year effects and explicit accommodation for this feature in the model (**Appendix B**). Bottom trawl projections show modes at approximately 500 and 1,500 Chinook salmon (Figure 3-1), at approximately the 0.25th and 0.75th quantiles. This suggests that, under the proposed action, Chinook salmon bycatch would be expected to fall within the 500 to 1,500 fish bounds approximately 50 percent of the time. Projections for non-whiting midwater trawl show modes at approximately 300, 1,300, and 8,500 fish, illustrating a somewhat more chaotic picture (Figure 3-1). The middle 50 percent of the midwater distribution is captured between 1,155 and 2,684 fish.

Non-whiting midwater bycatch rates tend to be higher and more variable than results shown for bottom trawl, and that is reflected in these predictions (Table 3-3; Figure 3-1). The number of hauls is also substantially lower for midwater trawl than bottom trawl, which plays a role in the uncertainty across quantiles. Bottom trawl projections showed a unimodal latitudinal distribution of predicted bycatch, while the midwater fishery showed a multimodal distribution (Figure 3-1).

Table 3-3. Quantiles for predicted distributions of annual Chinook salmon bycatch (number) by commercial non-whiting trawl gear types (bottom and mid-water), assuming groundfish harvest levels (= model thresholds; Table 3-2) and fishery conditions under the Council's proposed action. This information is also shown in Figure 3-1. Mean values were provided for comparison. Bycatch projections were rounded. Note: 404 Chinook salmon were also projected for non-trawl groundfish fisheries (commercial and recreational; see Section 3.1.3). Source: West Coast Groundfish Observer Program data.

	Chinook salmon projected bycatch (number)		
Quantiles	**Bottom trawl[a/]**	**Midwater trawl**	**Bottom and midwater trawl (total)**
Min	73	289	362
0.01	165	331	496
0.05	307	355	662
0.25	483	1,155	1,637
0.50	638	1,722	2,360
0.75	1,555	2,684	4,238
0.80	**1,642**	**2,938**	**4,580**
0.85	1,726	8,149	9,875
0.95	1,971	9,085	11,056
0.99	2,339	9,777	12,116
Max	3,290	11,184	14,474
Mean	960	2,898	3,858

[a/]Bottom trawl (0.80th quantile) + non-trawl bycatch (404) = 2,046 Chinook salmon

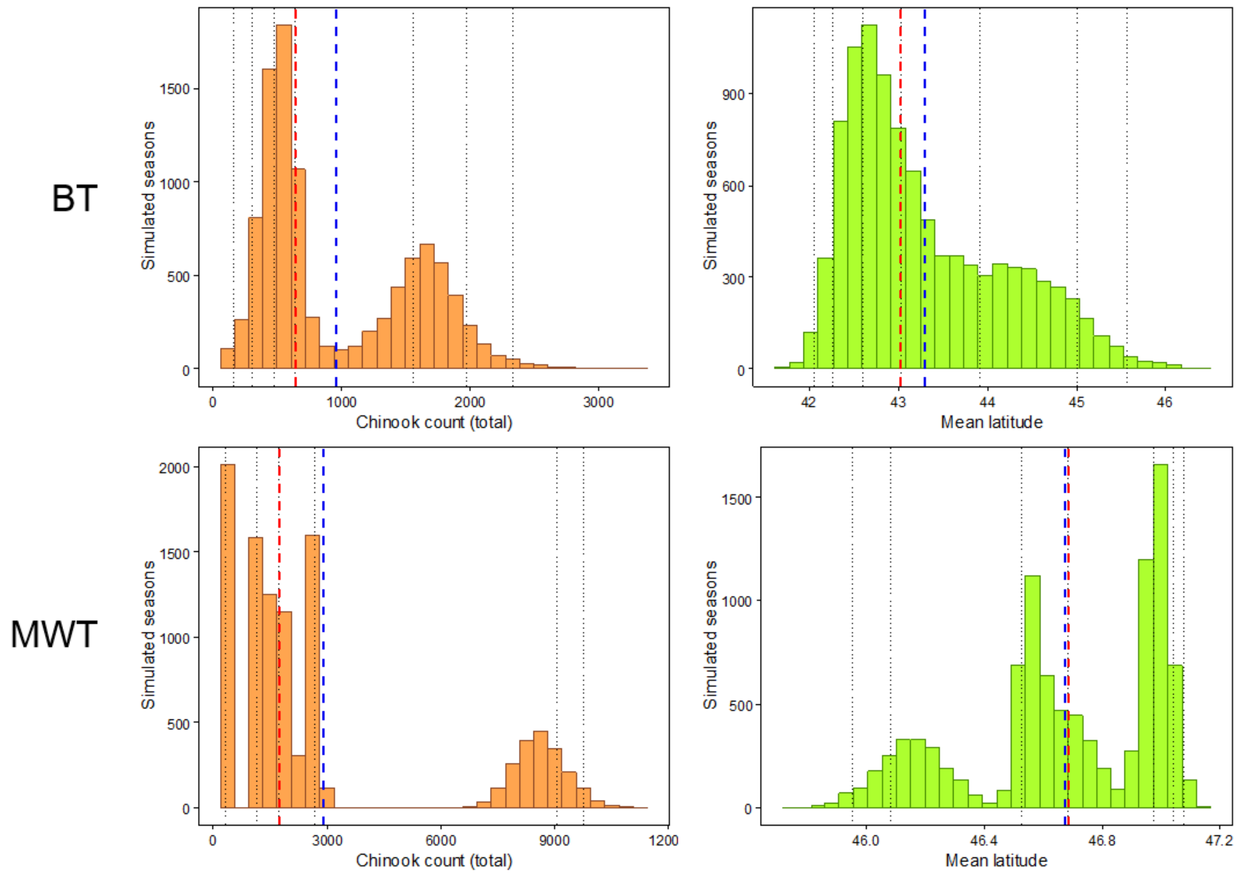

Figure 3-1. Model output for predicted distributions of Chinook salmon bycatch (count) and mean latitude (degrees), assuming groundfish catch thresholds and fishery conditions under the Council's proposed action (Table 1-1;Table 1-2), for bottom trawl and non-whiting midwater trawl. Model thresholds for assumed groundfish catch were informed by the Council's April motion (Table 1-1). Blue dashed line = mean, red dash = median, dotted lines = quantiles from Table 3-3 (0.01, 0.05, 0.25, 0.75, 0.95, and 0.99). Model informed by data from West Coast Observer Program (2012 to 2016).

3.2 Reserve analysis

3.2.1 Probability of more than one trawl sector needing access to the reserve

We examined two questions regarding access to the reserve. One question dealt with the potential for the non-whiting sector to meet or exceed its recommended Chinook salmon bycatch guideline (5,500) and, therefore, need access to the reserve (3,500 fish), or to exceed the sum of that guideline plus the reserve (9,000 Chinook total) (see Section 3.1). The other question dealt with the potential for multiple sectors (including the whiting sector) to need access to the reserve within the same year. We examined the distributions of predicted bycatch for the independent sector analyses, together with a longer time series of absolute bycatch and bycatch rate among the sectors, and we discussed the issues in terms of correlations among different sectors' bycatch and the tendency (or lack thereof) for multiple sectors to need access to the reserve within the same year.

We explored the idea of producing model-based estimates across all sectors to assess the probability of multiple sectors needing to access the reserve at the same time, but three major issues complicated the problem at hand. First, the projections for different sectors are informed by a different time series. Applying different time series to this type of analysis may result in confounding effects that cannot be isolated, such as the influence of different trends and factors within each of the different time series that may influence bycatch. This poses a barrier in terms of modeling multisector projections that are tied to each year, in that all sectors should share the same years. Even if the sectors were reduced to use the lowest range of common years, the estimates for those sectors in which input data had been trimmed would become different from those used in the document, and the multisector results would be irrelevant. Second, the at-sea sectors showed a strong latitudinal shift mid-time series in the data (2008 to 2016), so truncating these data would bias the estimates instead of reflecting the full range of fleet distribution. Third, by the nature of the question, it should be answered by using a long-term data set. Making longer range projections to inform probabilities of co-occurrence of high bycatch among different sectors would not be properly informed by a common set of four or five years of data.

The need for access to the reserve by multiple sectors at the same time was qualitatively evaluated using correlations of annual salmon bycatch between pairs of sectors. There were no apparent or significant relationships in annual bycatch of Chinook salmon between whiting and non-whiting sectors using data from 2002 to 2016 (Table 3-4; Figure 3-2; Figure 3-3). Significant correlations were observed within sectors, however (Figure 3-3). Significant relationships were found between shorebased whiting and at-sea whiting ($r = 0.538$, $p = 0.039$) and between bottom trawl and non-whiting midwater trawl ($r = 0.930$, $p = 0.007$). Relationships among other sectors were non-significant ($p > 0.05$). The at-sea and shoreside whiting sectors are covered within the same shared guideline of 11,000 Chinook salmon. Similarly, the two gear types within the non-whiting sector are covered by the same shared guideline of 5,500 fish. These results suggest a low likelihood of both whiting and non-whiting sectors exceeding their respective guidelines and needing access to the reserve within the same year.

Table 3-4. Chinook salmon bycatch by groundfish sector, gear type, and year. Source: West Coast Groundfish Observer Program data (2002 to 2016). NA = no non-whiting midwater trawling occurred from 2002 to 2010.

Year	At-sea whiting	Shorebased whiting	Tribal whiting	Bottom trawl	Midwater non-whiting
2002	1,679	1,062	1,018	14,915	NA
2003	2,648	425	3,439	16,460	NA
2004	805	4,206	3,740	2,221	NA
2005	3,963	4,018	3,985	1,242	NA
2006	1,209	839	1,940	175	NA
2007	1,321	2,462	2,404	317	NA
2008	722	1,962	697	324	NA
2009	319	378	2,147	299	NA
2010	714	2,997	678	53	NA
2011	3,990	3,708	906	175	19
2012	4,232	2,264	17	299	69
2013	3,737	1,229	1,025	319	78
2014	6,685	6,637	154	963	799
2015	1,809	1,998	NA	997	482
2016	3,050	738	NA	371	47

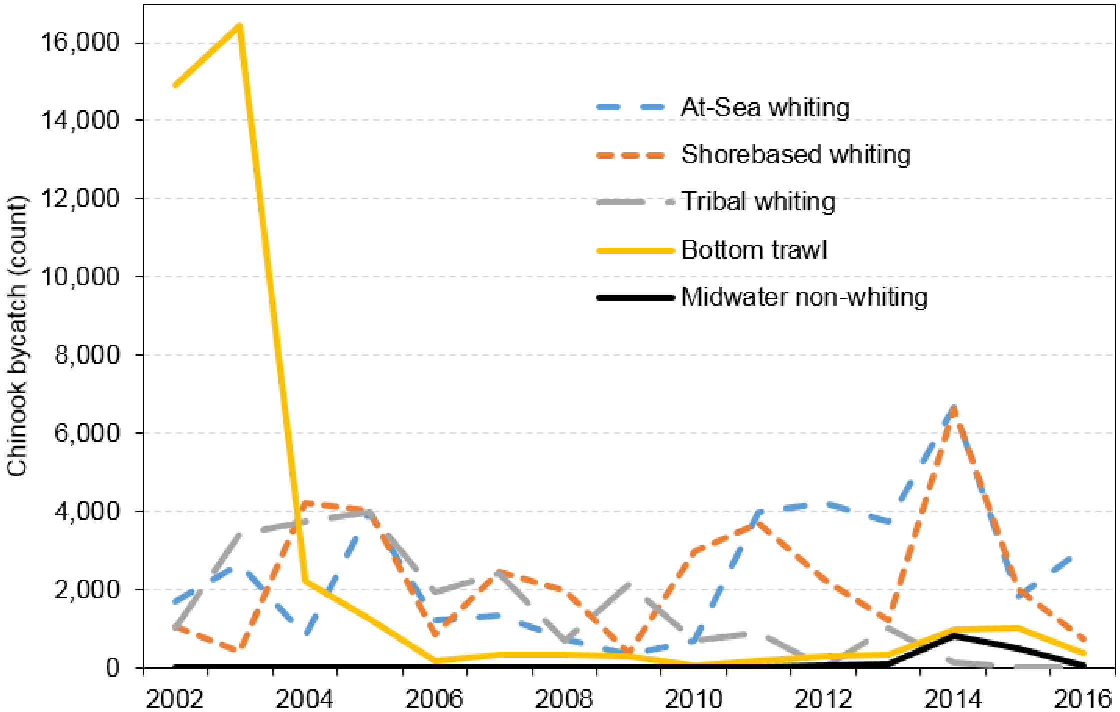

Figure 3-2. Chinook salmon bycatch by groundfish sector and year. Source: West Coast Groundfish Observer program data (2002 to 2016).

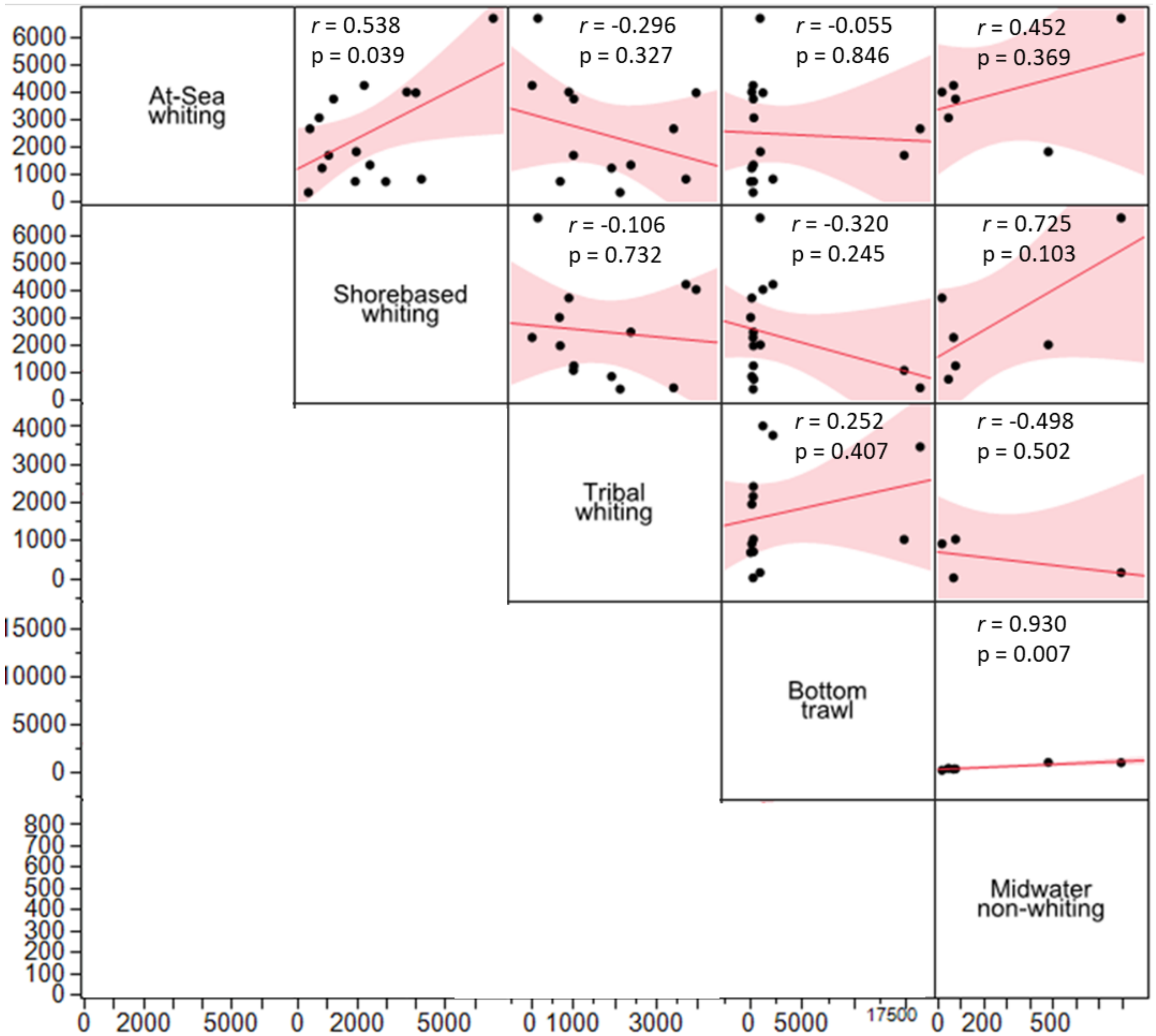

Figure 3-3. Relationships in annual Chinook salmon bycatch among groundfish sectors. Sample correlations (r) and significance levels (p) are shown for each comparison. Source data: West Coast Groundfish Observer Program (2002 to 2016).

3.2.2 Impacts among trawl sectors and gear types given full utilization of the reserve by a single sector or gear type

The Council's direction in its proposed action to evaluate impacts of one sector or gear type using the entire reserve (Table 1-1; Agenda Item F.3, Council Action, April 2017) was as follows:

> "In the analysis of the reserve, analyze three scenarios such that the entire reserve is taken in the following fisheries in their status quo times and areas: 1) whiting, 2) bottom trawl, and 3) midwater non-whiting trawl."

This analysis could not be formally modeled using bootstrap simulations with all sectors included in the model, for reasons discussed in Section 3.2.1. However, projected bycatch by each sector, along with associated quantiles, can be inferred from data produced from simulations shown in Table 3-5. As such, this analysis should be considered a simple and blunt characterization of potential outcomes.

Table 3-5 (a, b, c, d). Quantiles for predicted distributions of annual Chinook salmon bycatch (count) by targeted whiting sectors, assuming average annual attainment (3-5a and 3-5c) or 100 percent annual attainment (3-5b and 3-5d) for commercial (non-tribal) sectors. Data for at-sea whiting were blocked by their prominent latitudinal distribution. The at-sea fleet was described as northern (3-5a and 3-5b; 2008 to 2010 data) or southern (3-5c and 3-5d; 2012 to 2016 data) (see **Appendix B**). Shoreside predictions used data from 2012 to 2016. Source: **Appendix B**.

a. **North** at-sea scenario, 2008-2010 data; **Average Attainment**

Quantiles	Shoreside	CP	MS	Sum
min	938	42	207	1,187
0.01	1,075	59	264	1,397
0.05	1,139	72	297	1,508
0.25	1,724	98	366	2,188
0.50	4,682	551	1,012	6,245
0.75	5,523	642	1,108	7,273
0.80	**5,837**	**660**	**1,127**	**7,623**
0.85	8,174	682	1,151	10,006
0.95	9,623	767	1,216	11,606
0.99	10,594	891	1,292	12,777
max	11,961	1,117	1,449	14,528
mean	4,506	440	831	5,777

b. **North** at-sea scenario, 2008-2010 data; **100% Attainment**

Quantiles	Shoreside	CP	MS	Sum
min	1,207	39	226	1,472
0.01	1,359	64	310	1,734
0.05	1,445	76	344	1,865
0.25	2,173	103	416	2,693
0.50	5,935	593	1,168	7,696
0.75	7,018	684	1,272	8,974
0.80	**7,352**	703	**1,293**	**9,348**
0.85	10,474	724	1,315	12,514
0.95	12,125	808	1,388	14,321
0.99	13,088	942	1,474	15,505
max	14,942	1,272	1,695	17,909
mean	5,692	469	952	7,114

c. **South** at-sea scenario, 2012-2016 data; **Average Attainment**

Quantiles	Shoreside	CP	MS	Sum
min	938	1,763	347	3,048
0.01	1,075	2,234	415	3,724
0.05	1,139	2,520	457	4,116
0.25	1,724	3,001	695	5,420
0.50	4,682	3,417	3,206	11,305
0.75	5,523	4,532	4,282	14,337
0.80	**5,837**	**4,693**	**4,571**	**15,101**
0.85	8,174	4,852	4,833	17,859
0.95	9,623	5,358	5,446	20,427
0.99	10,594	5,941	5,994	22,529
max	11,961	7,112	7,104	26,177
mean	4,506	3,734	2,745	10,985

d. **South** at-sea scenario, 2012-2016 data; **100% Attainment**

Quantiles	Shoreside	CP	MS	Sum
min	1,207	2,042	414	3,663
0.01	1,359	2,427	480	4,267
0.05	1,445	2,707	528	4,681
0.25	2,173	3,190	827	6,191
0.50	5,935	3,620	3,699	13,254
0.75	7,018	4,819	4,971	16,807
0.80	**7,352**	**4,969**	**5,335**	**17,656**
0.85	10,474	5,143	5,648	21,265
0.95	12,125	5,634	6,282	24,040
0.99	13,088	6,276	6,816	26,181
max	14,942	7,935	8,010	30,887
mean	5,692	3,966	3,188	12,846

Under the proposed action for the non-whiting trawl sector (Table 1-1, Table 1-2), the maximum Chinook catch at the 0.80th quantile for bottom trawl and non-whiting midwater (1,642 Chinook salmon and 2,938 Chinook salmon, respectively) would total 4,580 Chinook salmon across all scenarios shown in Table 3-6. Hence, there is greater than an 80 percent probability (80 percent to 81 percent) that the non-whiting sector would remain below the bycatch guideline of 5,500 Chinook salmon. If one of the non-whiting gear types were to catch the remaining Chinook salmon (beyond the amount shown at the 0.80th quantile) up to the sector guideline plus reserve (i.e., totaling 7,358 Chinook salmon for mid-water non-whiting trawl or 6,062 Chinook salmon for bottom trawl during different years; Table 3-6), then the probability that the non-whiting sector would remain at or below its sector guideline and reserve (9,000 Chinook) would be between 80 percent and 81 percent.

Based on the simulations (see Figure 3-1), projected Chinook salmon catch by bottom trawl would likely never reach 6,062 fish, even though for the reserves analysis, we forced bottom trawl to achieve that amount (Table 3-6 and Table 3-7) to achieve Council's guidance. The maximum catch by bottom trawl at the maximum quantile would be 3,290 Chinook salmon (Table 3-3). Hence, for cases where we assumed bottom trawl would need the reserve in Table 3-6 and Table 3-7 and, the associated quantile was reported as "NA."

Footnotes in Table 3-6 and Table 3-7 show projected catch of Chinook salmon by federally managed non-trawl groundfish fisheries (see Section 3.1.1). For this analysis, we assumed that catch by non-trawl groundfish fisheries would not exceed 404 fish, and in most cases, would be much lower. Hence, the maximum bottom trawl, commercial fixed gear, and ocean recreational bycatch of Chinook salmon combined could reach 2,046 to 6,466 Chinook salmon under these reserve scenarios (Table 3-6; Table 3-7), depending on whether bottom trawl took the entire reserve (which would be unlikely, as indicated above) or remained at or below the catch level associated with the 0.80th quantile (Table 3-6a and Table 3-6b).

Projected bycatch of Chinook salmon by the whiting sector depends on the assumptions described in **Appendix B (**see Table 3-6**)**. These assumptions were (a) whether the distribution of fishing effort by the at-sea whiting fleet would fish northerly versus southerly and (b) whether annual whiting attainment would be assumed average or full (100 percent) for the whiting sectors.

For the northern distribution of the at-sea whiting fleet, it would be expected (at the 0.80th quantile) that the whiting sector would catch no more than 7,623 Chinook salmon assuming average whiting attainment (Table 3-6a) or no more than 9,348 Chinook salmon assuming full whiting attainment (Table 3-6b). Therefore, the whiting sector would most likely remain lower than its proposed guideline of 11,000 Chinook salmon regardless of the assumed whiting attainment level when fishing the northern distribution. Furthermore, these analyses show a 95 to 96 percent probability that the whiting sector would catch no more than its Chinook salmon guideline plus reserve, equaling 14,500 fish (Table 3-6b). This suggests there would be only a 4 percent to 5 percent probability that this sector would exceed 14,500 Chinook salmon. In most cases under these scenarios, the whiting sector would catch many fewer than 11,000 Chinook salmon (**Appendix B**).

When combining whiting and non-whiting sector information under the assumption that the at-sea whiting fleet fished the northern areas (**Appendix B)**, should one sector catch its entire Chinook salmon guideline plus reserve under the proposed action, then there is at least an 80 percent probability that the other sector would remain at or below its guideline. This would occur despite the assumption of whiting attainment (Table 3-6a and Table 3-6b).

Quantiles and distribution of Chinook salmon bycatch are much different for the whiting subsectors when the at-sea fleet shows a southern distribution of fishing effort (Table 3-6c and Table 3-6d) than when its distribution is northern (Table 3-6a and Table 3-6b). If the at-sea whiting fleet fished the southern distribution described in **Appendix B**, then there would be an 80 percent probability that Chinook catch would be equal to or less than 15,101 fish (assuming average whiting attainment) or 17,656 fish (assuming 100 percent whiting attainment). In both cases, there would be greater than a 20 percent probability that the whiting sector could exceed its guideline plus reserve of 14,500 Chinook (Table 3-6c and Table 3-6d).

If whiting and non-whiting sector information were combined under the assumption that the at-sea whiting fleet fished the southern areas (see **Appendix B**), there would be a less than 80 percent probability that Chinook catch would be equal to or lower than the guideline plus reserve for all trawl sectors combined (=20,000 fish) for five of six combinations of projected catches (Table 3-6c and Table 3-6d). Hence, in most cases, there would be greater than a 20 percent probability that Chinook catch by whiting and non-whiting sectors combined could exceed the Chinook harvest guideline and reserve for both sectors combined under the assumption of the southern distribution of effort (**see Appendix B**).

Table 3-7 provides a different perspective of projected Chinook catch assuming a southern distribution for the at-sea whiting fleet. In this case, the probability of reaching the Chinook salmon bycatch guidelines for the whiting and non-whiting trawl fisheries is evaluated. As shown above (Table 3-6), the probability that the non-whiting sector would catch less than or equal to its guideline or guideline plus reserve would be 80 percent or greater. However, the probability that the whiting sector would remain at or below its guideline or guideline plus reserve would be lower than 80 percent for all cases (Table 3-7). In the worst-case scenario, the probability that the whiting sector would remain below its guideline of 11,000 Chinook would be 25 percent to 50 percent and below its guideline plus reserve of 14,500 Chinook would be 60 percent to 61 percent (Table 3-7b). In these cases, additional management actions could be required to limit bycatch in the whiting fishery within its guideline or guideline plus reserve.

Table 3-6. Chinook counts and quantiles assuming one sector (e.g. whiting or non-whiting) or one gear type within the non-whiting sector (i.e., midwater trawl or bottom trawl) receives and catches the entire reserve (= shaded cells). Definitions: NA = exceeds the maximum possible quantile (Max = 3,290 Chinook salmon) shown in Table 3-3. [1]

a. Scenario that includes **NORTHERN** distribution of at-sea whting and **AVERAGE** whiting attainment

	Sector and geartype recieiving the reserve shown by shaded cells					
Sector/Geartype	Chinook count	Quantile	Chinook count	Quantile	Chinook count	Quantile
Bottom trawl a/	1,642	0.80	6,062	NA	1,642	0.80
Non-whiting MDT	7,358	0.80-0.81	2,938	0.80	2,938	0.80
Total (non-whiting sector)	9,000	0.80-0.81	9,000	0.80-0.81	4,580	0.80
Catcher/Processor (CP)	660	0.80	660	0.80	1,115	
Mothership (MS)	1,127	0.80	1,127	0.80	1,446	0.99-1.0
Shoreside whiting (SS)	5,837	0.80	5,837	0.80	11,939	
Total (whiting sector)	7,623	0.8	7,623	0.8	14,500	
a/BT + non-trawl	**2,046**		**6,466**		**2,046**	

10b. Scenario that includes **NORTHERN** distribution of at-sea whting and **100%** whiting attainment

	Sector and geartype recieiving the reserve shown by shaded cells					
Sector/Geartype	Chinook count	Quantile	Chinook count	Quantile	Chinook count	Quantile
Bottom trawl a/	1,642	0.80	6,062	NA	1,642	0.80
Non-whiting MDT	7,358	0.80-0.81	2,938	0.80	2,938	0.80
Total (non-whiting sector)	9,000	0.80-0.81	9,000	0.80-0.81	4,580	0.80
Catcher/Processor (CP)	703	0.80	703	0.80	824	
Mothership (MS)	1,293	0.80	1,293	0.80	1,398	0.95-0.96
Shoreside whiting (SS)	7,352	0.80	7,352	0.80	12,278	
Total (whiting sector)	9,348	0.80	9,348	0.80	14,500	
a/BT + non-trawl	**2,046**		**6,466**		**2,046**	

c. Scenario that includes **SOUTHERN** distribution of at-sea whiting fleets and **AVERAGE** whiting attainment

	Sector and geartype recieiving the reserve shown by shaded cells							
Sector/Geartype	Chinook count	Quantile		Chinook count	Quantile		Chinook count	Quantile
Bottom traw a/	1,642	0.80		6,062	NA		1,642	0.80
Non-whiting MDT	7,358	0.80-0.81		2,938	0.80		2,938	0.80
Total (non-whiting sector)	9,000	0.80-0.81		9,000	0.80-0.81		4,580	0.80
Catcher/Processor (CP)	4,693	0.80		4,693	0.80		4,693	0.80
Mothership (MS)	4,571	0.80		4,571	0.80		4,571	0.80
Shoreside whiting (SS)	5,837	0.80		5,837	0.80		5,837	0.80
Total (whiting sector)	15,101	0.8		15,101	0.8		15,101	0.8
[a/]**BT + non-trawl**	**2,046**			**6,466**			**2,046**	

d. Scenario that includes **SOUTHERN** distribution of at-sea whiting fleets and **100%** whiting attainment

	Sector and geartype recieiving the reserve shown by shaded cells							
Sector/Geartype	Chinook count	Quantile		Chinook count	Quantile		Chinook count	Quantile
Bottom trawl a/	1,642	0.80		6,062	NA		1,642	0.80
Non-whiting MDT	7,358	0.80-0.81		2,938	0.80		2,938	0.80
Total (non-whiting sector)	9,000	0.80-0.81		9,000	0.80-0.81		4,580	0.80
Catcher/Processor (CP)	4,969	0.80		4,969	0.80		4,969	0.80
Mothership (MS)	5,335	0.80		5,335	0.80		5,335	0.80
Shoreside whiting (SS)	7,352	0.80		7,352	0.80		7,352	0.80
Total (whiting sector)	17,656	0.8		17,656	0.8		17,656	0.8
[a/]**BT + non-trawl**	**2,046**			**6,466**			**2,046**	

[1.] Quantiles were set at a minimum of 0.80 for this analysis; projected Chinook salmon bycatch associated with that quantile was reported, based on simulation analyses. If salmon bycatch rates were high, and the guideline plus reserve would be exceeded at the 0.80th quantile, then projected catch at 0.80th quantile was reported (even if it exceeded the guideline plus reserve). If salmon bycatch rates were low, and bycatch would be less than the guideline plus reserve at the 0.80th quantile, then projected catches were increased until the guideline plus reserve was met; the associated quantile was then reported. Quantiles for predicted distributions of annual Chinook salmon bycatch by sector was described in Table 3-3for the non-whiting sector and in Table 3-5for the whiting sectors.

NOTE: We assumed average annual attainment or 100 percent annual attainment for commercial (non-tribal) whiting sectors. The at-sea data were blocked by their prominent latitudinal distribution showing northern years (2008 to 2010) and southern years (2012 to 2016) (see **Appendix B**). Shoreside predictions used data from 2012-2016. Sum of bottom trawl and non-trawl groundfish (commercial and recreational) projections of Chinook salmon bycatch are shown as a footnote (404 Chinook salmon was assumed maximum bycatch for commercial fixed gear and recreational groundfish fisheries, including the potential long-leader recreational fishery off Oregon, see Section 3.1.3)**.** Source: **Appendix B**.

Table 3-7. Chinook salmon counts and quantiles assuming one sector (e.g., whiting or non-whiting) or one gear type within the non-whiting sector (i.e., midwater trawl or bottom trawl) receives the entire reserve (= shaded cells). Definitions: NA = exceeds the maximum quantile; Max = 3,290 Chinook salmon (shown in Table 3-3). Source: Appendix B.

a. Scenario that includes **SOUTHERN** distribution of at-sea whiting fleets and **AVERAGE attainment**.
Also assumes the **whiting catch is capped** at either 11,000 or 14,500 Chinook (e.g., mitigation).

	Sector and geartype recieiving the reserve shown by shaded cells					
Sector/Geartype	Chinook count	Quantile	Chinook count	Quantile	Chinook count	Quantile
Bottom trawl (BT) /a	1,642	0.80	6,062	NA	1,642	0.80
Non-whiting MDT	7,358	0.80-0.81	2,938	0.80	2,938	0.80
Total (non-whiting sector)	9,000	0.80-0.81	9,000	0.80-0.81	4,580	0.80
Catcher/Processor (CP)	3,325	~0.40-0.50	3,325	~0.40-0.50	4,571	0.76-0.77
Mothership (MS)	3,119	~0.40-0.50	3,119	~0.40-0.50	4,345	0.76-0.77
Shoreside whiting (SS)	4,556	~0.40-0.50	4,556	~0.40-0.50	5,585	0.76-0.77
Total (whiting sector)	11,000	~0.40-0.50	11,000	~0.40-0.50	14,500	0.76-0.77
[a/]**BT + non-trawl**	**2,046**		**6,466**		**2,046**	

b. Scenario that includes **SOUTHERN** distribution of at-sea whiting fleets and **100%** attainment.
Also assumes the **whiting catch is capped** at either 11,000 or 14,500 Chinook (e.g., mitigation).

	Sector and geartype recieiving the reserve shown by shaded cells					
Sector/Geartype	Chinook count	Quantile	Chinook count	Quantile	Chinook count	Quantile
Bottom trawl /a	1,642	0.80	6,062	NA	1,642	0.80
Non-whiting MDT	7,358	0.80-0.81	2,938	0.80	2,938	0.80
Total (non-whiting sector)	9,000	0.80-0.81	9,000	0.80-0.81	4,580	0.80
Catcher/Processor (CP)	3,004	0.25-0.50	3,004	0.25-0.50	4,098	0.60-0.61
Mothership (MS)	3,070	0.25-0.50	3,070	0.25-0.50	4,197	0.60-0.61
Shoreside whiting (SS)	4,926	0.25-0.50	4,926	0.25-0.50	6,206	0.60-0.61
Total (whiting sector)	11,000	0.25-0.50	11,000	0.25-0.50	14,500	0.60-0.61
[a/]**BT + non-trawl**	**2,046**		**6,466**		**2,046**	

[1.] Only southern distribution of the commercial (non-tribal) at-sea whiting fleet is shown (years 2012 to 2016) for both average attainment and 100 percent attainment (**Appendix B**). Total projected catch is capped at the guideline or guideline plus reserve; quantiles associated with the projected catch is shown. Quantiles for predicted distributions of annual Chinook salmon bycatch by sector were described by Table 3-3for non-whiting sector and Table 3-5for whiting sectors. Shoreside predictions used data from 2012 to 2016. Sum of bottom trawl and non-trawl groundfish (commercial and recreational) projections of Chinook salmon bycatch are shown as a footnote (404 Chinook salmon were assumed maximum bycatch for commercial fixed gear and recreational groundfish fisheries, including the potential long-leader recreational fishery off Oregon, see Section 3.1.1).

4 DISCUSSION

Chinook salmon bycatch projections for non-whiting midwater trawl and bottom trawl fisheries, which were based on the proposed action (Table 1-1, Table 1-2), were within the bycatch guideline of 5,500 Chinook salmon; annual bycatch was projected to be equal to or less than 4,580 Chinook salmon 80 percent of the time (Table 3-5). These projections may be considered high or risk averse due to assumptions that were made regarding anticipated trawling effort and then were applied in the simulation model.

Although assumptions about groundfish catch (Table 1-1, Table 1-2) by bottom trawl are considerably lower than the 1990s amounts assumed in Alternative 2B(1) in the March 2017 Alternatives Document (approximately 26,000 mt versus 41,000 mt respectively), the projected amount of groundfish catch may still be considered somewhat optimistic, given that recent annual groundfish catches (recent bottom trawl landings have remained near 16,000 mt). The attainment estimate shown in Table 1-2 for non-whiting midwater trawl (9,800 mt) is considerably higher than the assumed attainment estimate shown in the March 2017 Alternatives Document (1,500 mt) or by recent trawl landings (2015 and 2016 non-whiting midwater trawl landings have averaged 1,600 mt). However, these risk-averse projections may soon be plausible because several important constraining overfished stocks of rockfish have recently rebuilt, including canary rockfish. As such, there is justification for optimistic attainment levels for this fishery because the past bycatch constraints of these species on target catch have been reduced.

Historical datasets were analyzed to evaluate uncertainty and potential interannual variation for the non-whiting trawl fisheries (**Appendix A**). Chinook salmon bycatch shown by Pikitch et al. (1988) and Sampson (2002) was higher than shown herein. The Pikitch discard study and the EDCP study were both carried out during the trip-limit management era (pre-2011) and prior to the development of RCAs (pre-2002). Prior to 2002, there was no mandatory at-sea monitoring and, subsequently, little individual accountability during the development of these historical databases.

Differences in management, incentives, and technology between this current catch share program era and the historical trip-limit era may partly explain the lower bycatch projections shown in Table 3-3 relative to projections shown in **Appendix A** (i.e., projections using historical catch data). In addition, at the time of the Pikitch et al. (1988) discard study, commercial troll landings (http://www.pcouncil.org/salmon/background/document-library/historical-data-of-ocean-salmon-fisheries/ and the bottom trawling effort (towing hours and number of vessels; PacFIN data) were among the highest on record. The EDCP study also took place during a period of high trawling effort. These additional factors could be responsible for higher bycatch estimates shown by these historical databases.

It is likely that current management, current incentives (e.g., retention of MSC certification), and technological improvements (e.g., use of salmon excluder devices) may all lead to lower Chinook salmon bycatch relative to what was observed during the 1980s and 1990s.

It is possible that bycatch rates by the non-whiting trawl fishery may be higher during some years than assumed for the development of Table 3-3 in this document; however, management and voluntary responses to reduce bycatch rates can be rapid, if needed. NMFS and the GMT currently have real-time (updated daily) observer and electronic monitoring data with Chinook salmon counts available by IFQ sector. Further, if those data reveal an impending conservation issue, WCGOP has indicated that it could provide more granular data detailing Chinook salmon bycatch by area and depth, which would support quick inseason decision making for implementing specific block area closures. Additionally, between improved efficiencies, improved technologies (see Introduction), and open communication between the groundfish trawl fleet and the salmon troll fleet (see **Appendix C**), fishermen may exhibit an increased proactive approach, more so than has been observed in the past, to reduce their projected impacts on Chinook salmon. Finally, the goal of maintaining current aggregate bycatch rates could be accomplished by using the recommended system of block area closures, which could be implemented pre-season or inseason, "for groundfish and protected species (primarily salmon)" as specifically mentioned in the Council's April motion (Agenda Item F.3, Council Action, April 2017).

4.1 Potential impacts of the 2018 trawl gear EFP

The proposed action outlining the future of the groundfish fishery and management measures (Table 1-1) includes EFPs to provide for exempted trawl fisheries in 2017 and 2018 (**Appendix C**). In 2017, the Council recommended and NMFS approved a trawl gear EFP that provided exemptions to minimum mesh size requirements for bottom trawl and the requirement to use the selective flatfish trawl shoreward of the RCA and north of 42°N. latitude.

The Council, at its September 2017 meeting, recommended a new trawl gear EFP (or two separate EFPs) for 2018, which carried over all the provisions from 2017 trawl gear EFP. The Council also recommended that NMFS consider extending the geographic scope of the EFP in 2018 and added additional elements, such as year-round non-whiting midwater trawling in all areas north of 40°10' N. latitude and non-whiting midwater trawling within the current boundaries of the RCA south of 40°10' N. latitude, year-round (Agenda Item E.4, Council Action, September 2017).

While this analysis was not able to directly predict the impact of the EFP on salmon bycatch in 2018, the impacts would be included within the estimates shown for the non-whiting fishery as provided by the provisions of the EFP (Table 3-3). These estimates assume that the full allocation of most non-whiting groundfish species (including midwater species) would be taken; therefore, the salmon impacts would

shift from the primary midwater fishery to the EFP. Furthermore, by design, NMFS could modify or close the EFP if the midwater bycatch harvest guideline of 800 were exceeded prior to May 15th (and would then reopen at the start of the primary season), or if the total of 3,547 Chinook salmon were taken by the EFP and midwater fishery combined. Furthermore, NMFS may close the proposed EFP south of 42° N. latitude at any time should Chinook salmon catch exceed a harvest guideline of 80 fish.
Additional analyses were performed in **Appendix C** to evaluate impacts of extending the midwater trawl fishery south of 40°10' N. latitude (year-round) within the boundaries of the current trawl RCA. Conclusions are shown in **Appendix C** are as follows:

1. Future EFP Chinook salmon bycatch will likely remain within the general non-whiting projections and are not in addition to them.
2. The EFP has harvest guidelines that would limit potential impacts.
3. Mid-water trawl effort (including within the RCA) would likely occur south of 42° N. latitude prior to May 15th and south of 40°10' N. latitude before and after May 15th (within the trawl RCA), but the proportion of effort relative to northern mid-water trawling effort would likely be lower than historically observed.

4.2 Projections and use of the reserve

One task within the reserve analysis was to evaluate the impacts on (a) non-whiting midwater trawl if bottom trawl used the entire reserve or (b) the impacts on bottom trawl if non-whiting midwater trawl used the entire reserve. This analysis was difficult for two reasons:

- Chinook salmon bycatch correlates significantly between bottom trawl and non-whiting midwater trawl ($r = 0.930$; Figure 3-3). Holding one gear type at a constant bycatch level that would be observed at the 0.80th quantile (i.e., non-whiting midwater trawl) while forcing the other gear type to take the remaining guideline plus reserve (i.e., bottom trawl) is likely realistic between sectors of different target type (one whiting sector versus one non-whiting sector), but not between two sectors with the same target type (i.e. at-sea vs shoreside IFQ whiting, or bottom trawl vs midwater trawl non-whiting). Bycatch would likely increase (or decrease) in tandem for whiting sectors, or for non-whiting sectors, but not between the two sector types.
- The maximum simulated catch by bottom trawl was 3,290 Chinook salmon (Table 3-3), which would be much lower than the assumed bycatch for bottom trawl when forced to reach the reserve (6,062 Chinook salmon).

These two caveats may cancel each other out, at some point. In other words, if Chinook salmon catch by bottom trawl reached the maximum level shown in Table 3-3, then catch by non-whiting midwater trawl would likely be higher than shown at the 0.80th quantile (i.e., greater than 2,938 Chinook salmon) in Table 3-6 and Table 3-7. The degree to which these two situations counter each other is uncertain.

The probabilities of exceeding the Chinook salmon bycatch guidelines for the Pacific whiting sectors under the proposed action for various conditions are shown in **Appendix B**. These conditions would include (a) whether the distribution of fishing effort was northerly versus southerly and (b) whether one would assume 100 percent whiting attainment or average whiting attainment.

Projected Chinook salmon bycatch numbers for non-whiting and whiting fisheries were made over a variety of scenarios (Table 3-6 and Table 3-7). Results indicate that it is unlikely that any two sectors might exceed their bycatch guidelines described in the proposed action at the same time (Figure 3-2; Figure 3-3). Under any scenario, when the geographic distribution of the at-sea whiting fleet is most northerly, there is more than an 80 percent probability that the total Chinook salmon bycatch across sectors would be lower than the bycatch guideline plus the reserve amount; neither sector would negatively impact the other (Table 3-6a and Table 3-6b). However, if the at-sea whiting fleet were to fish primarily in its southern fishing areas, where Chinook salmon bycatch rates are higher (Table 3-5; **Appendix B**), there would be only a 25 percent to 50 percent probability that the whiting fleet would catch equal to or less than its 11,000 Chinook salmon guideline (depending on assumed attainment), and a 60 percent to 77 percent chance that the whiting sectors would catch less than their bycatch guideline plus the reserve (14,500 Chinook salmon, depending on assumed attainment) (Table 3-7a and Table 3-7b). Hence, in five of six cases, there would be a greater than 20 percent probability that the Chinook salmon guideline plus reserve across sectors would be exceeded if the at-sea whiting fleet fished a southern distribution (**Appendix B**) throughout the year (Table 3-6c and Table 3-6d).

The at-sea whiting sector has been under pressure in recent years to avoid Pacific Ocean perch (POP) and darkblotched rockfish, two overfished (or formerly overfished) species, for which densities and abundance are highest in northern waters. These species are managed using hard catch limits (hard caps) that are low and difficult for at-sea fleets to maintain. If either the mothership or catcher-processor fisheries exceed their hard caps, then NMFS has the authority to close that fishery through regulations at Codified Federal Regulations(CFR) §660.60(d).

NMFS recently published a proposed rule for Amendment 21-3 which changes the management of darkblotched rockfish and POP allocations for the at-sea whiting sectors from hard bycatch limits to yields managed as set-asides (soft caps). This conversion to managing POP and darkblotched rockfish allocations as set-asides removes the regulatory requirement that NMFS take automatic action to close the mothership or catcher-processor sectors if their sector-specific allocations are exceeded.

In June 2016, the Council recommended, and NMFS implemented, through publication of the 2017-2018 Harvest Specifications and Management Measures Environmental Assessment (NMFS 2016a), a new off-the-top deduction, or "buffer." The buffer provided specific amounts of yield that were deducted from the annual catch limits (ACLs) for canary rockfish, darkblotched rockfish, and POP to account for unforeseen catch events. This new management measure set the fishery limit (the catch amount from which the allocations were based) on the amount after the buffer was subtracted from the ACL. The result was an amount of yield for these three species that was unallocated at the start of the year, but which was held in reserve as a buffer. The full POP and darkblotched buffers were released to the at-sea whiting sector in 2017 through an inseason action taken by NMFS (82 FR 31494). At the time of its creation, the buffer was purposefully limited to the 2017-2018 biennium. However, the Council will consider recommending buffers for the 2019-2020 biennium through Amendment 27 to the FMP (i.e., analyzed in the 2017-2018 Harvest Specifications and Management Measures, NMFS 2016a).

As a result of the two management actions shown above (i.e., for darkblotched rockfish and POP, the addition of potential buffers along with managing the at-sea allocations as set-asides), the whiting fishery footprint could emulate the northern distribution described in **Appendix B** more frequently. If both regulations are effective in 2018, and if the buffer is provided to the at-sea whiting fishery, then the fleet would probably follow the northern distribution model most often. In addition to this added flexibility for the at-sea whiting fleets, recent stock assessments show that both darkblotched rockfish and POP are no longer overfished (Wallace and Gertseva 2017; Wetzel et al. 2017). The Council adopted the darkblotched rockfish updated stock assessment at its June 2016 Council meeting (Decision Summary Document, PFMC, June 9-14, 2017). If both assessments are adopted by the Council, and if NMFS provides final approval and makes a best scientific information available (BSIA) determination, then the resulting higher ACLs would further increase the likelihood of attaining whiting allocations while reducing Chinook salmon impacts, due to increased flexibility for the at-sea fleet to increase fishing effort in areas with lowest Chinook salmon bycatch rates (e.g., the northern fishing area), if needed.

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Appendix A

Alternative methods for projecting Chinook salmon bycatch potential using historical databases under the Council's preliminary preferred alternative (PPA) for rockfish conservation area (RCA)

A.1 INTRODUCTION

Bottom groundfish trawling has been prohibited within RCAs since 2003 (NMFS 2014). Bottom trawling was also first prohibited within darkblotched rockfish conservation areas in 2002. As such, WCGOP data includes few direct observations of salmon catch within the trawl Rockfish Conservation Area (RCA) by bottom groundfish trawlers, except for limited observations in 2002. The proposed action includes the possibility of opening portions of the current RCA to bottom trawling. Therefore, there is additional uncertainty in the bycatch rates and magnitude of the bycatch that could occur within the trawl RCA. For the reasons discussed in the main text (Introduction, Section 1), the use of bycatch rates and distribution in Alternative 2B(1) for the proposed action is supported. The purpose of showing this information is to explore that uncertainty and inform potential annual variability of Chinook salmon bycatch by groundfish trawls. Two historical databases utilized observers during voluntary trips to collect catch and discard data (including Chinook salmon) onboard limited entry groundfish trawlers during the pre-RCA era: (a) the Enhanced Data Collection Project (EDCP, 1995 to 1999) described by Sampson (2002), and (b) the "discard" study (1985 to 1987) described by Pikitch et al. (1988) and Erickson and Pikitch (1994). Erickson and Pikitch (1994) also projected Chinook salmon bycatch estimates and confidence intervals for the Oregon and Washington coasts.

In the Alternatives Document provided at the March, 2017 Council meeting (NMFS 2017), we applied salmon catch rates from the EDCP database to estimate 2018 salmon bycatch that may occur within the current trawl RCA boundaries in waters off Oregon and California, in the event RCAs were removed as specified under the Council's Preliminary Preferred Alternative (PPA) at the November 2016 meeting (Agenda Item F.4, Council Action, November 2016) as one possible scenario (Alternative 2B(2)). During the preparation of the March 2017 Alternatives Document, it was thought that the EDCP database was the only data available that directly collected salmon bycatch information within the current RCA area. However, a second historical database assembled in the 1980s (i.e., Pikitch et al., 1988) was also available, and it included trawling effort and catch within and outside the area bounded by the current trawl RCA. In this section, we provide impacts estimated across a range of proportions. The estimates describe distribution of groundfish landings within and outside the area of the current trawl RCA to be removed under the Council's November, 2016 PPA (Agenda Item F.4, Council Action, November 2016) using both the EDCP database (Sampson 2002) and the Pikitch et al. (1988) database.

As mentioned in Section 2, Introduction, and Section 5, Discussion, in the main document, we concluded that projecting current and future Chinook salmon bycatch using historical data would not necessarily reflect what we would expect to occur in the current fishery. Comments by the Groundfish Advisory Panel (GAP; e.g., Agenda Item I.1.a, Supplemental GAP Report, March 2017; Agenda Item F.3.a, Supplemental GAP Report, April 2017) and others suggested that historical groundfish landings data are not equivalent to modern landings due to differences in retention rates, increases in efficiency leading to increases in catch per unit of effort, dramatic changes in management and monitoring, and changes in incentives (or disincentives). Erickson and Pikitch (1994) also advised against using their data to project future catches for similar reasons. Projected Chinook salmon bycatch using historical databases is provided within this appendix to explore uncertainty and to further illustrate interannual variability.

A.2. Methods

Historical data were provided in two studies that collected catch and discard information for most species (including Chinook salmon) onboard bottom trawl and midwater trawl vessels. The studies were conducted by Oregon State University during the 1980s (Pikitch et al. 1988; Erickson and Pikitch 1994) and by ODFW during 1990s (Enhanced Data Collection Program, EDCP; Sampson 2002). The Northwest Fisheries Science Center (NWFSC) provided the Pikitch et al. (1988) discard data, and the Oregon Department of Fish and Wildlife (ODFW) provided the EDCP data.

We used three data sources to inform the distribution of trawling effort. These data sources included coastwide trawl logbook data (source: Pacific Fisheries Information Network [PacFIN]), data from the EDCP study [for 1996 to 1998; Sampson 2002]), and data from the Pikitch et al. (1988) study (for 1985 to 1987). The latter two sources were also used to inform the model-based predictions of Chinook salmon bycatch directly within the preliminary preferred alternative (PPA) under this analysis. We excluded current essential fish habitat closed areas (EFHCAs) from the analysis of historical data for better alignment with current data for that exercise.

The substantial changes in management and technology over time provide good reasons to avoid using historical data to project bycatch to current or future years (see Introduction, Section 1, of the main document). For example, Figure A-1 demonstrates that groundfish landings were somewhat constant from 2002 to the present, whereas effort (trips) declined throughout that period. Adjustments were possible to compensate for some of these effects within this analysis (i.e., less discard during IFQ relative to pre-IFQ), but not all of them. We chose to scale groundfish landings to reflect changes in retention rates by trawl vessels over time. Scaling landings is an approach that is tractable, well informed by the available data, and well justified by clear differences in groundfish retention rates between pre-IFQ and IFQ eras (on the order of approximately 20 percent). Development of a specific approach to address changes in catch per unit effort (CPUE) due to technological advances in fishing and behavior due to the additional freedom in when and how to fish (choice of weather, season, etc.) was a more complex and debatable task. Thus, it was not used here.

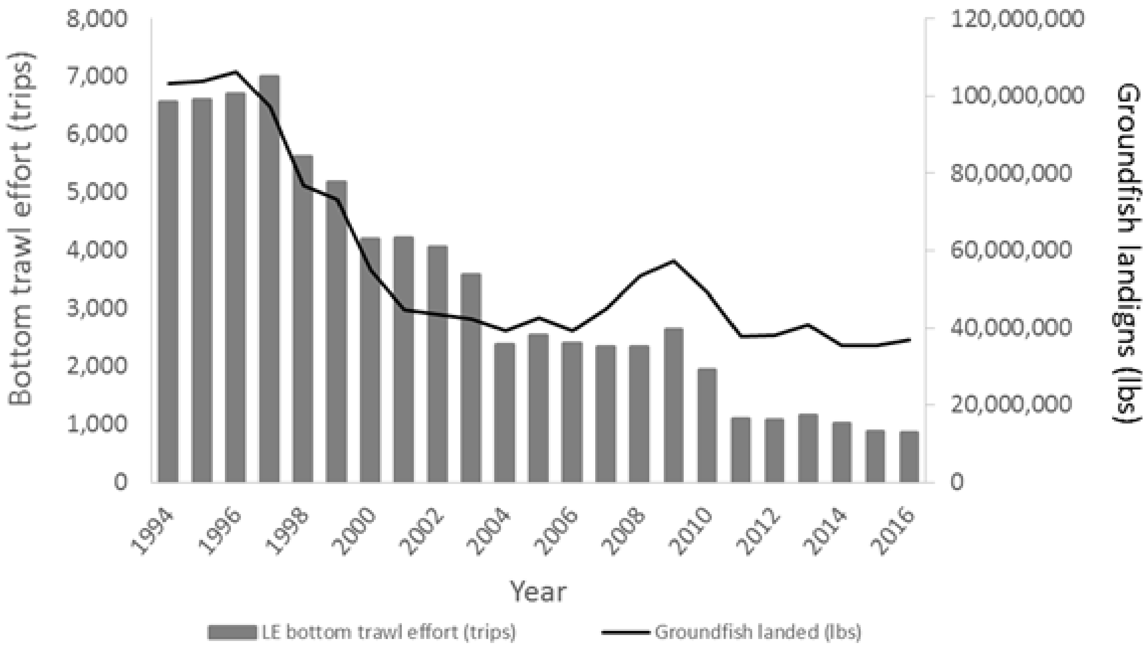

Figure A-1. Non-whiting limited entry trawl trips (number, bars) and pounds of groundfish landed (line) by year. Source: PacFIN.

We employed an adjustment to modeling historical groundfish landings based on the idea that they represent comparatively larger groundfish catch than is reflected on the fish ticket. Ratios relating old and new retention rates were used to scale down the harvest level (= model threshold; see Table 1-2 in the main document) at which the model stops accumulating groundfish and Chinook salmon and reports the distributions and quantiles. This implementation resulted in an equalization of the currency in bycatch rates, scaled up to the modern equivalent.

The mean annual retention rate estimated for all groundfish species captured with bottom trawl, from observer data from 2012 to 2016 was 0.922 (S.D. = 0.0110). The mean annual retention rate estimated for the trawl RCA PPA area to be opened was 0.6981 (S.D. =0.0372) using Pikitch et al. (1988) data and 0.7513 (S.D. = 0.0720) using EDCP data.

The groundfish model threshold deflation factor used for the Pikitch model run was 0.7565, and the value used for EDCP was 0.8149. Historical retention rates in the EDCP case, for example, are 81.5 percent of the modern IFQ-era rates.

A.3 Results

The subsections below detail results of the studies described by Pikitch et al. (1988) and the Sampson et al. (2002).

A.3.1 Chinook salmon bycatch predictions using Pikitch et al. (1988) data to estimate bottom trawl catch within the RCA areas to be opened

Pikitch et al. (1988) data showed a mean annual proportion of 0.256 of groundfish landings within the area recommended to be opened (std. dev. = 0.147) under the Council's November, 2016 PPA (Agenda Item F.4, Council Action, November 2016). Using logbook data for the year 1987, the ratio of groundfish landed as a proportion of the total inside the area to be opened under the Council's PPA was 0.0961. The logbook data may provide the most precise estimate, and likely the most accurate, given that it has the widest coastwide range, and it was estimated from approximately 30,000 hauls per year. The proportion calculated using logbook data was substantially lower than that provided by Pikitch et al. (1988) data.

Oregon and Washington began submitting logbook data to PacFIN in 1987, representing the final year of the Pikitch et al. (1988) study. Our goal was to provide coastwide estimates of salmon bycatch; therefore, we provided estimates for 1987 only when logbook data within the area showed approximately 30,000 hauls per year across the three states. Although the estimate is only from one year, the sample size within the year is large, and it is coastwide. Compliance rates (percentage of logbooks reported to states) were low during this period (see Erickson and Pikitch 1994); this analysis assumes that compliance rates were similar both within and outside of areas defined by current RCA and would not affect our estimate of fleet distribution.

We averaged the 1987 logbook and study-derived proportions, for a value of 0.1761, and we used this to apportion groundfish landings between the two areas—within and outside the trawl RCA. We performed two model runs to inform the estimates seen in Table A-1 (1) the Pikitch et al. (1988) discard data for bottom trawl within the RCA to be opened and (2) WCGOP observer data for bottom trawl in the open areas and for midwater trawl in all areas.

The 0.80th quantiles were 4,178 Chinook salmon for bottom trawl and 2,938 Chinook salmon for midwater trawl, totaling 7,116 (Table A-1). Therefore, the maximum Chinook salmon bycatch at the 0.80th quantile was greater than the bycatch guideline for the non-whiting fishery under the Council's proposed action (= 5,500 Chinook salmon). This suggests that access to some portion of the reserve could occur in some years.

Estimates of Chinook salmon bycatch using these data were multimodal (Figure A-2) with strong year effects (Table A-2). Annual aggregate bycatch rates for the Pikitch et al. (1988) bottom trawl data (Table A-2) showed two low bycatch years and one high year. The high year was due to several hauls with relatively large numbers of Chinook salmon, rather than one or two extreme catch events.

Table A-1. Quantiles for predicted distributions of annual Chinook salmon bycatch (numbers of fish) by commercial non-whiting trawl (bottom and mid-water), assuming groundfish harvest levels under the proposed action (= model thresholds; Table 1-2 in the main document), and the Council PPA for the RCA (bottom trawl effort distribution and bycatch predictions informed by Pikitch discard study data 1985 to 1987).

Quantiles	**Bottom trawl (non-RCA)**	**Bottom trawl; new area (formerly RCA)**	**Bottom trawl (total)**	**Midwater trawl**	**Bottom and midwater trawl (total)**
Min	66	28	94	289	382
0.01	120	40	160	331	490
0.05	241	46	287	355	643
0.25	401	58	459	1,155	1,614
0.5	544	370	914	1,722	2,636
0.75	1,292	2,684	3,975	2,684	6,659
0.80	**1,362**	**2,806**	**4,178**	**2,938**	**7,116**
0.85	1,436	2,915	4,352	8,149	12,500
0.95	1,663	3,171	4,833	9,085	13,918
0.99	1,977	3,447	5,424	9,777	15,200
Max	2,718	3,924	6,642	11,184	17,826
Mean	808	1,082	1,890	2,898	4,788

Note: Current, non-RCA bycatch predictions for bottom trawl informed by recent WCGOP data and non-whiting midwater trawl were informed entirely by WCGOP data. Modeled groundfish thresholds were adjusted as described in the text, to account for differences in groundfish retention rates between eras. Bycatch projections were rounded.

Table A-2. Groundfish landed (unadjusted), Chinook salmon count, and Chinook salmon bycatch rate using bottom trawl gear, from the Pikitch et al. (1988) discard study, within the area to be opened to bottom trawl fishing under the Council's PPA for the RCA. Decimal Chinook counts may result from estimation or expansion.

Year	Groundfish landed (mt)	Chinook salmon (number)	Bycatch rate
1985	67.37	1	0.0148
1986	48.26	5	0.1036
1987	66.64	53.86	0.8082

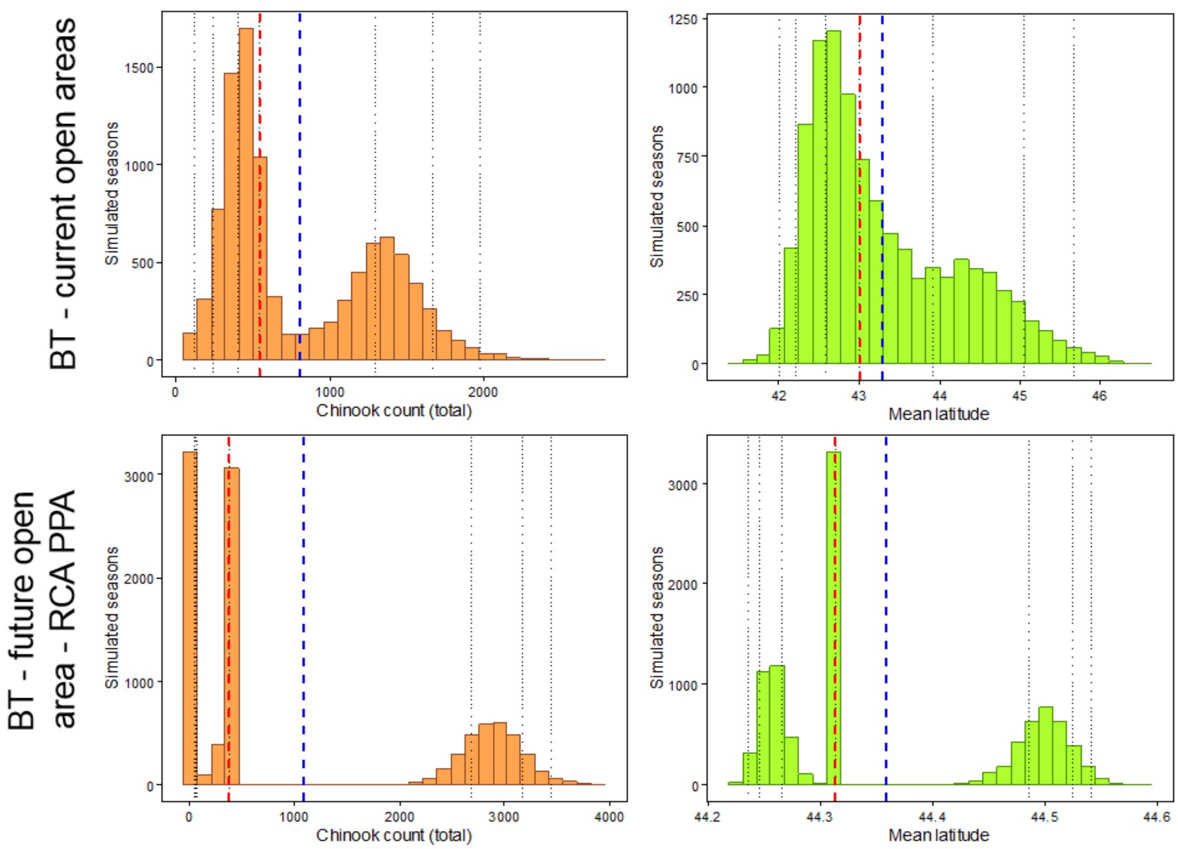

Figure A-2. Model output for predicted distributions of Chinook salmon bycatch (count), and mean latitude (degrees), under the conditions specified under the proposed action, for groundfish bottom trawl. Modeled groundfish thresholds (Table 1-2, main document) were informed by the Council's April motion (Table 1-1, main document). Bottom trawl effort distribution and bycatch predictions informed by Pikitch discard study data (1985 to 1987). Current, non-RCA bycatch predictions for bottom trawl informed by current WCGOP data. Blue dashed line = mean, red dash = median, dotted lines = quantiles from Table A-1 (excluding mean, min and max). Modeled-groundfish thresholds were adjusted as described in the text.

A.3.2 Chinook salmon bycatch predictions using EDCP data to estimate bottom trawl catch within RCAs to be opened

Estimating groundfish effort distribution between areas using EDCP data (Sampson 2002) yielded a mean proportion of 0.1286 (standard deviation = 0.0802) groundfish landings within what would be the newly opened RCA (relative to the landings across all areas), under the Council's PPA relative to total landings. Data from 1996 to 1998 were used for this analysis; 1995 and 1999 data were excluded from simulations due to small haul numbers within the RCA (i.e., 5 hauls in 1995 and 12 hauls in 1999).

Using logbook data from years 1996 to 1998 (= EDCP years), the average annual ratio of groundfish landed inside the area to be opened under the Council's PPA, as a proportion of the total groundfish landed, was 0.1314, with a standard deviation of 0.0220. This is the most precise estimate, and likely the most accurate, given that it has the widest coastwide range, and it was estimated from approximately 30,000 hauls per year. This proportion was nearly identical to the one estimated from EDCP data. To encompass data from different sources, we averaged the two nearly identical values to partition the groundfish landings (i.e., model-groundfish threshold) for the bottom trawl from Table 1-2 of the main document between the two areas. The value we used was 0.130. We made two separate model runs of the area-specific proportion (see above) of the model-groundfish threshold to estimate Chinook salmon bycatch from the two different data sources: (1) EDCP for bottom trawl within the RCA to be opened and (2) WCGOP observer data for bottom trawl in the other non-RCA areas and for non-whiting midwater trawl (all areas).

Predicting Chinook salmon bycatch for bottom trawl within what would be the newly opened area under the PPA for the EFH/RCA action using historical data showed disparate potential outcomes. Bycatch rose steeply with increasing quantile (Table A-3). For example, the predicted maximum bycatch at the 0.80th quantile was 15,144 Chinook, which would exceed the combined Chinook salmon bycatch guideline and reserve for the non-whiting trawl fishery (total of 9,000 Chinook salmon) under the Council's proposed action. The mean was much higher than the median, due to pronounced year effects (i.e., high bycatch in 1997) and relatively small sample sizes for the area within the RCA to be opened. Just 165 hauls among the three years used for bottom trawl fell within the area to be opened under the PPA for the EFH/RCA action.

Estimates of Chinook salmon catch for this area were multimodal (Figure A-2). Strong EDCP year effects were largely due to high bycatch in 1997 within the PPA RCA area (Table A-4). Chinook salmon bycatch was high during 1997 but low during 1996 and 1998.

Table A-3. Quantiles for predicted distributions of annual Chinook salmon bycatch (numbers of fish) by commercial non-whiting trawl (bottom and mid-water), assuming groundfish harvest levels under the proposed action (= model thresholds; Table 1-2 of the main document), and the Council PPA for the RCA (bottom trawl effort distribution and bycatch predictions informed by EDCP data 1996 to 1998).

Quantiles	**Bottom trawl (non-RCA)**	**Bottom trawl; new area (formerly RCA)**	**Bottom trawl (total)**	**Midwater trawl**	**Bottom and midwater trawl (total)**
0.00	66	559	625	289	913
0.01	120	653	773	331	1,103
0.05	241	689	930	355	1,286
0.25	401	745	1,146	1,155	2,301
0.50	544	795	1,339	1,722	3,061
0.75	1,292	10,527	11,819	2,684	14,502
0.80	**1,362**	**10,814**	**12,176**	**2,938**	**15,144**
0.85	1,436	11,088	12,524	8,149	20,672
0.95	1,663	11,784	13,447	9,085	22,532
0.99	1,977	12,428	14,405	9,777	24,181
1.00	2,718	13,853	16,571	11,184	27,755
Mean	808	4,208	5,015	2,898	7,913

Note: Current, non-RCA bycatch predictions for bottom trawl were informed by current WCGOP data, and midwater trawl bycatch predictions were entirely informed by WCGOP data. Modeled groundfish thresholds were adjusted as described in the text, to account for differences in groundfish retention rates between eras. Bycatch estimates were rounded.

Table A-4. Groundfish landed (unadjusted), Chinook salmon count, and bycatch rate using bottom trawl gear from the EDCP study (Sampson 2002), within the area to be opened to trawl fishing under the Council's PPA for the RCA.

Year	**Groundfish landed (mt)**	**Chinook salmon (number)**	**Bycatch rate**
1996	43.10	12	0.2784
1997	64.44	257	3.9879
1998	21.89	6	0.2741

Note the high Chinook salmon count and bycatch rate in 1997. This example of high interannual variability was due to many hauls with large numbers of Chinook salmon, rather than one or two extreme catch events.

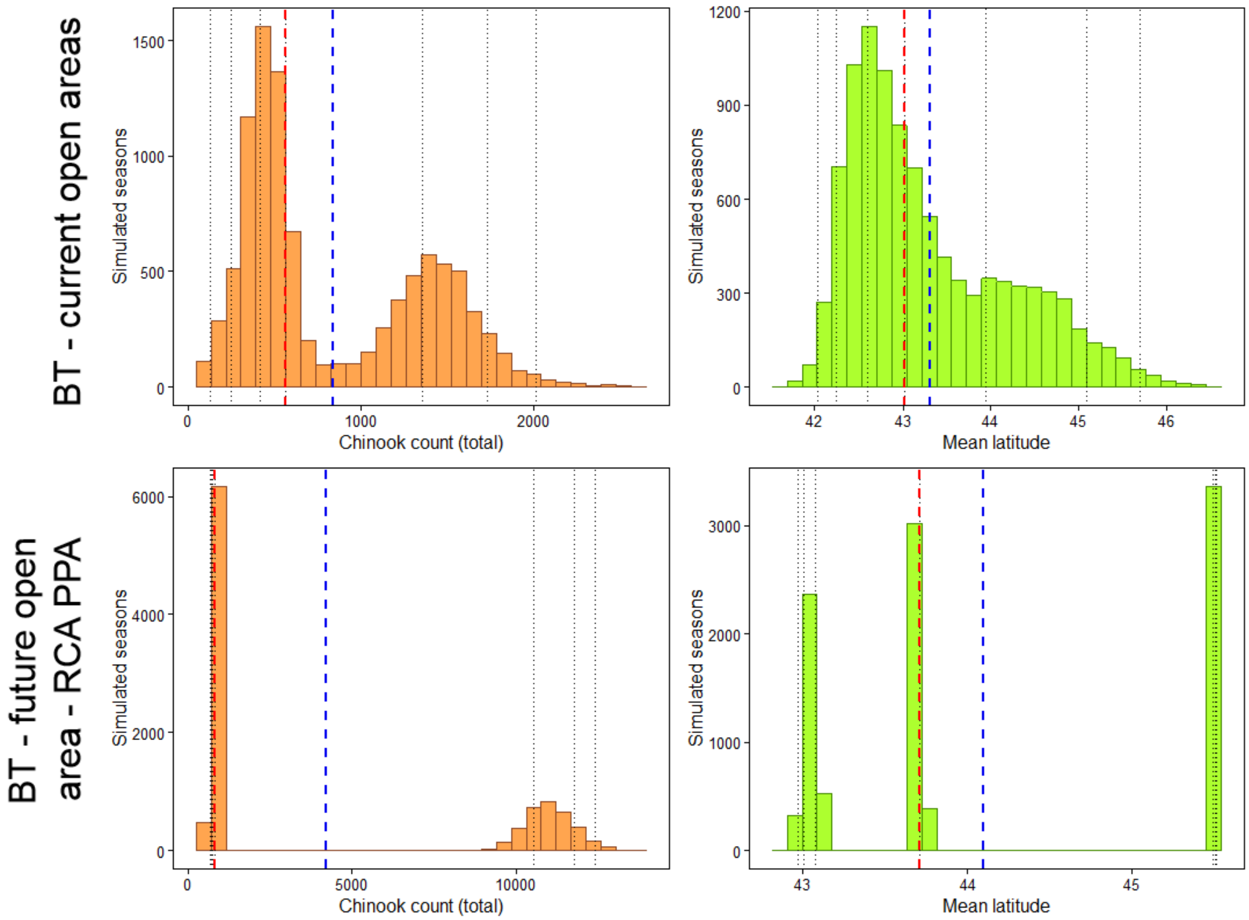

Figure A-3. Model output for predicted distributions of Chinook salmon bycatch (count), and mean latitude (degrees), under the conditions specified proposed action, for groundfish bottom trawl. Modeled groundfish thresholds (Table 1-2, main document) were informed by the Council's April motion (Table 1-1, main document). Bottom trawl effort distribution and bycatch predictions were informed by EDCP data (1996 to 1998). Current, non-RCA bycatch predictions for bottom trawl were informed by current WCGOP data. Blue dashed line = mean, red dash = median, dotted lines = quantiles from Table A-3 (excluding mean, min and max). Modeled-groundfish thresholds were adjusted as described in the text.

A.4 Discussion

Projections using Pikitch et al. (1988) data for the area to be opened under the Council PPA (Table A-1) were somewhat higher than those in Table 3-3 (main document), which used only observer data under recent fishery conditions. Predictions made using EDCP study data (Table A-3) were dramatically higher than those using Pikitch data (Table A-1), especially at the high end of the bycatch distribution, which highlights the large degree of interannual variability in Chinook salmon bycatch and bycatch rates (strong year effects), as well as calling attention to the era in which the data were collected and differences in fishery management measures and fishery behavior among eras. These differences between eras could have a substantial effect upon the results.

All three data sources (Pikitch, EDCP, and WCGOP) show similarities in how Chinook salmon bycatch varies among hauls, except that the EDCP operates at a much higher scale overall (i.e., bycatch rates were much higher than shown in the other databases). A common feature across data sets is that most hauls either catch zero to a handful of Chinook salmon, while a much smaller number of hauls catch an intermediate amount. Finally, a very small number of hauls catch a comparatively very large amount of Chinook, on the order of 100 or more fish, and these extreme bycatch events tend to occur as "lightning strikes," once to a few times per year.

The Pikitch et al. (1988) data and the EDCP data showed multimodal results with strong year effects (two low bycatch years and one high year, respectively). The importance of interannual variation in salmon bycatch by limited entry trawl vessels was described by Erickson and Pikitch (1994), who estimated 1986 and 1987 Chinook salmon bycatch by bottom trawl vessels off Oregon and Washington at levels of 5,300 and 7,601 fish. These bycatch estimates did not include catch by non-whiting midwater trawl and represent mean catches; the upper 95 percent confidence interval for 1987 was 21,683 Chinook salmon.

At the time of the Pikitch et al. (1988) discard study, commercial salmon troll landings and bottom trawl effort (towing hours and number of vessels) were among the highest on record. The EDCP study also took place during a period of high trawling effort. The Pikitch discard study and the EDCP study were both carried out during the trip-limit management era and prior to the implementation of RCAs. There was no mandatory at-sea monitoring and, subsequently, little individual accountability during the development of these historical data. As such, using historical data to project current and future Chinook salmon bycatches is not advisable. The lower confidence in the use of these data to project catch of ESA species during modern times was described in the main body of this document, within this appendix, and by Erickson and Pikitch (1994). The purpose for providing projected bycatch information using the historical databases here is to explore the acknowledged uncertainty in the bycatch estimates and, further, to demonstrate the degree of interannual variation in Chinook salmon bycatch.

Appendix B

Analysis of Directed Commercial Whiting Sectors for the 2017 Salmon Biological Opinion under the Council's Final Proposed Action, from the April 2017 Meeting

B.1 Summary

We analyzed the directed commercial whiting sectors in the groundfish fishery to predict Chinook salmon bycatch in support of the biological opinion for listed runs under the Endangered Species Act (ESA). The assumed fishery conditions hinged upon the April 2017 Council motion, and we presented additional alternatives that deviated from the motion for a few factors that were highly influential upon variability in Chinook bycatch. This was done to bracket uncertainty in our predictions.

We found that the level of attainment of the whiting TAC and sector allocations was influential upon projected bycatch. We included assumptions of both 100 percent attainment and average annual sector attainment to portray a more realistic range under the Council's high total allowable catch (TAC) assumption.

Projections made using the average attainment assumption were likely more representative of future conditions. Alternatively, the combined assumptions of the highest whiting TAC ever, together with 100 percent attainment, created what were likely unrealistically high estimates of Chinook bycatch. Also important was the latitudinal distribution of the fleet (particularly important to stock composition); a northern distribution was associated with much less bycatch than a southern one. These findings align with those of the March Alternatives Document.

Predicted distributions were multimodal, owing to strong year effects. The medians of those distributions ranged between 6,000 and 13,000 Chinook salmon according to different combinations of assumptions for whiting attainment, and fleet latitude.

B.2 Introduction

We conducted an analysis of the whiting sectors in the groundfish fishery to predict Chinook salmon bycatch in support of the biological opinion for listed runs under the Endangered Species Act (ESA). We examined a range of scenarios for targeted whiting fisheries that hinged upon the motion carried by the Pacific Fishery Management Council (Council) at the April 2017 meeting, which described the final proposed action for the state of the groundfish fishery in the near future. Our analysis also considers input from the Groundfish Management Team (GMT) from its statement at the April 2017 Council meeting, and from a working subgroup of commercial fishery specialists from the GMT.

For the targeted whiting sectors, our analysis reexamines Alternative 1A from the Alternatives Document presented in the March 2017 meeting. We added more years of data and used a bootstrap simulation modeling approach, as suggested by the Scientific and Statistical Committee (SSC) to project bycatch. Additionally, we produced projected alternative impacts estimates, depending upon the latitudinal distribution of Chinook bycatch in the commercial at-sea sectors (via predominantly northern versus southern effort and corresponding bycatch patterns). Previous analysis in the Alternatives Document indicated that latitude was an important factor in determining expected Chinook bycatch.

We assumed 100 percent attainment, along with a TAC level of 500,000 metric tons (mt), which were both recommended in the Council motion. We also assumed average annual attainment for each sector, which is representative of recent fishery performance, and likely more indicative of the future. Values for the United States portion of the Joint Canada/United States Whiting TAC are presented in Table B-1, along with sector allocations and attainment values for those allocations, over the past eight years, from 2008 to 2016.

Table B-1. Annual values for the United States portion of the Joint Canada/United States Whiting TAC (mt), together with sector allocations and attainment values (percent) for those allocations, over the past eight years, from 2008 to 2016.

Year	CP	MS	SS	TAC	CP	MS	SS
2008	93%	99%	85%	267,545	115,789	58,087	58,669
2009	98%	100%	100%	135,939	35,376	24,034	40,738
2010	102%	95%	95%	193,935	53,379	37,679	65,938
2011	95%	94%	97%	290,903	75,138	53,039	92,818
2012	99%	98%	95%	186,037	55,584	39,235	68,662
2013	98%	93%	99%	269,745	79,573	56,170	98,297
2014	100%	85%	77%	316,206	103,203	73,049	127,835
2015	68%	39%	46%	325,072	100,873	71,204	124,604
2016	95%	81%	60%	367,553	114,149	80,575	141,007
Average	94%	87%	**79%**	261,437	81,452	54,786	90,952

The Council recommended assuming that the TAC would be fully harvested, and this appears to be one reasonable alternative. However, lower attainment in recent years, including substantially lower attainment in 2015 across all whiting sectors (Table B-1) makes it prudent for us to include an alternative based on average annual attainment to consider major source of uncertainty that influences Chinook bycatch.

B.3 Methods

B.3.1 General Methods

The bootstrap method employed here is a non-parametric simulation approach that builds empirical distributions of one or more specified statistics by resampling actual data within stated parameters. It circumvents shortcomings of parametric simulation approaches (such as Monte Carlo and MCMC) that result from non-standard distributions typically seen in fishery data. Forcing an assumption of a particular distribution upon an analysis that does not fit the data well can introduce error (not easily predicted or corrected), which can have important consequences for conclusions and downstream decision making.

A bootstrap simulation approach has been recently used in different fisheries within in the Council arena, although it was used at least as early as 2013 by ODFW staff to manage recreational halibut catch (Patrick Mirick, unpublished report). It was used to evaluate hard caps on bycatch of protected species in the drift gillnet fishery by Stohs (2015), and the GMT later adapted it to evaluate rockfish bycatch in the at-sea whiting fisheries (Mirick, Niles, and Doerpinghaus 2015). Mirick (2016, unpublished) also used it to evaluate uncertainty, accompanying a Chinook salmon bycatch projection made using a bycatch rate approach for the mid-water non-whiting trawl sector, which we referenced in the March Alternatives Document (NMFS 2017).

In the March 2017 Alternatives Document, we examined a number of different potential scenarios among the various sectors, screening them using a straightforward method of 3 x 3 matrices, which combined ranges of interannual bycatch rates and retained catch estimates to produce biaxial matrices of predicted bycatch of Chinook salmon. Although that approach was time-efficient for screening many potential scenarios, and it was effective for comparing and summing groups of predictions informed by varying data content, the bootstrap approach painted a more detailed picture of the uncertainty in the predictions through distributions of possible outcomes.

The West Coast Groundfish Observer Program (WCGOP) provided data that included both total Chinook counts and total combined retained groundfish weights (round, mt), from 2011 to 2016. Data from 2016 were combined from both observed and electronically monitored (EM) trips. At-sea data were queried from the NORPAC 4900 comprehensive table in the Pacific Fisheries Information Network (PacFIN) database.

The goal of the approach was to predict likely Chinook impacts for later evaluation in the biological opinion, compared with the 11,000-fish threshold and the 3,500-fish reserve proposed to manage Chinook bycatch in the whiting fishery. We accomplished this through simulating fishing seasons by randomly drawing many bottom trawl hauls with replacement; year effects were explicitly incorporated into the model conditions (in agreement with SSC recommendations) by randomly selecting a year first, before drawing hauls from within that year, when simulating a season.. We built cumulative tallies of target species (retained groundfish) versus bycatch (counts of Chinook salmon), and we evaluated those tallies against their respective caps. This process was repeated 10,000 times (for 10,000 simulated seasons), the results were aggregated into distributions, and the quantiles and measures of central tendency from those distributions were calculated. The quantiles can be used as reasonable approximations of probabilities under the implicit and explicit conditions and assumptions of a particular model run, as well as the input data used (Davidson and Hinkley 1997).

Separate projections were made for each whiting sector. The quantiles of the predicted distributions were calculated for each sector, then those same quantiles were summed across the three sectors to generate aggregate prediction statistics for the whole commercial directed whiting fishery.

B.3.2 Model Conditions, Parameters, and Assumptions

According to the Council's recommendation, we assumed 100 percent attainment by each sector under a United States TAC of 500,000 mt. We allocated the TAC in accordance with current regulation and recent set-aside values. From the 500,000 mt TAC, we subtracted 17.5 percent for a tribal allocation (87,500 mt) and a 1,500 mt set-aside for research and incidental catch, resulting in a harvest guideline (HG) of 411,000 mt. From there, we allocated the HG among the three whiting sectors as follows: 34 percent to catcher-processor (CP, 139,740 mt), 24 percent to mothership (MS, 98,640 mt), and 42 percent to shorebased IFQ (SB, or SS, 172,620 mt). We adjusted each of these by the average annual retention rate over the modeled period, which resulted in very slightly reduced cap values (139,000, 98,344, and 171930 mt, respectively). This produced model caps for the various sectors that are shown in Table B-2.

We also produced a second set of hake catch caps for the model. Given that the average attainment of the commercial whiting sectors from 2008 to 2016 was generally lower than the Council's recommendation of 100 percent (between 6 and 14 percent lower, Table B-1), we ran a second set of projections with caps informed by the average attainment values. This likely paints a more realistic picture of the near future, especially considering recent fishery performance over the past several years (2014 to 2016).

Since our goal was to estimate distributions of bycatch counts of Chinook salmon and their latitudinal distributions, coincident with simulated seasons with defined amounts of hake catch, we did not impose a cap on the amount of Chinook bycatch itself.

Table B-2. Specifications used to generate model caps (retained hake catch) among the whiting sectors (CP = catcher-processor; MS = mothership; SS = shoreside, part of the shorebased IFQ program), using assumptions of full attainment, and average annual attainment over the modeled periods (2008 to 2016 for at-sea, and 2011 to 2016 for shoreside whiting).

Specification	TAC and allocations set-asides	Allocations adjusted for retention rate	Retention rate	Allocations adjusted for retention and attainment	Attainment
TAC	500,000	NA	NA	NA	NA
Tribal; 17.5% of TAC	87,500	NA	NA	NA	NA
Research and inc.	1,500	NA	NA	NA	NA
HG	411,000	NA	NA	NA	NA
CP; 34% of HG	139,740	**139,600**	0.999	**131,675**	0.943
MS; 24% of HG	98,640	**98,344**	0.997	**85,700**	0.871
SS; 42% of HG	172,620	**171,930**	0.996	**135,945**	0.791

B.4 Results and discussion

The sections below present aggregate results and relevant discussion. They also present projections for northern and southern distributions of Chinook bycatch.

B.4.1 Aggregated Model Results among Sectors—Coastwide, All Years

We ran the model with the sector-specific whiting caps shown in Table B-2, and other parameters described in Section 3.2, Methods used to project non-whiting trawl bycatch of Chinook salmon under future fishery and management conditions. Results are included for the three commercial sectors, assuming full and average annual attainment, and three scenarios for latitudinal effort distribution of the at-sea fleets.

Table B-3 shows projected distributions of Chinook bycatch under different assumptions for latitudinal fleet distributions, assuming full attainment of all commercial whiting sector allocations. Table B-4 shows the same, assuming average annual attainment from 2008 to 2016. We used the median of the distribution of simulated catch as the risk-neutral predictor of Chinook bycatch; by definition, there is an equal likelihood that the predicted value falls above or below it.

Within Table B-3, Table B-3.a shows projected bycatch distributions under a mixed latitudinal distribution of hake effort and Chinook bycatch; Table B-3.b and Table B-3.c show two versions of a northern pattern of fleet effort and Chinook bycatch which include 2008 to 2011, and 2008 to 2010, respectively. Table B-3.d shows predicted distributions for a southern pattern of fleet effort and Chinook bycatch, informed by 2012 to 2016. Table B-4 is structured in the same way (Table B-4.a, B-4b, B-4c, and B-4.d). Histograms showing the corresponding distributions for Tables 3 and 4 are shown in Figures B-1 and B-2.

The two most notable aspects of the results are (1) that the projected bycatch is substantially higher, under the assumption of 100 percent attainment, than under average attainment; (2) the distributions are multimodal. Projections under both attainment assumptions also follow the Council's recommended assumption for a TAC value of 500,000 mt, which is higher than any TAC in United States history. This reflects the large interannual variation in Chinook bycatch seen in both the March Alternatives Document and in the accompanying Chinook bycatch report. It also suggests variable alternative outcomes in terms of both Chinook bycatch and the location of that bycatch. Some of the variation in both projected bycatch and location was removed by focusing on northern or southern years of input data for the projections (and attributed to variation in latitude, see Section 3.2, Methods used to project non-whiting trawl bycatch of Chinook salmon under future fishery and management conditions).

Each commercial sector in Figure B-1 (using all years, including those with all latitudinal fleet distributions) generally shows a trimodal distribution of bycatch, with a low (below 2,000), medium (between 2,000 and 4,000 for CP; between 4,000 and 8,000 in SS) and high mode (between 4,000 and 6,500 in CP; 9,000 to 14,000 in SS), and a combined medium-high mode was seen in the MS sector (2,000 to 7,000 fish). Distributional patterns in bycatch are essentially the same in Figure B-2, but the estimated bycatch values themselves are notably lower, due to the average attainment assumption, rather than 100 percent attainment. The summed (among sectors) medians of predicted distributions ranged between approximately 6,000 and 13,000 Chinook according to different combinations of assumptions for whiting attainment and fleet latitude.

Regarding location, a range of mean seasonal latitude of 43 to 44.5 degrees N. latitude was the most frequent in the at-sea sectors, and the multimodal distributions generally trailed raggedly northward, except for a secondary high mode in the MS sector just north of 47 degrees N. latitude. In the shoreside sector, three relatively equally spaced modes were seen between 44 and 45.5 degrees N. latitude, and another somewhat lesser peak was seen near 47 degrees N. latitude. This applies to Figure B-1 and Figure B-2 under both attainment assumptions.

Assuming average annual whiting attainment, the estimated Chinook bycatch impacts are generally much lower than under the full attainment assumption. Tables B-4.a through B-4.d show those results.

Tables B-3.a-d. Quantiles for predicted distributions of annual Chinook bycatch by targeted whiting sector, assuming 100 percent attainment for commercial (non-tribal) sectors, with at-sea years blocked by their prominent latitudinal distribution (northern versus southern); with two alternative definitions of the northern years (2008 to 2011 versus 2008 to 2010), and one definition for southern years. Shoreside predictions used all years analyzed (2011 to 2016).

a. Chinook, coastwide - all years

Quantiles	Shoreside	CP	MS	Sum
min	1,206.64	44.00	236.76	1,487.40
0.01	1,359.44	70.00	333.34	1,762.78
0.05	1,445.29	89.00	384.17	1,918.46
0.25	2,173.35	677.00	799.62	3,649.97
0.5	**5,935.27**	**3,252.42**	**1,321.00**	**10,508.69**
mean	**5,692.16**	**2,914.61**	**2,366.46**	**10,973.22**
0.75	7,017.66	4,709.64	3,938.92	15,666.23
0.95	12,124.68	5,681.82	5,929.15	23,735.64
0.99	13,088.32	6,205.49	6,605.21	25,899.02
max	14,941.94	7,261.34	7,956.60	30,159.87

b. Chinook, North at-sea scenario, 2008-2011 (North-1)

Quantiles	Shoreside	CP	MS	Sum
min	1,206.64	42.00	253.17	1,501.82
0.01	1,359.44	65.00	315.00	1,739.43
0.05	1,445.29	79.00	351.76	1,876.05
0.25	2,173.35	395.52	899.86	3,468.73
0.5	**5,935.27**	**654.00**	**1,237.10**	**7,826.37**
mean	**5,692.16**	**1,695.84**	**1,356.57**	**8,744.56**
0.75	7,017.66	4,310.30	1,813.05	13,141.01
0.95	12,124.68	5,705.55	2,805.03	20,635.26
0.99	13,088.32	6,227.34	3,136.03	22,451.69
max	14,941.94	7,591.24	3,787.04	26,320.21

c. Chinook, North at-sea scenario, 2008-2010 (2011 omitted, North 2)

Quantiles	Shoreside	CP	MS	Sum
min	1,206.64	39.00	226.17	1,471.82
0.01	1,359.44	63.99	310.17	1,733.60
0.05	1,445.29	76.00	344.17	1,865.46
0.25	2,173.35	103.00	416.17	2,692.52
0.5	**5,935.27**	**592.52**	**1,168.00**	**7,695.79**
mean	**5,692.16**	**469.33**	**952.33**	**7,113.82**
0.75	7,017.66	684.00	1,272.00	8,973.66
0.95	12,124.68	808.39	1,388.00	14,321.06
0.99	13,088.32	942.08	1,474.33	15,504.73
max	14,941.94	1,272.10	1,695.11	17,909.14

d. Chinook, South at-sea scenario, 2012-2016

Quantiles	Shoreside	CP	MS	Sum
min	1,206.64	2,042.41	414.09	3,663.15
0.01	1,359.44	2,427.45	480.33	4,267.22
0.05	1,445.29	2,707.28	528.09	4,680.66
0.25	2,173.35	3,190.49	827.03	6,190.86
0.5	**5,935.27**	**3,619.54**	**3,698.91**	**13,253.73**
mean	**5,692.16**	**3,966.00**	**3,187.98**	**12,846.14**
0.75	7,017.66	4,818.84	4,970.60	16,807.10
0.95	12,124.68	5,634.02	6,281.57	24,040.26
0.99	13,088.32	6,276.37	6,816.39	26,181.07
max	14,941.94	7,934.84	8,010.28	30,887.05

Tables B-4.a-d. Quantiles for predicted distributions of annual Chinook bycatch by targeted whiting sector, assuming average annual attainment for commercial (non-tribal) sectors, with at-sea years blocked by their prominent latitudinal distribution (northern versus southern); with two alternative definitions of the northern years (2008 to 2011 versus 2008 to 2010), and one definition for southern years. Shoreside predictions used all years analyzed (2011 to 2016).

a. Chinook, coastwide - all years

Quantiles	Shoreside	CP	MS	Sum
min	938.30	40.00	221.00	1,199.30
0.01	1,074.82	68.00	283.00	1,425.82
0.05	1,139.18	85.00	333.34	1,557.52
0.25	1,724.00	641.94	702.44	3,068.38
0.5	**4,682.06**	**3,054.49**	**1,146.72**	**8,883.26**
mean	**4,506.41**	**2,757.93**	**2,036.28**	**9,300.61**
0.75	5,522.98	4,456.08	3,373.42	13,352.49
0.95	9,623.15	5,350.91	5,178.88	20,152.94
0.99	10,594.09	5,924.88	5,772.16	22,291.13
max	11,961.42	6,822.83	7,019.56	25,803.81

b. Chinook, North at-sea scenario, 2008-2011 (North-1)

Quantiles	Shoreside	CP	MS	Sum
min	938.30	41.00	199.00	1,178.30
0.01	1,074.82	61.99	266.34	1,403.15
0.05	1,139.18	74.00	302.00	1,515.18
0.25	1,724.00	127.00	446.07	2,297.07
0.5	**4,682.06**	**611.60**	**1,078.66**	**6,372.33**
mean	**4,506.41**	**1,554.38**	**1,182.20**	**7,242.99**
0.75	5,522.98	910.59	1,691.28	8,124.85
0.95	9,623.15	5,363.90	2,469.15	17,456.19
0.99	10,594.09	5,904.86	2,739.05	19,238.00
max	11,961.42	7,140.54	3,276.00	22,377.96

c. Chinook, North at-sea scenario, 2008-2010 (2011 omitted, North 2)

Quantiles	Shoreside	CP	MS	Sum
min	938.30	42.00	206.59	1,186.89
0.01	1,074.82	59.00	263.59	1,397.41
0.05	1,139.18	72.00	296.59	1,507.77
0.25	1,724.00	98.00	365.76	2,187.76
0.5	**4,682.06**	**551.00**	**1,012.00**	**6,245.06**
mean	**4,506.41**	**439.65**	**831.29**	**5,777.34**
0.75	5,522.98	642.00	1,108.00	7,272.98
0.95	9,623.15	767.00	1,216.00	11,606.15
0.99	10,594.09	891.40	1,292.00	12,777.49
max	11,961.42	1,117.38	1,449.00	14,527.80

d. Chinook, South at-sea scenario, 2012-2016

Quantiles	Shoreside	CP	MS	Sum
min	938.30	1,762.75	347.04	3,048.10
0.01	1,074.82	2,234.01	415.25	3,724.07
0.05	1,139.18	2,519.72	457.40	4,116.31
0.25	1,724.00	3,001.46	694.66	5,420.12
0.5	**4,682.06**	**3,417.24**	**3,205.93**	**11,305.22**
mean	**4,506.41**	**3,733.68**	**2,745.15**	**10,985.23**
0.75	5,522.98	4,532.01	4,281.80	14,336.79
0.95	9,623.15	5,357.85	5,445.56	20,426.55
0.99	10,594.09	5,940.68	5,993.80	22,528.56
max	11,961.42	7,111.83	7,104.18	26,177.43

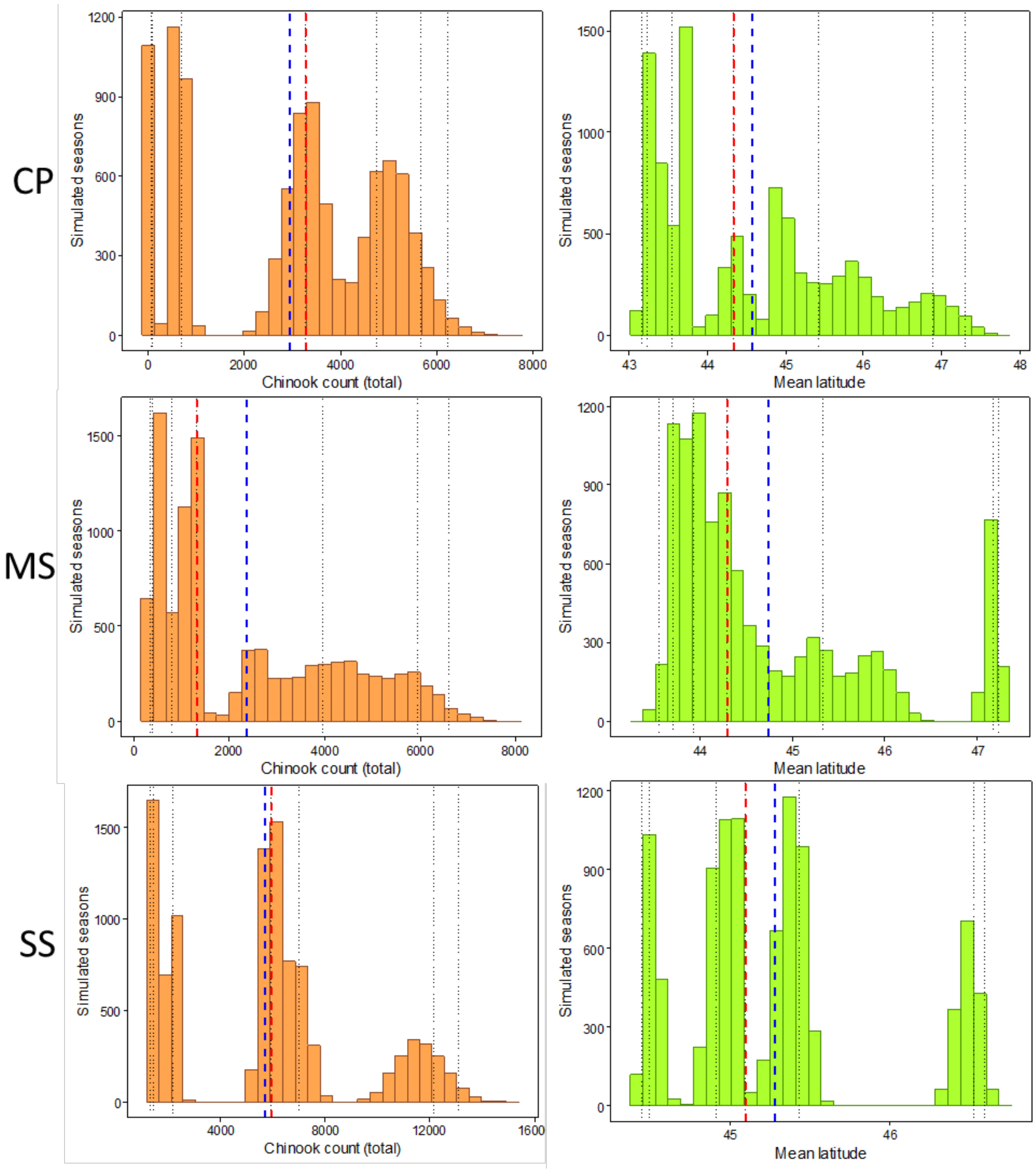

Figure B-1. Projected distributions of Chinook bycatch representing annual coast-wide distributions of hake effort and Chinook bycatch, using 2008 to 2016 for at-sea sectors and 2011 to 2016 for the shoreside sector, with model caps on hake catch informed by 100 percent attainment for each sector, applied to a hake TAC of 500,000 mt. Model output for predicted distributions of Chinook bycatch (count), and mean latitude (degrees), under the conditions specified for the final projected action, for the CP targeted whiting sector. Blue dashed line = mean, red dash = median, dotted lines = quantiles from Table B-1 (excluding mean, minimum and maximum).

B.4.2 Projections for Northern and Southern Distributions of Chinook Bycatch

Over the period from 2008 to 2016, there have been both northern and southern distributional tendencies by year for Chinook bycatch in the at-sea sectors (Figure B-2 and B-3). In the March Alternatives Document, 2008 through 2011 were used to demonstrate a northern pattern, and 2012 through 2016 were used to show a southern pattern. The shorebased whiting sector however, has not shown a conspicuous pattern of northern or southern blocks over time. The overall latitudinal variation has also been noticeably lower in the shoreside sector (Figures B-2 and B-3 versus Figures B-4 and B-5) than the at-sea sectors.

Thus, we defined the northern option for the at-sea sectors as including 2011 in this analysis by default to remain consistent with the structure of the Alternatives Document. However, we made two sets of model runs for the at-sea sectors to examine potential differences between defining the northern block inclusive or exclusive of 2011. We retained the same definition of the southern option as in the Alternatives Document, and we did not look at alternatives to that definition.

Table B-4 shows the results. Figure B-7 shows the same estimates as histograms with overlain means, medians, and quantiles, as well as histograms of predicted Chinook catch latitude. Omission of 2011 from the data representing a northern fleet distribution did result in some notable differences in predicted bycatch. The mean and median Chinook catch were much higher when 2011 was included, particularly for the CP sector, and for the high end of the at-sea distributions (Tables B-3.b, B-3.c, B-4.b, and B-4.c). Mean latitude was roughly one degree further north with 2011 omitted as well (Figure B-7), and there was less overlap with the latitudinal range with the southern estimates presented in Figure B-8 and in Tables B-3.d and B-4.d. Thus, the “N2” alternative presents a more exaggerated northern assumption about fleet distribution and its reflection upon Chinook bycatch.

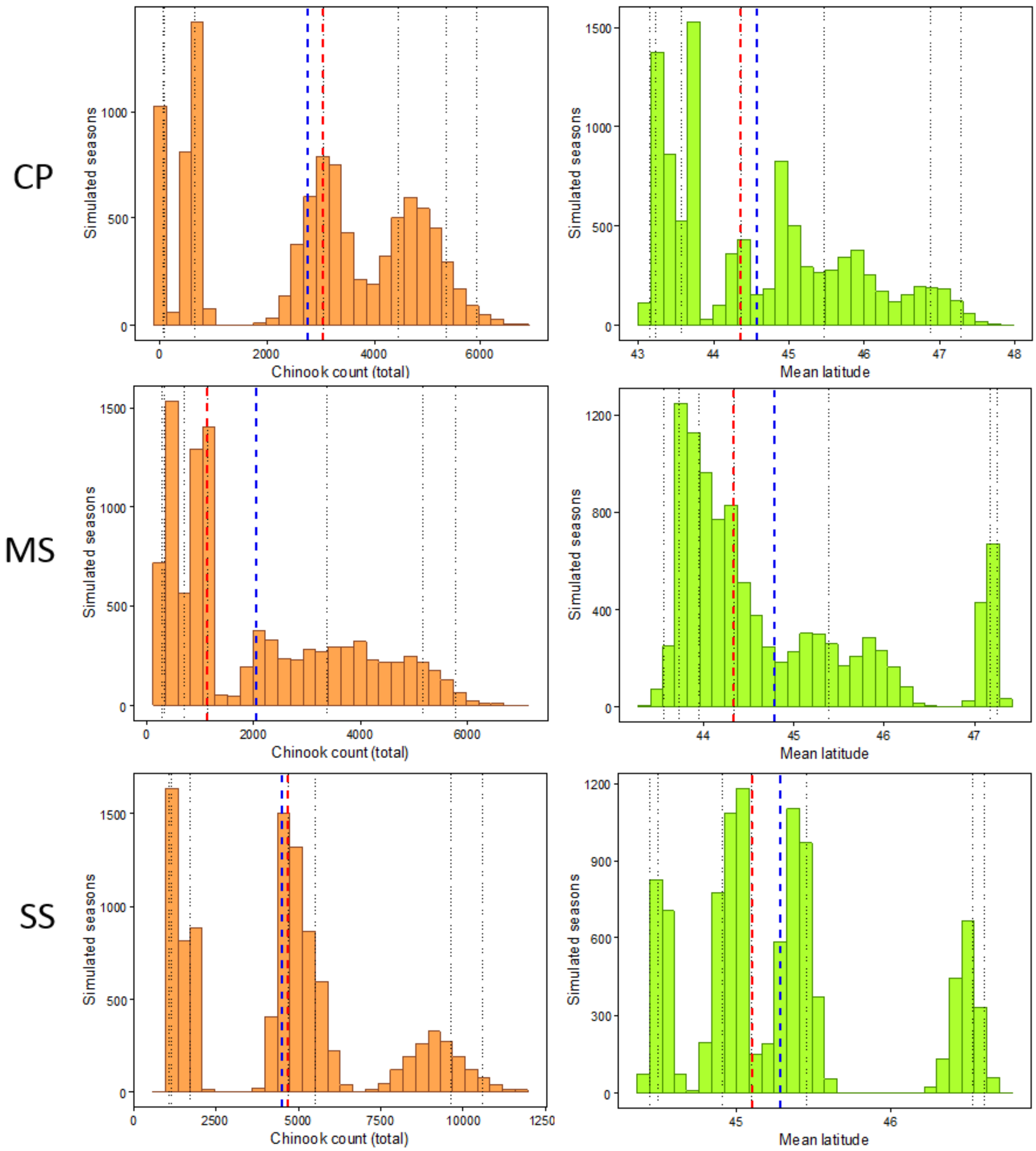

Figure B-2. Projected distributions of Chinook bycatch representing annual coast-wide distributions of hake effort and Chinook bycatch, using 2008 to 2016 for at-sea sectors and 2011 to 2016 for the shoreside sector, with model caps on hake catch informed by average sector attainment over the years modeled, applied to a hake TAC of 500,000 mt. Model output for predicted distributions of Chinook bycatch (count), and mean latitude (degrees) under the conditions specified for the final projected action for the CP targeted whiting sector. Blue dashed line = mean, red dash = median, dotted lines = quantiles from Table B-1 (excluding mean, min and max).

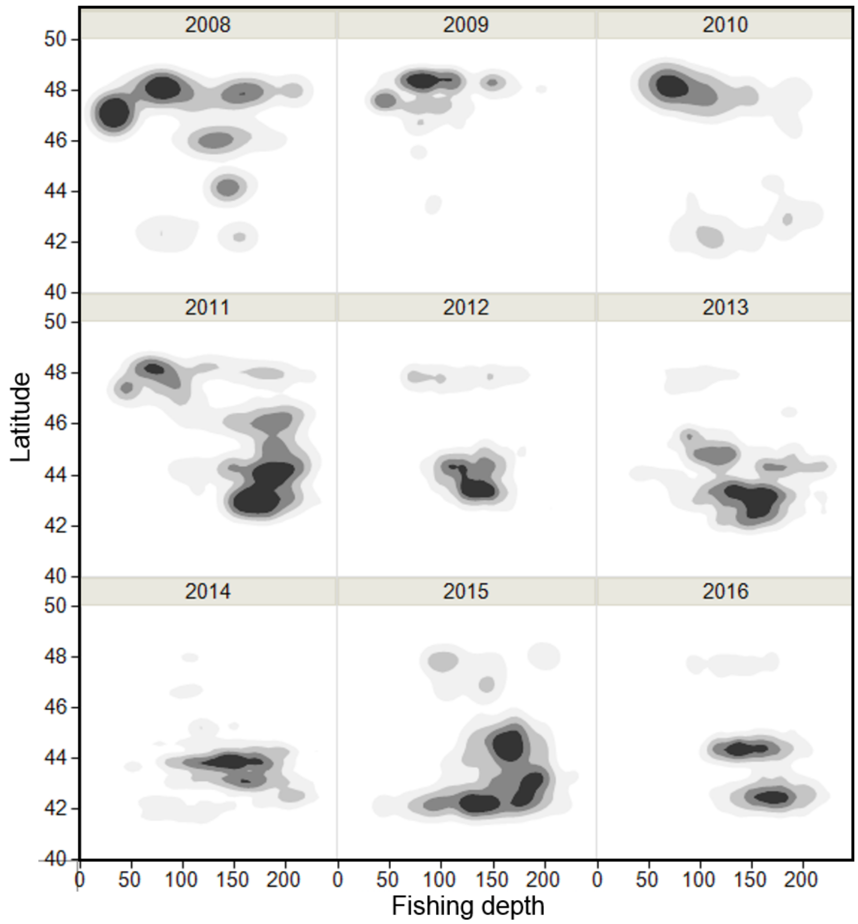

Figure B-3. Contour density plot showing patterns in Chinook-positive haul density by latitude and fishing depth, for combined at-sea sectors, for each year between 2008 and 2016.

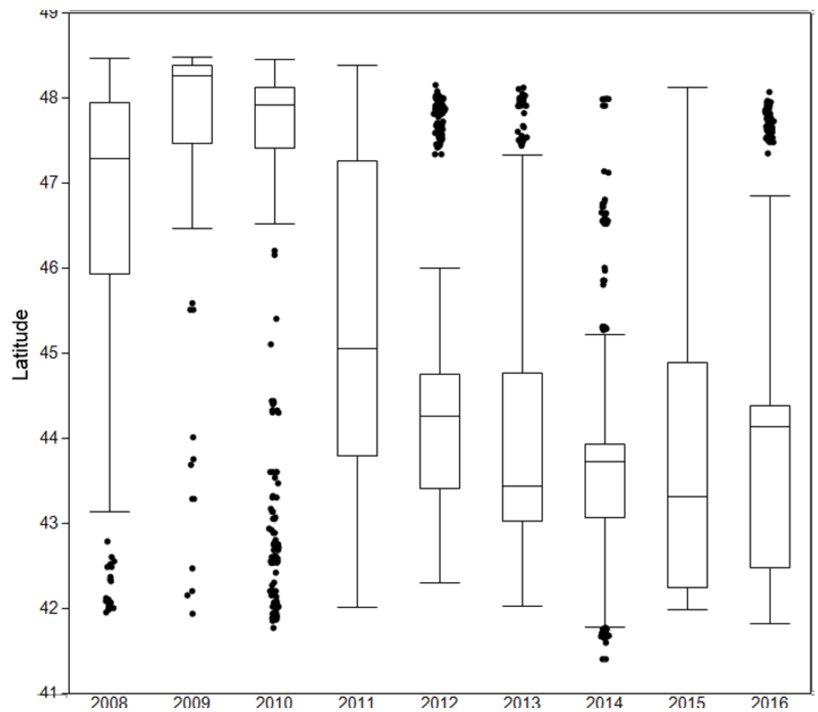

Figure B-4. Box plot showing patterns in Chinook-positive haul density by latitude, for combined at-sea sectors, for each year between 2008 and 2016.

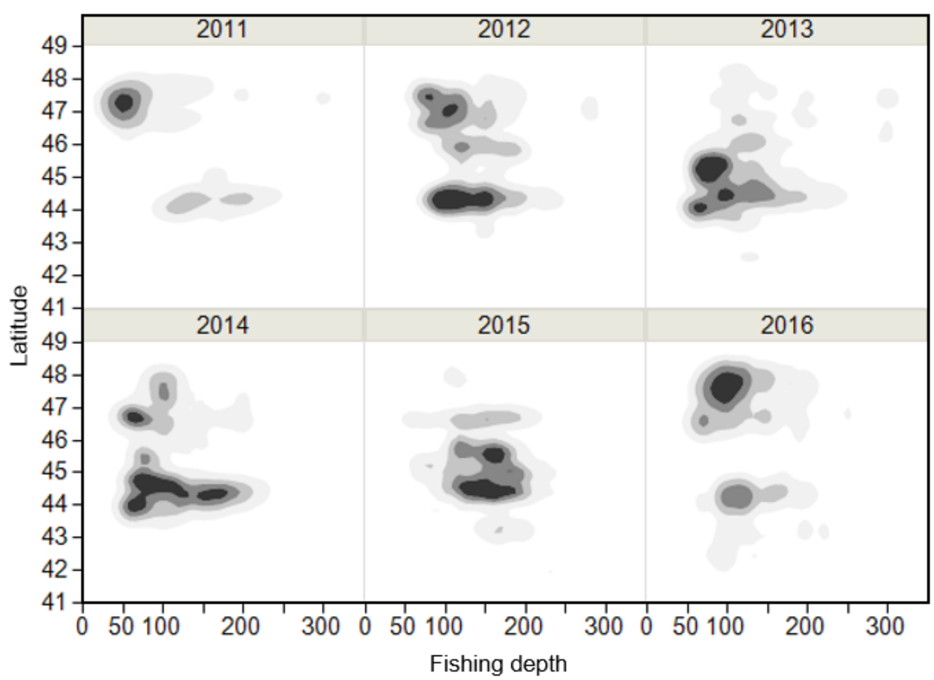

Figure B-5. Contour density plot showing patterns in Chinook-positive haul density by latitude and fishing depth, for the shoreside hake sector, for each year between 2011 and 2016.

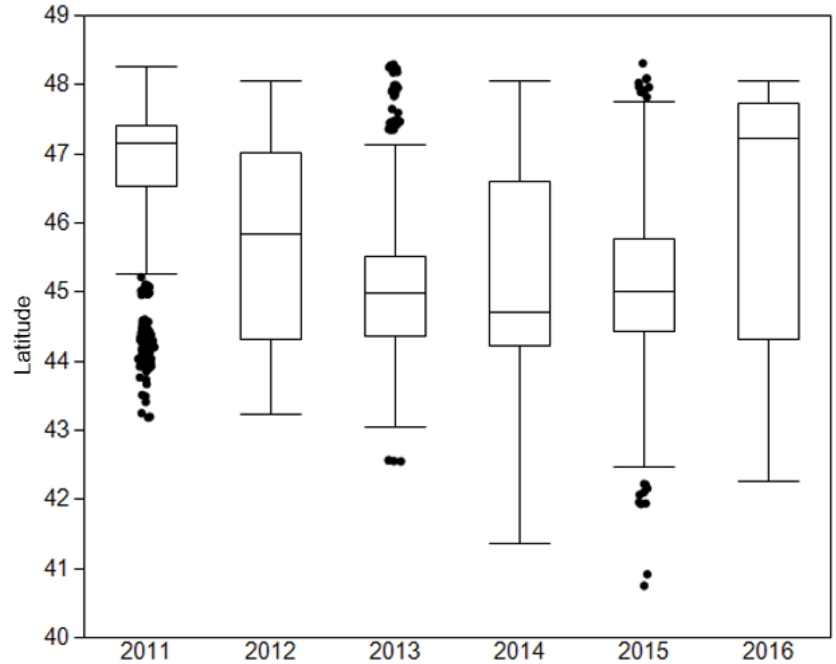

Figure B-6. Box plot showing patterns in Chinook-positive haul density by latitude, for the shoreside whiting sector, for each year between 2008 and 2016.

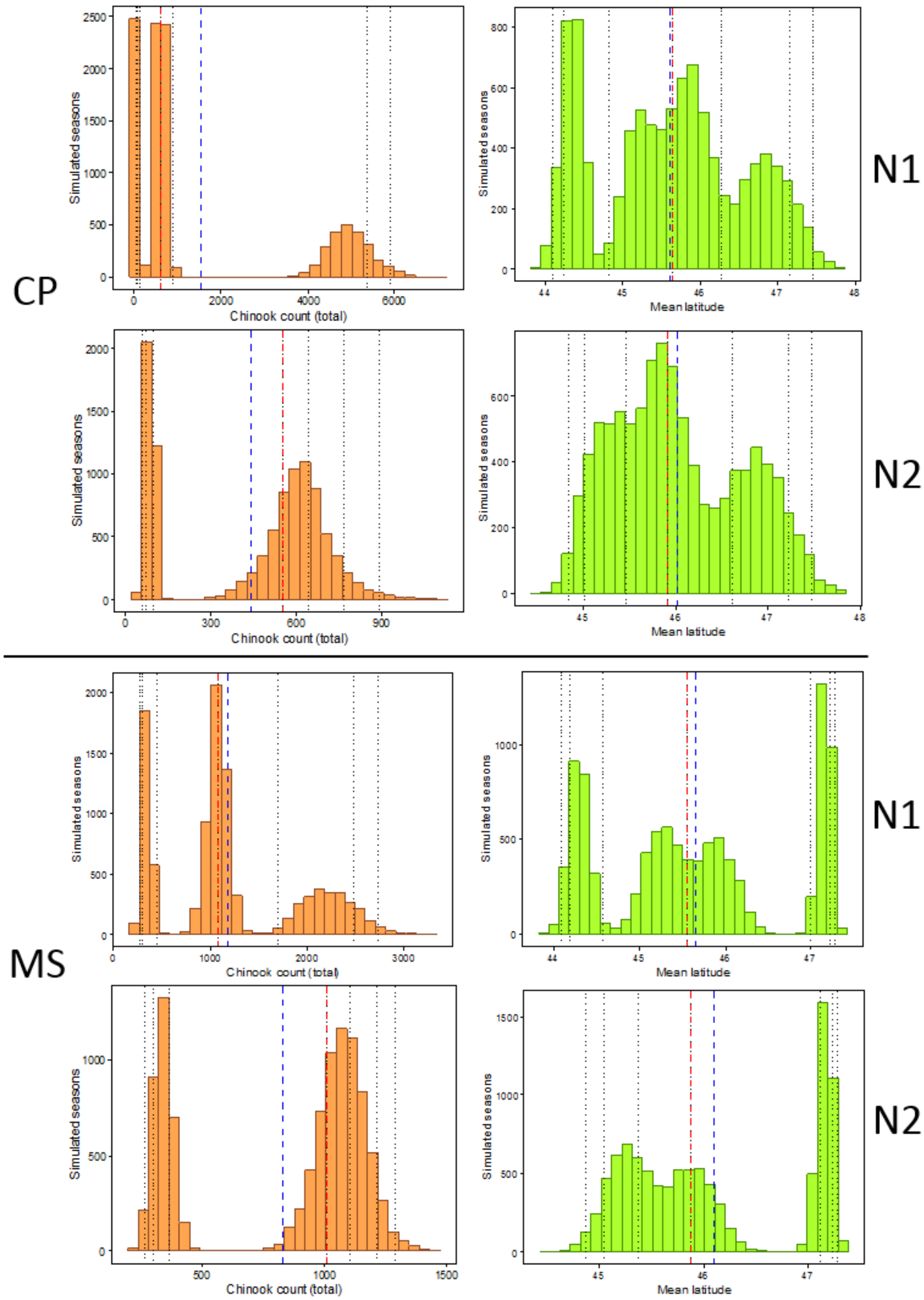

Figure B-7. Modeled predictions of annual Chinook bycatch in commercial at-sea, non-tribal whiting sectors, and mean latitude (assuming average annual whiting attainment). Years were blocked by their prominent latitudinal distribution, with two alternative definitions of the northern years (N1 = 2008 to 2011; N2 = 2008 to 2010) and one definition for southern years. Omission of 2011 from the northern block resulted in apparent removal of an intermediate bycatch mode and removal of a southern latitudinal mode, and less overlap.

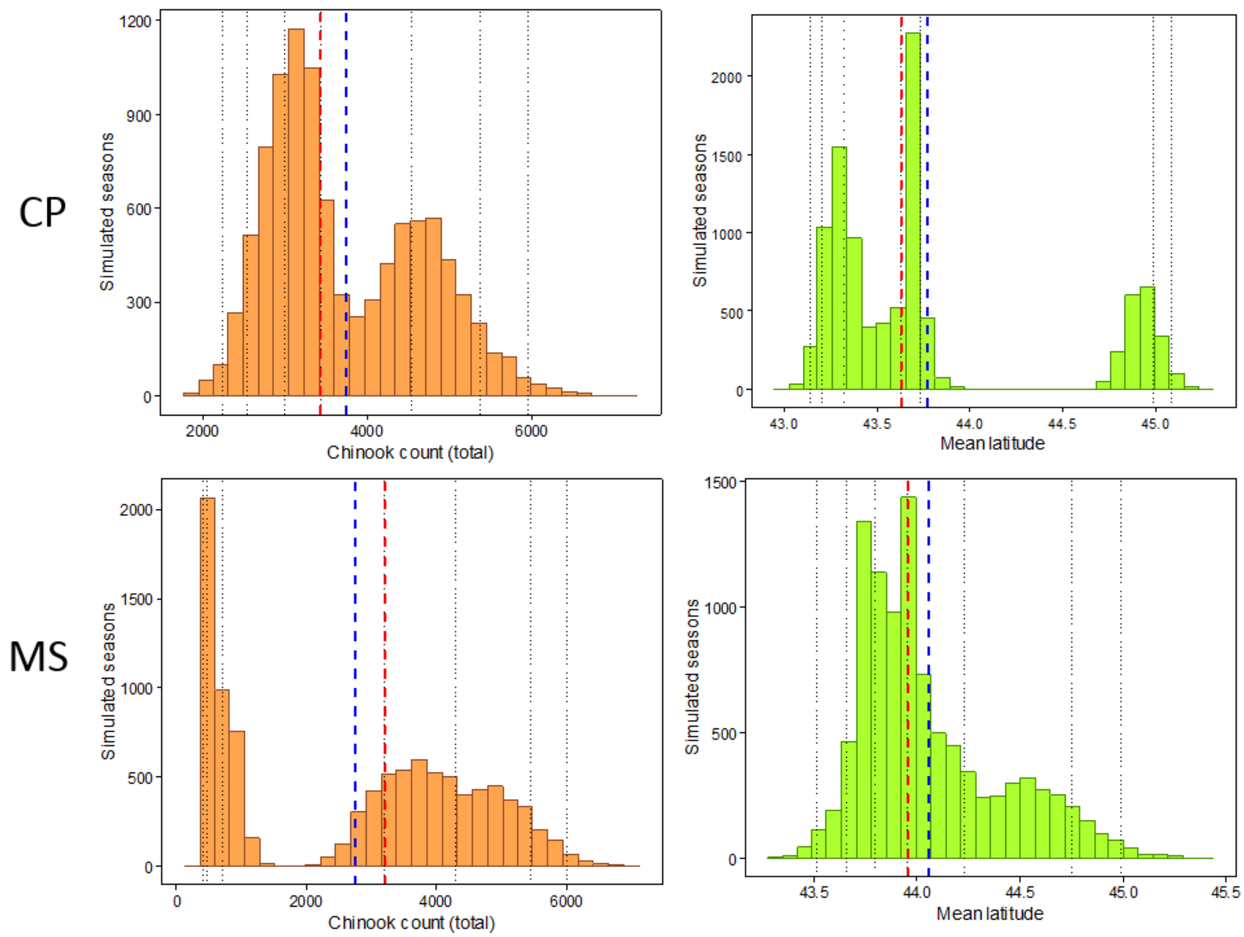

Figure B-8. Model-estimated distributions for predictions of annual Chinook bycatch in commercial at-sea, non-tribal whiting sectors, and mean latitude, assuming average annual whiting attainment, and informed by years with southern fleet distribution (2012-2016).

Appendix C

Considerations for the 2017 and 2018 Trawl Gear Exempted Fishing Permits

The information in Appendix C presents summaries of the 2017 and 2018 trawl exempted fishing permit (EFP) fisheries. It also describes potential impacts of the EFPs on Chinook salmon. It includes discussion of the potential impact on salmon that could occur with implementation of the 2018 year-round, non-whiting midwater trawl EFP.

C.1 Introduction

The proposed action for estimating Chinook salmon bycatch in support of the biological opinion includes a description of the perceived future of the groundfish fishery, as well as ongoing and potential future management measures (main document; Table 1-1; Agenda Item F.3, Council Action, April 2017). This description includes exempted fishing permits (EFPs) in 2017 and 2018 to allow vessels to target rockfish stocks more effectively on a pilot basis, while also gathering data and information that will help the National Marine Fisheries Service (NMFS) assess potential impacts of the Pacific Fisheries Management Council's (Council's) recommended changes to the current trawl gear restrictions (Agenda Item G.8 Attachment, March 2016; NMFS 2017). Both the 2017 and 2018 EFPs were in the Council's final motion of recommendations for the proposed action for the Endangered Species Act (ESA) Salmon Consultation (Agenda Item F.3, Council Action, April 2017).

The 2017 EFP was initiated on February 24th, 2017 (Agenda Item F.8, Supplemental Attachment 2, June 2017) and exempted certain bottom trawl regulations (Table C-1) north of 42°N latitude (see **Appendix D**). A new 2018 groundfish trawl EFP application was submitted at the June 2017 Council meeting to allow regulatory exemptions for both the bottom trawl and non-whiting midwater trawl fleets beginning January 1, 2018 (Agenda Item F.8, Attachment 1, June 2017). This 2018 trawl EFP was modified and submitted as a supplemental document at the September 2017 Council meeting (Agenda Item E.4.a, Supplemental EFP Application 1, September 2017). The Council made final recommendations for the 2018 EFP requirements and exemptions at the September 2017 Council meeting (Agenda Item E.4, Council Action, September 2017).

The purpose of this appendix is threefold. First, this appendix provides a summary of both the 2017 and 2018 trawl EFP fisheries. Second, the potential impacts of these EFPs on Chinook salmon bycatch are described here, or it is noted where they have been analyzed, (e.g., NMFS 2017). Third, an analysis examines the potential impacts on salmon that may occur through implementation of the 2018 year-round, non-whiting midwater trawl EFP with a focus on the area south of 42° N. latitude (see Agenda Item E.4, Council Action, September 2017; Agenda Item E.4.d, Supplemental Staff Report, September 2017) (**Appendix E**). In addition to specific EFP harvest guidelines described in this appendix (below), the Chinook salmon bycatch that occurs in the EFPs will accrue to the non-whiting harvest guideline that was described in the main text of the document (Section 1, Introduction), consistent with the proposed action.

C.1.1 The 2017 EFP

In 2017, the Council recommended and NMFS implemented a trawl gear EFP that provided several exemptions for vessels fishing in the area shoreward of the trawl RCA and north of 42° N. latitude (Table C-1). The purpose of this EFP is to evaluate and better understand bycatch associated with providing gear exemptions that may allow vessels to more efficiently target widow, yellowtail, and canary rockfishes. Potential impacts of this EFP, including salmon impacts, were analyzed in an Environmental Assessment (NMFS 2017).

Table C-1. Exemptions in the 2017 trawl gear EFP.

1.	The prohibition of a vessel using small footrope trawl gear (except selective flatfish gear) to fish for groundfish or have small footrope trawl gear (except selective flatfish gear) onboard while fishing north of 42° N. latitude and shoreward of the rockfish conservation area (RCA) defined at paragraph § 660.130(e) and at §§660.70 through 660.74 (§ 660.130 (c)(2)).
2.	The requirement to use selective flatfish trawl north of 42° N. latitude and shoreward of the RCA defined at paragraph § 660.130(e) and at §§660.70 through 660.74 (§ 660.130 (c)(2)(i)).
3.	The minimum mesh size for bottom trawl gear of 4.5 inches (§ 660.130(b)(2)).
4.	For vessels using electronic monitoring, the prohibition on retaining salmon and eulachon (§§ 660.12 (a)(1), 660.112(a)(2)(i), and 660.140(g)(1)). Salmon and eulachon must be retained until landing and disposed of after being documented by a catch monitor. Salmon must be disposed of in such a way as not to enter the commercial market. This exemption applies only to salmon and eulachon. Any incidentally caught marine mammal; seabird; sea turtle; other ESA-listed fish; large pelagic fish (6-ft or greater in length); Dungeness crab caught seaward of Washington or Oregon; or Pacific halibut must be discarded according to the Vessel Monitoring Plan and recorded in the vessel's logbook.
5.	The prohibition at § 660.12(a)(4) only as it relates to the above exemptions.

In addition to these exemptions, the 2017 trawl gear EFP included several general terms and conditions that were required of the participants (**Appendix D**). Participants were required to abide by several gear restrictions, including use of gear that met the definition of bottom trawl, the definition of small footrope bottom trawl, and compliance with other bottom trawl restrictions. Participants were also prohibited from fishing in the Columbia River Salmon Conservation Zone. Participants were required to abide by all declaration and logbook requirements. Finally, participants were required to keep their Chinook salmon take within NMFS' harvest guideline. NMFS set a harvest guideline of 3,547 Chinook salmon, of which no more than 800 could be taken before May 15th (i.e., the start of the primary whiting season). If the cumulative take of Chinook salmon reached the 800-fish harvest guideline before May 15th, the EFP would be closed until May 15th. Upon reaching May 15th, the EFP would reopen with the start of the primary whiting season. At this point, non-whiting midwater trawl vessels would be able to start fishing and any Chinook salmon bycatch that they took would also be counted under the 3,547 Chinook salmon harvest guideline.

C.1.2 Update of the 2017 EFP

A progress report for the 2017 EFP was provided at the September, 2017 Council meeting (Agenda Item E.4.b, Supplemental NMFS Report 1, September 2017). As of September 5, 2017, the 2017 EFP included nine trawl vessels that caught 2,123,796 pounds of groundfish, four Chinook salmon, and no coho salmon (Agenda Item E.4.b, Supplemental NMFS Report 1, September 2017). This report also showed that non-EFP boats (i.e., non-whiting midwater trawl vessels that began fishing after May 15th) caught few salmon (17 Chinook salmon and no coho salmon) while landing 6,990,764 pounds of groundfish.

To put these low bycatch rates in perspective, a comparison was made between Chinook salmon bycatch rates by the 2017 trawl gear EFP (as of September 5, 2017) and bycatch rates by the commercial fishery during 2012-2016 (Table C-2). The geographic extent of these two datasets is not equal; data relative to the non-EFP bottom trawl fishery extended to southern California, whereas the EFP was restricted to an area north of 42^{o} N. latitude. These commercial catches were presented in Table 2-1 and Table 2-2 of the main document. The 2017 trawl gear EFP bycatch rates of Chinook salmon are considerably lower than the Chinook salmon bycatch rates for both non-EFP bottom trawl (4x to 15x lower by year) and for non-whiting midwater trawl (7x to 175x lower by year) for 2012 to 2016 (Table C-2). The 2017 non-whiting midwater trawl fishery has also encountered less Chinook salmon bycatch relative to 2012 to 2016 (Table C-2). It is unclear if the lower bycatch rates from the 2017 EFP (and 2017 non-whiting midwater trawl) are due to low salmon abundance, an effort by industry to actively avoid areas where they may be more likely to encounter salmon, or a combination of those and other factors.

Table C-2. Groundfish landings (mt), Chinook salmon bycatch (number), and bycatch rate for bottom trawl and non-whiting midwater trawl for 2012 to 2016.

	Year	Groundfish landed (mt)	Chinook count	Commercial fishery bycatch rate (A)	2017 EFP bycatch rate (B)	2017 Non-whiting midwater trawl bycatch rate (C)	Ratio of bycatch rates (A) / (B)	Ratio of bycatch rates (A) / (C)
Bottom trawl	2012	17,026	305	0.0179	0.0042		4.3	
	2013	18,715	323	0.0173			4.2	
	2014	15,876	984	0.0620			14.9	
	2015	15,943	996	0.0625			15.0	
	2016	16,457	371	0.0225			5.4	
Non-whiting midwater trawl	2012	391	12	0.0307	0.0042	0.0054	7.4	5.7
	2013	622	71	0.1142			27.5	21.3
	2014	909	661	0.7270			175.1	135.6
	2015	1,817	482	0.2653			63.9	49.5
	2016	1,222	47	0.0385			9.3	7.2

Note: Comparisons were made between bycatch rates shown for the 2012 to 2016 non-whiting bottom trawl and midwater trawl fisheries relative to the 2017 trawl gear EFP as of September 5, 2017. Relative bycatch rates were also compared between the 2012 to 2016 non-whiting midwater trawl fishery and the 2017 non-whiting midwater trawl fishery.

C.1.3 2018 trawl gear and year-round midwater rockfish EFP

A revised trawl-gear and year-round coastwide midwater rockfish EFP application was submitted to the Council at its September 2017 meeting (Agenda Item E.4.a, Supplemental EFP Application 1, September 2017). In addition to the elements and exemptions shown in Table C-3, Council recommendations for the 2018 trawl gear EFP(s) (Agenda Item E.4, Council Action, September 2017; Agenda Item E.4.d, Supplemental Staff Report, September 2017) included the following:

1. A continuation of the 2017 trawl gear EFP with consideration of extending it into the area between 42° N. latitude and 40°10′ N. latitude after consideration of the 2018 preseason salmon stock abundance analysis (e.g., PFMC 2017) that is expected in March
2. Inclusion of an exemption to the minimum mesh size requirement and a change to how mesh size is measured
3. An exemption to the prohibition on multiple trawl gears onboard and fished on the same trip
4. An exemption to the requirement to stow a previous haul before another haul is brought onboard
5. An exemption for non-whiting midwater trawl vessels from the prohibition on fishing prior to May 15th

6. An allowance for midwater fishing within the RCA prior to May 15th, including the area south of 40°10′ N latitude (Table C-3)

Additional details can be found in the Council's September 2017 recommendations (Agenda Item E.4, Council Action, September 2017), in a summary report developed by NMFS, GMT, and Council staff at the September 2017 meeting (Agenda Item E.4.d, Supplemental Staff Report, September 2017) and in a letter from the Council office to NMFS, dated September 26, 2017 (**Appendix E**).

Table C-3. Council recommended elements for the 2018 trawl gear EFP.

2017 Trawl Gear EFP Proposal Elements	**2018 Trawl EFP Elements Recommended by the Council at the September 2017 meeting**
Exemption to the requirement to use selective flatfish trawl gear north of 42° N. latitude (50 CFR 660.130(c)(2))	Same
Not included.	Exemption to the requirement to use selective flatfish trawl gear between 42° N. latitude and 40°10′ N. latitude (§660.130(c)(2)(i)) pending the results of the March 2018 salmon forecast
Exemption from the minimum mesh size of 4.5 inches for bottom trawl (§660.130(b)(2))	Same
Not included.	Exemption from the minimum mesh size of 3 inches for midwater trawl (§660.130(b)(2))
Not included.	Change the requirement for how mesh size is measured (§660.11(7)).
Not included.	Exemption to the prohibition on bringing a new haul on board before a previous haul is stowed (§660.130)
Not included.	Exemption to the prohibition of multiple gears onboard (would allow both midwater and bottom trawl gears to be carried onboard and fished on the same trip) (§660.130)
Not included.	Exemption to the requirement for vessels targeting non-whiting species with midwater gear north of 40°10′ N. latitude to only do so during the Pacific whiting primary season for the Pacific whiting IFQ fishery (§ 660.130(c)(3))
Not included.	Exemption to the prohibition on operating a vessel with midwater groundfish trawl gear while targeting non-whiting inside the RCA outside of the Pacific whiting primary season (§660.130(e)(4)(i))
Not included.	Exemption to the prohibition on operating a vessel with groundfish trawl gear onboard within the trawl RCA south of 40°10′ N. latitude, except for continuous transit (§660.130(e)(4))

Note: Several elements recommended for the 2018 trawl gear EFP were first proposed in the trawl gear rulemaking package that was recommended by the Council at its March 2016 meeting.

Other Council-recommended exemptions to the elements shown in Table C-3 for the 2018 trawl EFP included several general terms and conditions that would be required of the participants. Participants would be required to abide by several gear restrictions, including use of gear that met the definition of bottom trawl and small footrope bottom trawl, as well as comply with all other bottom and midwater trawl restrictions currently in regulation. Participants would be prohibited from fishing in the Columbia River Salmon Conservation Zone and the Klamath Conservation Zone. Participants would be required to abide by all declaration and logbook requirements. EFP participants who elect to fish multiple gears during the same trip (i.e., midwater and bottom trawl) would be required to (a) declare the gear change while at sea prior to making the next set and (b) sort and stow the catch separately by gear type. Finally, all eulachon and salmon bycatch would have to be separated by haul and information on bycatch by haul and the gear configurations would have to be made available to NMFS. Additional recommended provisions not shown herein or in Table C-3, such as monitoring and catch-retention requirements, can be found in the September Council Action (Agenda Item E.4, Council Action, September 2017), the supplemental staff report (Agenda Item E.4.d, Supplemental Staff Report, September 2017), and in **Appendix E**.

All trawl EFP participants (north and south of 42° N. latitude) would be required to keep their Chinook salmon take within NMFS' overall harvest guideline provided for the 2017 EFP. That harvest guideline was set at 3,547 Chinook salmon, of which no more than 800 could be taken before May 15th (i.e., the start of the primary whiting season). Should the cumulative take of Chinook salmon reach the 800-harvest guideline before May 15th, the EFP would be closed until May 15th. Furthermore, an additional sub-harvest guideline was recommended by the Council at its September 2017 meeting for EFP participants fishing south of 42° N. latitude (Agenda Item E.4, Council Action, September 2017). South of 42° N. latitude, the Council recommended a year-round sub-harvest guideline of 80 Chinook salmon for all trawl EFP participants combined (i.e., bottom trawl and non-whiting midwater trawl EFPs). All EFP participation south of 42° N. latitude described in Table C-3 would be closed for the remainder of the year upon reaching the 80 Chinook salmon harvest guideline.

C.1.4 Midwater trawl components of the 2018 EFP south of 40º10' N latitude

Components of the EFP that allow for expansion of the midwater trawl fleet south of 40°10′ N. latitude were not fully analyzed in the main document because the latitudinal range of available data for the non-whiting midwater trawl fishery did not extend south of 44º N. latitude during 2012 to 2016. These sampling years were selected to calculate the mean latitudinal distributions shown in Figure 3-1 of the main document. The specific exemptions to the 2018 EFP were unknown at the time of that original analyses. As such, we discuss and analyze those 2018 EFP components within this appendix that were not analyzed in the main document.

One of the Council's recommendations for the 2018 trawl gear EFP includes an exemption to the prohibition on midwater trawling year-round within the RCA, including the area south of 40°10′ N.

latitude (Agenda Item E.4, Council Action, September 2017). Current regulations allow for midwater trawling beginning May 15th seaward, within, and shoreward of the RCA north of 40°10′ N. latitude. South of 40°10′ N. latitude, regulations prohibit all midwater groundfish trawling within and shoreward of the RCA (Agenda E.4.d, Supplemental Staff Report, September 2017).

We assumed that allowing fishing with midwater trawl gear outside of the primary whiting season (i.e., allowing midwater trawling from January 1st to May 15th) would not result in additional bycatch of Chinook salmon beyond that assessed in the main document. This assumption was made because all midwater vessels participating in the EFP would be bound by the 800 Chinook salmon sub-harvest guideline prior to May 15th (coastwide), and this sub-harvest guideline would count toward the coastwide bottom trawl and midwater trawl EFP harvest guideline of 3,547 Chinook salmon (Table C-4; Agenda Item E.4, Council Action, September 2017). Furthermore, bottom trawl and midwater trawl EFP participants fishing south of 42° N. latitude would be bound by the 80 Chinook salmon sub-harvest guideline for the entire year or the duration of the EFP. All EFP catch would accrue toward the non-whiting overall Chinook salmon bycatch guideline under the Council's proposed action (5,500 Chinook salmon guideline and access to 3,500 reserve). All Chinook salmon harvest guidelines and sub-harvest guidelines (numbers of Chinook salmon) within the provisions of the trawl EFPs are included in the projected impacts shown in Table 3-3 of the main document.

Table C-4. Chinook salmon harvest guidelines and sub-harvest guidelines by gear, area, and time for the 2018 bottom trawl EFP and the 2018 year-round coastwide non-whiting midwater trawl EFP. All sub-harvest guidelines count toward the 3,547 Chinook salmon harvest guideline. BT = bottom trawl; MDT = midwater trawl.

Coastal area and gear type	**Period**	**Council-proposed harvest guideline or sub-harvest guideline**
Harvest Guideline		
Coastwide (BT and MDT EFP + non-EFP non-whiting midwater trawl)	January 1–December 31	3,547 Chinook salmon
Sub-Harvest Guideline		
Coastwide (BT and MDT EFP)	January 1–May 15	800 Chinook salmon
South of 42° N latitude (BT and MDT EFP)	January 1–December 31	80 Chinook salmon

Projected Chinook salmon catches shown in Table 3-3 of the main document were made under the assumption of 100 percent attainment of all midwater species allocated to the non-whiting sector (main document, Table 1-2). This includes those midwater species that would be targeted in the 2018 midwater trawl EFP (including southern species such as chilipepper rockfish). Therefore, we can assume that any take of Chinook salmon associated with the implementation of the 2018 trawl gear EFP (in numbers) would be expected to fall within the range analyzed for the non-whiting fishery shown in the main document (Table 3-3).

Two analytical components are necessary to project Chinook salmon impacts under the 2018 EFP (Table C-3). First, a projection of Chinook salmon bycatch (numbers) by the 2018 EFP must be known. As discussed above, the Council's motion includes a sub-harvest guideline of 80 Chinook salmon for all EFP participants south of 42° N. latitude for the entire year (Table C-4; **Appendix C**). Hence, the maximum impact in terms of the number of Chinook salmon caught south of 42° N. latitude would be known (less than or equal to 80 fish). The second and undefined component for this analysis is the potential change in the geographic distribution of non-whiting midwater trawling effort north and south 40°10′ N. latitude for the midwater EFP participants. Midwater trawling within the RCA south of 40°10′ N. latitude has been prohibited for more than a decade. In addition, the latitudinal distribution of recent non-whiting midwater trawl effort shown in the main document (Figure C-1) is north of 42º N. latitude (i.e., there has been no non-whiting midwater trawling south of 42º N. latitude since the inception of the catch shares program). Impacts of non-whiting midwater trawling effort (see Table 3-3 of the main document) were estimated using data from 2012 to 2016, consistent with the Council direction to use bycatch rates and distribution prescribed by the modified 2B(1) scenario for the proposed action (see Table 1-1 of the main document). Hence, additional information is needed to project the spatial distribution of non-whiting midwater trawl fishing under the 2018 proposed EFP. This information is needed to estimate impacts to specific evolutionarily significant units (ESUs).

C.1.5 Methods – latitudinal distribution of non-whiting midwater trawl effort under the 2018 EFP

Canary rockfish, widow rockfish, and the southern stock of bocaccio rockfish were declared overfished in 2000, 2001, and 1999, respectively (PFMC 2016). Darkblotched rockfish was also declared overfished in 2002 (PFMC 2016). These overfished determinations led to the implementation of the darkblotched rockfish conservation area in 2002 and the trawl RCA in 2003 (NMFS 2014), as well as even more restrictive trip limits relative to previous years (and midwater trawl prohibitions) that impacted or eliminated catch of these species or associated species (e.g., chilipepper and yellowtail rockfish) using midwater trawl gear. For this analysis, the period prior to 2000 will be referred to as the "less-restrictive period." Even though other species were declared overfished or depleted prior to 2000, such as Pacific Ocean perch (POP), the impacts of those species on midwater trawling were relatively smaller than the impacts of overfished declarations on more pelagic species (such as widow rockfish).

Limited targeting of widow and yellowtail rockfish by non-whiting midwater trawl was reinitiated shortly after the inception of the catch shares program in 2011 (Pacific Fisheries Information Network [PacFIN]). However, because canary rockfish and widow rockfish were still overfished, few non-whiting midwater trips were made off Oregon or Washington (none was conducted off California; PacFIN). Canary and widow rockfish have since been declared rebuilt based on 2015 stock assessments (PFMC 2016). As a result, annual catch limits (ACLs) and trawl harvest guidelines have increase dramatically for some of these species that constrained midwater trawling (Table C-5).

Table C-5. Annual trawl allocations (metric tons [mt]) of rockfish species encountered by non-whiting midwater trawl fisheries.

Species	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Bocaccio	261	75	79	82	85	302	283
Canary	35	53	54	57	59	1,061	1,061
Widow	491	1,284	1,284	1,711	1,711	12,094	11,318
Chilipepper	1,331	1,100	1,067	4,893	4,677	1,921	1,846
Yellowtail	3,407	3,235	3,239	1,203	1,196	4,546	4,375

Note: Allocations in the above table are rounded to the nearest mt.

Because pelagic or semi-pelagic species such as canary rockfish and widow rockfish have recovered (Table C-5), historical geographic distributions of non-whiting midwater trawling effort (the pre-RCA and less-restrictive period, i.e., before 2000) could inform assumptions about the geographic distribution of midwater trawling effort under the 2018 Council recommended EFP; it could be the best predictor of how the fishery may look going forward. This distribution can be compared to recent geographic distributions of midwater trawling (i.e., 2012 to 2015) to test this assumption. The latitudinal distribution of non-whiting midwater trawling effort (tows) is shown annually from 1987 to 2001 (historical distribution) and from 2012 to 2015 (recent distribution) (Table C-1). The historical period (1987 to 2001) was selected because (a) Oregon and Washington began submitting logbooks to PacFIN in 1987 and (b) management impacts of overfished species declarations would become clear in 2002 or earlier (e.g., due to the implementation of trawl RCA and increased restrictions on catch limits).

Historical latitudinal distributions of midwater fishing effort were estimated using trawl logbook data obtained from PacFIN. The data were filtered to (a) identify non-whiting midwater trawl sets and (b) to eliminate errors such as incorrect gear identification or unlikely latitude entries. Filters applied to these data were as follows:

- Delete unreasonable latitudes (i.e., off Canada or Mexico) and unrecorded latitudes.
- Include only gear identified as midwater trawl (i.e., GRID=MDT).
- Delete all hauls where the identified target was Pacific whiting (i.e., where PACFIN_TARGET = PWHT).
- Delete all hauls where Pacific whiting catch was greater than 50 percent of the total adjusted catch weight.
- Delete all hauls where pelagic species catch was less than 50 percent of the total adjusted catch weight. Pelagic species were defined as widow rockfish (WDW1 and WDOW), yellowtail rockfish (YTR1 and YTRK), bank rockfish (BNK1 and BANK), chilipepper rockfish (CLP2 and CHL1), canary rockfish (CNR1 and CNRY), and unidentified rockfish (URCK).

C.1.5 Results – Latitudinal distribution

Figure C-1 shows the latitudinal distribution of non-whiting midwater hauls from 1987 to 2001 ("less-restrictive period") and 2012 to 2015 (recent years). The 2016 logbook data was unavailable on PacFIN at the time of this analysis. Prior to 2002, the distribution of midwater trawl hauls (including outliers) ranged from 34^{o} N. latitude to the United States/Canadian border. Excluding the outliers, however, the minimum latitude of non-whiting midwater hauls prior to 2002 was approximately 40° N. latitude or greater, except during 1993 and 2001. The lower quantiles prior to 2001 were consistently near 44^{o} N. latitude, except 1998, where the lower quantile was near 46° N. latitude. The historical values suggest that, in most cases, the distributions were relatively similar across years. There were cases, however, that did not fit the general historical pattern (i.e., 1993 and 1998). In addition, the latitudinal distribution in 2001 extended much farther south than the other historical distributions. This may be due to increasingly restrictive management measures, especially north of 40^{o}10' N. latitude, due to overfished species declarations (e.g., canary rockfish; PFMC 2002). The most appropriate range of years to project future latitudinal distributions of the midwater trawl fleet would, therefore, be 1987 to 2000.

The historical latitudinal range of non-whiting trawl effort extends farther south than the southernmost range observed during recent IFQ years (2012 to 2015), where the minimum value (including and excluding outliers) was approximately 44^{o} N. latitude (Figure C-1). Median values (50th percentile) were often somewhat similar between historical and recent periods (Figure C-1). This is likely due to the higher non-whiting midwater fishing effort (number of vessels and hauls) off Oregon and Washington relative to California, even when midwater fishing was allowed within the RCA area south of 40°10′ N. latitude.

Even during the historical periods (pre-2001), almost all fishing effort south of 40°10′ N. latitude is shown as outliers in Figure C-1 (the exception being 1993).

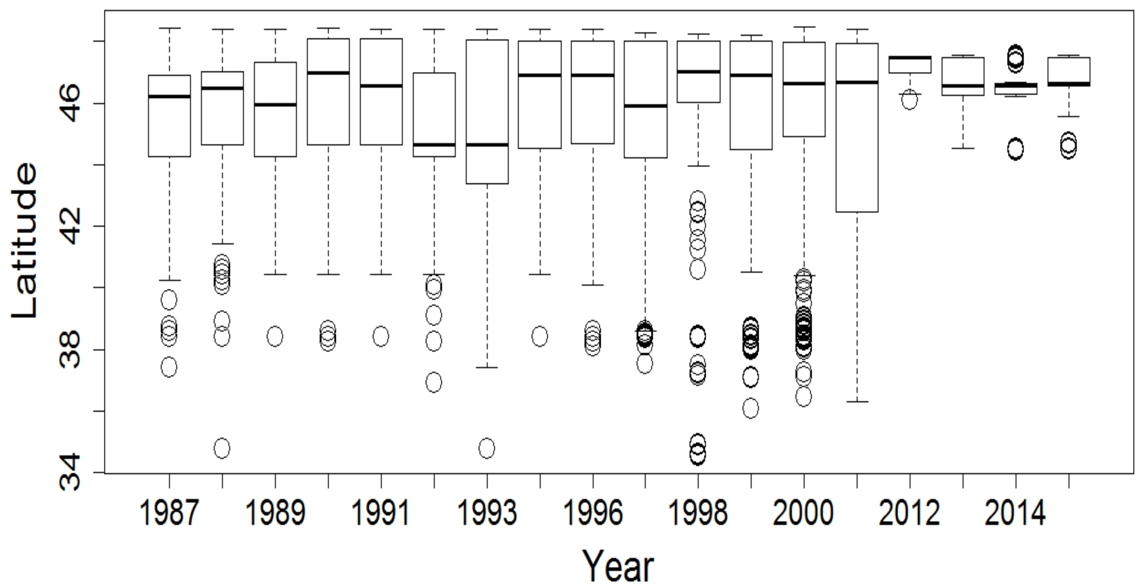

Figure C-1. Box plots showing latitudinal effort (tows) by non-whiting midwater trawl during the less restrictive era (1987 to 2000, with 2001 included as a transition year) and during recent years (2012 to 2015). These plots show median (dark line within the boxes), upper quartile (upper box; 25 percent of the data are greater than that value), lower quartile (lower box; 25 percent of the data are less than that value), maximum value (upper whisker; greatest value, excluding outliers), minimum value (lower whisker; least value, excluding outliers), and outliers (less than or more than 1.5 times the lower or upper quartiles, respectively). Source: Trawl logbook data from PacFIN.

C.1.6 Discussion and conclusions

The general conclusion that can be drawn from this analysis is that future bottom trawl and non-whiting midwater trawl EFP Chinook salmon bycatch would likely be within the general non-whiting projections shown in Table 3-3 the main document, and are not in addition to them. Two components are required to project Chinook salmon impacts by the trawl EFP. The first is estimating Chinook salmon bycatch (counts) that might be attributed to the EFP fishery. Since these EFPs include harvest guidelines, the maximum likely bycatch by the EFP holders (bottom trawl and non-whiting midwater trawl) would be known and would fall within Council's recommended Chinook salmon harvest guidelines and within the range analyzed in the main document.

EFP bycatch also counts toward the proposed action guideline for non-whiting trawl (i.e., included in the limit of 5,500 Chinook salmon coastwide, not in addition to it). As such, it is unlikely that the EFPs would result in a greater Chinook salmon bycatch than that analyzed in the main document (Table 3-3). Nor would it result in bycatch exceeding the guidelines in the proposed action (see the main document) because the EFPs have bycatch limits (i.e., harvest guidelines) that would limit potential impacts. For example, the EFPs south of 42° N. latitude are limited to 80 Chinook salmon. Once a harvest guideline or sub-harvest guideline is met, all of the trawl gear EFPs south of 42° N. latitude would be closed for the rest of the year. An EFP-termination clause is also provided for total Chinook salmon catch across all EFPs coastwide (i.e., 3,547 fish) (see Table C-1), which falls within the projected impacts in Table 3-3 in the main document.

The second component is understanding the likely geographical distribution of the Chinook salmon bycatch so that estimated impacts on individual ESUs can be determined. The latitudinal range for the bottom-trawl fishery analyzed in the main document encompasses the latitudinal range included in the EFP. Thus, impacts on specific ESUs would be similar for bottom trawl between EFP-caught Chinook salmon and those caught outside of the EFP. Expansion of the non-whiting midwater trawl fishery south of 40°10′ N. latitude within the RCA was, however, outside the latitudinal range of recent data and required additional analysis within this appendix.

The latitudinal distribution of non-whiting midwater trawling effort was estimated for the southern expansion of the midwater EFP. Although we expect some additional midwater trawling south of 42° N. latitude for EFP participants, the increased effort would likely be minimal relative to non-whiting midwater trawling effort north of 42° N. latitude, based on historical distributions of fishing effort (Figure C-1). In addition, NMFS plans to limit EFP participation in this southern area, which would further reduce impacts south of 42° N. latitude. The Council-recommended harvest guidelines and low expectation of EFP effort in the southern area would, therefore, limit the relative impact to southern ESUs under the trawl EFP.

It’s unlikely that 2018 fishing effort south of 40°10′ N. latitude will precisely match the latitudinal distribution shown in Figure C-1 prior to 2001. The southerly shift in effort would likely be less than that shown in Figure C-1 because processing abilities off California have been drastically reduced, and the vessel buyback program significantly reduced trawling effort in the southern range relative to this historical time period (PFMC and NMFS 2017). Even though processing capabilities south of 42^o N. latitude are lower than prior to 2000, fish may be shipped from ports with no processors to the north to process them. Hence, although midwater trawling effort would likely occur under this EFP in the southern waters, applying the relative geographic distribution shown in Figure C-1 would provide a maximum expectation for the distribution of southern effort.

C.1.6 References

National Marine Fisheries Service (NMFS). 2017. Exempted fishing permit program for an experimental midwater rockfish fishery – An Environmental Assessment. National Marine Fisheries Service, West Coast Region, Seattle, WA 98115.

Pacific Fishery Management Council (PFMC). 2002. Status of the Pacific Coast groundfish fishery through 2001 and acceptable biological catches for 2002: stock assessment and fishery evaluation. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384. http://www.pcouncil.org/wp-content/uploads/SAFE_July_2002.pdf

Pacific Fishery Management Council (PFMC). 2016. Status of the Pacific Coast Groundfish Fishery: Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384. http://www.pcouncil.org/wp-content/uploads/2017/02/SAFE_Dec2016_02_28_2017.pdf

Pacific Fishery Management Council (PFMC). 2017. Preseason Report I: Stock Abundance Analysis and Environmental Assessment Part 1 for 2017 Ocean Salmon Fishery Regulations. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384. http://www.pcouncil.org/salmon/background/document-library/historical-data-of-ocean-salmon-fisheries/

Appendix D

Template of the 2017 selective flatfish trawl EFP permit

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region, Sustainable Fisheries Division
7600 Sand Point Way NE, Building 1
Seattle, WA 98115

PACIFIC COAST GROUNDFISH FISHERY
EXEMPTED FISHING PERMIT (EFP)
AUTHORITY: Title 50, Code of Federal Regulations
Sections 600.745 and 660.406, and part 660

Selective Flatfish Trawl EFP: Monitoring and Minimizing Salmon Bycatch When Targeting Rockfish in the Shorebased Individual Fishing Quota (IFQ) Fishery

Permit Number: **RF-##**

Vessel Name	USCG Documentation Number	Pacific Coast Groundfish Limited Entry Permit Number

In accordance with the Magnuson-Stevens Fishery Conservation and Management Act provisions (16 U.S.C. 1801 et seq.), 50 CFR 600.745, and 50 CFR 660.30 (subpart C), the above named vessel is exempt from the regulations specified below while participating in the "Selective Flatfish Trawl EFP: Monitoring and Minimizing Salmon Bycatch When Targeting Rockfish in the Shorebased Individual Fishing Quota (IFQ) Fishery" study. Note: Excerpts of some regulations cited in this EFP are provided in Appendix A.

The purpose of the study is to test gear configurations to better target pelagic rockfish species and to collect information on the nature and extent of bycatch that results. Vessels operating under this EFP are exempt from the requirement to use a selective flatfish trawl inshore of the Rockfish Conservation Areas (RCAs) north of 42°N latitude and the minimum mesh size of 4.5 inches, provided that they follow the scientific protocol and terms and conditions of this permit. Vessels operating under this EFP will use bottom trawl gear only.

EXEMPTIONS

1. The prohibition on a vessel using small footrope trawl gear (except selective flatfish gear) to fish for groundfish or have small footrope trawl gear (except selective flatfish gear) onboard while fishing north of 42°N. latitude and shoreward of the RCA defined at paragraph § 660.130(e) and at §§660.70 through 660.74 (§ 660.130 (c)(2)).
2. The requirement to use selective flatfish trawl north of 42°N. lat. and shoreward of the RCA defined at paragraph § 660.130(e) and at §§660.70 through 660.74 (§ 660.130 (c)(2)(i)).
3. The minimum mesh size for bottom trawl gear of 4.5 inches (§ 660.130(b)(2)).
4. For vessels using electronic monitoring, the prohibition on retaining salmon and eulachon (§§ 660.12 (a)(1), 660.112(a)(2)(i), and 660.140(g)(1)). Salmon and eulachon must be retained

until landing and disposed of after being documented by a catch monitor. Salmon must be disposed of in such a way as to not enter the commercial market. This exemption applies only to salmon and eulachon. Any incidentally caught marine mammal; seabird; sea turtle; other ESA-listed fish; large pelagic fish (6-ft or greater in length); Dungeness crab caught seaward of Washington or Oregon; or Pacific halibut must be discarded according to the Vessel Monitoring Plan and recorded in the vessel's logbook.

5. The prohibition at § 660.12(a)(4) only as it relates to the above exemptions.

Exemptions are valid provided the vessel complies with the terms and conditions of the permit as described in the following sections. The vessel must comply with all other regulations, including requirements to have IFQ to cover catch of any IFQ species. This permit is effective when signed by both the Regional Administrator and the authorized representative of the vessel owner (hereinafter referred to as the "EFP holder") and on the later of the two signature dates. It expires 24 hours after actual notice to the EFP holder by the Regional Administrator of termination of the EFP, or when any of the conditions listed at A.2 are met, or at 11:59 p.m. PST on December 31, 2017, whichever is earlier. It also may be terminated or modified earlier by regulatory action pursuant to 50 CFR Part 660, or by revocation, suspension, or modification pursuant to 15 CFR Part 904, or successor regulations, or by the terms and conditions of this permit.

A copy of this EFP and the terms and conditions must be carried on board the vessel while on an EFP trip and when fish caught while fishing under the EFP are onboard the vessel.

Date Signed

Barry Thom, Regional Administrator
West Coast Region
National Marine Fisheries Service

Signature Date Signed

EFP Holder (Authorized Representative of Vessel Owner)

Print EFP Holder Name

By signing this document, the EFP holder agrees that the EFP holder, the vessel owner(s), all vessel operators, and crew members of the vessel understand and will comply with the intent and the terms and conditions of this permit.

Vessel Owner's Name/Address:

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TERMS AND CONDITIONS

The exemptions are valid provided the above listed vessel complies with the following conditions and requirements.

A. SCOPE

1. This EFP is effective while the permitted vessel is fishing on an "EFP trip," defined as any trip taken under the following declaration:
    a. Limited entry bottom trawl, shorebased IFQ, not including demersal trawl (§ 660.13(d)(5)(iv)(A)(7)).

2. Participating vessels must meet the following eligibility criteria:
    a. Participant owns the vessel proposed to be used or has written permission of the owner;
    b. Participant has a valid trawl Pacific Coast Groundfish limited entry permit and a valid vessel account set up to receive quota pounds under the IFQ program;
    c. The vessel has a current and valid U.S. Coast Guard Vessel Safety Check decal;
    d. The participant has not had a violation of fishing regulations in the last 3 years in which the participant was fined more than $1,000 for a criminal penalty or $5,000 for a civil penalty;
    e. The participant has never had a violation for falsification of observer, logbook, or fish ticket data;
    f. The vessel has had no unobserved fishing trips or fishing days since the inception of the IFQ program; and,
    g. The participant is willing and able to follow the terms and conditions of the EFP.

3. The NMFS West Coast Regional Administrator may terminate this permit by any of the following:
    a. At the request of the EFP holder, in which case the original EFP must be returned in person or by mail to the NMFS West Coast Region Fisheries Permits Office, 7600 Sand Point Way NE, Bldg. 1, Seattle, WA 98115-0070;
    b. The Regional Administrator determines it is necessary to issue amended EFPs containing additional or revised terms and conditions, in which case this EFP will cease to be effective upon NMFS receipt of an amended permit signed by the EFP holder, or seven calendar days after the NMFS mailing date of the amended permit, whichever occurs first;
    c. The Shorebased IFQ sector is closed for any reason, including a bycatch limit, commercial harvest guideline, or species harvest guideline, in which case this EFP is no longer effective concurrent with the closure as announced in the Federal Register, and further written notification to the EFP holder or vessel owner is not required;
    d. Superseding Federal regulations become effective;
    e. NMFS finds that the EFP has unintended impacts; and/or
    f. NMFS finds that the EFP holder no longer meets the eligibility criteria.

B. GENERAL RESPONSIBILITIES

1. Gear Restrictions. While on an EFP trip, the vessel is required to comply with the following gear restrictions.

a. While fishing north of 42°N. lat. and shoreward of the RCA defined at § 660.130(e) and at §§660.70 through 660.74, the vessel must use small footrope trawl gear that:
   i. Meets the definition of bottom trawl gear defined at § 660.11.
   ii. Meets definition of small footrope bottom trawl gear defined at §§ 660.11 and 660.130(b)(3)(ii).
   iii. Complies with all other restrictions on bottom trawl gear specified at § 660.130(b).
b. While fishing between 42°N. lat. and 40°10'N. lat. and shoreward of the RCA, the vessel must use selective flatfish gear consistent with requirements at § 660.130 (c)(2)(i).
c. Small footrope trawl gear (except selective flatfish gear) is still prohibited from being used from 42°N. lat. to 40°10'N. lat. and shoreward of the RCA on an EFP trip.

2. Columbia River Salmon Conservation Zone. The vessel is prohibited from fishing in the Columbia River Salmon Conservation Zone while on an EFP trip. The Columbia River Salmon Conservation Zone is defined as the ocean area surrounding the Columbia River mouth bounded by a line extending for 6 nm due west from North Head along 46°18'N.lat. to 124°13.30'W. long., then southerly along a line of 167 True to 46°11.10'N. lat. and 124°11'W. long. (Columbia River Buoy), then northeast along Red Buoy Line to the tip of the south jetty.

3. Gear Description Form. The EFP holder is required to complete and submit a NMFS-provided form(s) describing the gear configuration and bycatch reduction device used on EFP trips.

C. BEFORE AN EFP TRIP

1. Declaration Reports: The vessel must have a valid declaration with the NMFS Office of Law Enforcement (OLE) for bottom trawl shorebased IFQ for an EFP trip.
   a. To change your vessel's current declaration call: **888-585-5518** (leave a message if after hours). When prompted to leave a comment, state that you will be fishing in the "trawl gear EFP" and indicate whether your vessel will be using EM or an observer. Your vessel's declaration will stand until changed.

D. DURING AN EFP TRIP

4. Retention and Catch Handling (**EM Vessels Only**). The vessel must retain all salmon and eulachon until landing. Salmon and eulachon must be sorted and stored following instructions in the NMFS-accepted VMP. The vessel operator is responsible for ensuring that all catch is handled in a manner that enables the EM system to record it.

5. Logbooks: The EFP holder must complete a state bottom trawl logbook for retained catch for each EFP trip.

E. AFTER AN EFP TRIP

1. Salmon and Eulachon Disposition (**EM Vessels Only**). Salmon and eulachon landed must be documented by a catch monitor. Handling and disposition of salmon and eulachon is the responsibility of the first receiver. Salmon and eulachon must be disposed of in a way that

Page **4** of **7**

ensures it will not enter the commercial market, and may not be retained for personal use by a vessel owner or crew, a first receiver or processing crew. Salmon and eulachon may be disposed of in a landfill, taken back out to sea, or by some other method that does not enter the commercial market. Salmon suitable for human consumption may be donated to a surplus food collection and distribution system or nonprofit charitable organization for the purpose of reducing hunger and meeting nutritional needs.

2. Report Submission. The EFP holder is required to complete and submit a gear characterization form to NMFS for each net used while declared into the EFP following instructions provided by NMFS.

F. OTHER TERMS AND CONDITIONS

1. Data Confidentiality. The fishing activities carried out under this permit are for the purpose of collecting catch information. Information about fishing activities from the EFP will be confidential consistent with the Magnuson-Stevens Act. To facilitate communication between EFP holders about bycatch avoidance, the EFP holder authorizes NMFS and PSMFC to release catch information to the staff of the West Coast Seafood Processors Association and the Oregon Trawl Commission for purposes of monitoring EFP performance and communicating information on bycatch and avoidance measures to other EFP holders.

2. Sanctions. Failure to comply with the terms and conditions of this EFP, a notice issued under 50 CFR Part 660 or any other applicable provision of 50 CFR Parts 600 and 660, the Magnuson-Stevens Act, or any other regulations promulgated hereunder, may be grounds for revocation, suspension, or modification of this EFP (50 CFR 600.745 (b)(9)), as well as civil or criminal penalties under the Magnuson-Stevens Act with respect to all persons and vessels conducting activities under the EFP. Such failure may result in a vessel's inability to obtain an EFP permit in the future.

Appendix A: Excerpts of Regulations Cited (effective February 23, 2017)

1. Excerpt from 50 CFR 660.11:

"*Fishing gear* includes the following types of gear and equipment:

* * *

(11) *Trawl gear* means a cone or funnel-shaped net that is towed through the water, and can include a pair trawl that towed simultaneously by two boats. For the purpose of this definition, trawl gear includes groundfish and non-groundfish trawl. See definitions for groundfish trawl and non-groundfish trawls (previously called "exempted trawl").

(i) *Bottom trawl* means a trawl in which the otter boards or the footrope of the net are in contact with the seabed. It includes demersal seine gear, and pair trawls fished on the bottom. Any trawl not meeting the requirements for a midwater trawl in §660.130(b), subpart D is a bottom trawl.

* * *

(C) *Small footrope trawl gear* means a bottom trawl gear with a footrope diameter of 8 inches (20 cm) or smaller, including any rollers, bobbins, or other material encircling or tied along the length of the footrope. Selective flatfish trawl gear that meets the gear component requirements in §660.130(b), subpart D is a type of small footrope trawl gear."

2. Excerpt from 50 CFR 660.130:

"(b) Trawl gear requirements and restrictions. Trawl nets may be fished with or without otter boards, and may use warps or cables to herd fish.

(1) *Codends*. Only single-walled codends may be used in any trawl. Double-walled codends are prohibited. Chafing gear may not be used to create a double-walled codend.

(2) *Mesh size*. Groundfish trawl gear, including chafing gear, must meet the minimum mesh size requirements in this paragraph. Mesh size requirements apply throughout the net. Minimum trawl mesh sizes are: Bottom trawl, 4.5 inches (11.4 cm); midwater trawl, 3.0 inches (7.6 cm). Minimum trawl mesh size requirements are met if a 20-guage stainless steel wedge, less one thickness of the metal wedge, can be passed with only thumb pressure through at least 16 of 20 sets of two meshes each of wet mesh.

(3) *Bottom trawl gear*—(i) *Large footrope trawl gear*. Lines or ropes that run parallel to the footrope may not be augmented with material encircling or tied along their length such that they have a diameter larger than 19 inches (48 cm). For enforcement purposes, the footrope will be measured in a straight line from the outside edge to the opposite outside edge at the widest part on any individual part, including any individual disk, roller, bobbin, or any other device.

(ii) *Small footrope trawl gear*. Lines or ropes that run parallel to the footrope may not be augmented with material encircling or tied along their length such that they have a diameter larger than 8 inches (20 cm). For enforcement purposes, the footrope will be measured in a straight line from the outside edge to the opposite outside edge at the widest part on any individual part, including any individual disk, roller, bobbin, or any other device.

(A) *Selective flatfish trawl gear.* Selective flatfish trawl gear is a type of small footrope trawl gear. The selective flatfish trawl net must be a two-seamed net with no more than two riblines, excluding the codend. The breastline may not be longer than 3 ft (0.92 m) in length. There may be no floats along the center third of the headrope or attached to the top panel except on the riblines. The footrope must be less than 105 ft (32.26 m) in length. The headrope must be not less than 30 percent longer than the footrope. The headrope shall be measured along the length of the headrope from the outside edge to the opposite outside edge. An explanatory diagram of a selective flatfish trawl net is provided as Figure 1 of part 660, subpart D.

* * *

(iii) Chafing gear restrictions for bottom trawl gear. Chafing gear may encircle no more than 50 percent of the net's circumference and may be in one or more sections. Chafing gear may be used only on the last 50 meshes, measured from the terminal (closed) end of the codend. Only the front edge (edge closest to the open end of the codend) and sides of each section of chafing gear may be attached to the codend; except at the corners, the terminal edge (edge closest to the closed end of the codend) of each section of chafing gear must not be attached to the net. Chafing gear must be attached outside any riblines and restraining straps.

(4) *Midwater (pelagic or off-bottom) trawl gear.* Midwater trawl gear must have unprotected footropes at the trawl mouth, and must not have rollers, bobbins, tires, wheels, rubber discs, or any similar device anywhere on any part of the net. The footrope of midwater gear may not be enlarged by encircling it with chains or by any other means. Ropes or lines running parallel to the footrope of midwater trawl gear must be bare and may not be suspended with chains or any other materials. Sweep lines, including the bottom leg of the bridle, must be bare. For at least 20 ft (6.15 m) immediately behind the footrope or headrope, bare ropes or mesh of 16-inch (40.6-cm) minimum mesh size must completely encircle the net.

* * *

(c)(2) *Fishing with small footrope trawl gear.* North of 40°10′ N. lat., it is unlawful for any vessel using small footrope gear (except selective flatfish gear) to fish for groundfish or have small footrope trawl gear (except selective flatfish gear) onboard while fishing shoreward of the RCA defined at paragraph (e) of this section and at §§660.70 through 660.74. South of 40°10′ N. lat., small footrope gear is required shoreward of the RCA. Small footrope gear is permitted seaward of the RCA coastwide.

(i) North of 40°10′ N. lat., selective flatfish gear is required shoreward of the RCA defined at paragraph (e) of this section and at §§660.70, through 660.74. South of 40°10′ N. lat., selective flatfish gear is permitted, but not required, shoreward of the RCA. The use of selective flatfish trawl gear is permitted seaward of the RCA coastwide.

Appendix E

Council recommendations on issuance of exempted fishing permits

Pacific Fishery Management Council

7700 NE Ambassador Place, Suite 101 Portland, OR 97220-1384
Phone 503-820-2280 | Toll free 866-806-7204 | Fax 503-820-2299 | www.pcouncil.org
Philip Anderson, Chair | Charles A. Tracy, Executive Director

September 26, 2017

Mr. Barry Thom
Regional Administrator
National Marine Fisheries Service – West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
Portland, OR 97232-1274

Subject: Council Recommendations on Issuance of Exempted Fishing Permits for Trawl Gear and Coastwide Year-Round use of Midwater Trawl for Nonwhiting Trips

Dear Mr. Thom:

At its September 2017 meeting, the Council made recommendations on the issuance of exempted fishing permits (EFPs) for trawl gear configuration and the coastwide, year-round use of midwater trawl gear for nonwhiting trips. The application by the West Coast Seafood Processors Association, Oregon Trawl Commission, Midwater Trawlers Cooperative, and Environmental Defense Fund (enclosed) was initially reviewed at the June 2017 Council meeting and modified thereafter based on Council recommendations. After discussing this application at length at its September 2017 meeting, the Council recommended approval of the EFP application but also made recommendations that address both the process for approving the EFP (including whether there should be one or two EFPs) and modification of provisions that were proposed in the application.

With respect to the process, the Council recommends that National Marine Fisheries Service (NMFS) issue a single EFP that starts on January 1, 2018 and may be modified throughout the year. The January 1st EFP would, at a minimum, provide a continuation of the 2017 gear EFP with some differences, discussed below. The January 1st EFP might also provide exemptions to prohibitions on time and areas during which participants can use midwater trawl gear to target non-whiting species, or such exemptions might be added to the EFP later in the year. Inclusion of exemptions related to non-whiting midwater trawl will depend on the completion of the Endangered Species Act (ESA) salmon consultation and time required thereafter to complete the impact analysis for the EFP. Additionally, the geographic scope of the provisions related to the 2017 gear EFP may be expanded south of 42° N. latitude, down to 40° 10’ N. latitude, depending on the condition of salmon stocks as indicated by information in Salmon Preseason Report I. As the EFP is developed, the Council recommends that NMFS decide whether two separate EFPs might reduce analytical complexity and prevent a delay of a January 1st implementation.

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If two EFPs are developed, NMFS should investigate whether there is a need to prevent vessels from participating in more than one of these EFP. During its discussion, the Council also acknowledged that where necessary NMFS may limit the number of participants in the EFP, possibly on the basis of geographic associations with respect to EFP fishing opportunities south of 42° N. latitude.

The following are the primary provisions of the EFP, as recommended by the Council. The EFP should include continuation of all elements of the 2017 gear EFP, with the addition of the change to how mesh size is measured, an exemption to the definition of selective flatfish trawl that would allow the use of a four seam selective flatfish trawl net, and a possible geographic extension down to 40° 10' N. latitude. Additionally, the Council recommends that the EFP provide an exemption to the prohibition on the use of multiple trawl gears (midwater and bottom trawl) during the same trip, an exemption allowing new hauls to be brought on board and dumped on deck before all catch from previous hauls has been stowed, and an exemption to the prohibition on use of midwater trawl gear year-round (including prior to May 15th) shoreward, within, and seaward of the RCAs north or 40° 10' N. latitude and within and sea-ward of the RCAs south of 40° 10' N. latitude. With respect to vessels using multiple gears, all retained catch must be sorted by gear and kept separate until landed. If two EFPs are issued in response to this application, the midwater trawl related provisions should be grouped with the provisions on dumping nets and provisions allowing the use of multiple trawl gears; and the exemption from the minimum mesh size regulations that was part of the 2017 gear EFP should be extended to the midwater trawl EFP (except with respect to the first 20 feet behind the footrope or headrope).

The Council recommended against inclusion of the following specific provisions proposed in the EFP application:

1. Eliminate codend restriction,
2. Eliminate chafing gear restrictions,
3. Allow non-whiting midwater targeting shoreward of the RCA south of 40° 10' N. latitude,
4. Allow maximized retention on all vessels.

With respect to bycatch retention, vessels must abide by the same retention and sorting requirements included as part of the 2017 trawl gear EFP: for electronic monitoring vessels salmon and eulachon must be retained and kept sorted by haul until landing; and for observed vessels prohibited species must be discarded after observers have taken needed samples from the haul.

A proposed 3,547 Chinook salmon harvest guideline (HG) would apply to all activity covered in this EFP application—both the gear related provisions and the midwater trawl related provisions—regardless of whether a single or two EFPs are issued. Further, as specified by the applicants, this HG would apply to the entire non-whiting midwater fishery, though exceeding this HG would only constrain the EFP related activity, not non-EFP midwater targeting of non-whiting species. Within the 3,547 Chinook HG, the application also includes an 800 Chinook sub-HG that applies before May 15th. Additionally, the 800 Chinook sub-HG includes within it an 80 Chinook salmon sub-HG for the area south of 42° N. latitude. The Council recommends that this 80 Chinook sub-HG apply year-round to all EFP activity in that area and covered in this application, not just midwater trawling and not just prior to May 15th. The Council also recommends closure of the Klamath Salmon Conservation Zones and Columbia River Salmon Conservation Zone, closures that were

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not included in the EFP application. Measures intended to mitigate impacts to salmon in the area south of 42° N. latitude may be adjusted based on Salmon Preseason Report I forecasts.

The Council also noted that the EFP(s) should include a requirement that both haul-level data on all salmon bycatch and information on gear configuration be collected; and that Tribal partners on the Salmon Advisory Subpanel requested any tag recoveries from the Klamath River area be shared with them.

Should you or your staff have any questions, please feel free to contact me or Dr. Jim Seger on the Pacific Council staff.

Sincerely,

Charles A. Tracy

Charles A. Tracy
Executive Director

JLS:ael

Enclosure

Cc: Pacific Council Members
Groundfish Advisory Subpanel
Groundfish Management Team
Ms. Karen Palmigiano
Mr. Shems Jud
Mr. George Kautsky
Ms. Heather Mann
Mr. Brad Pettinger
Ms. Lori Steele
Mr. Dave Hillemeier