UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
7600 Sand Point Way, NE, Bldg 1
Seattle, Washington 98115-0070

December 7, 2022

Refer to NMFS No: WCRO-2022-02582

MEMORANDUM FOR: Ryan Wulff
Assistant Regional Administrator
Sustainable Fisheries Division

FROM: Lynne Barre
Seattle Office Branch Chief
Protected Resources Division

SUBJECT: Endangered Species Act Section 7(a)(2) Concurrence Letter for the Reinitiation of consultation on continued operation of the groundfish fishery under the Pacific Coast Groundfish Fishery Management Plan and the effects of the fishery on Southern Resident killer whales

On September 28, 2022, NOAA's National Marine Fisheries Service (NMFS) Protected Resources Division (PRD) received your request from NMFS Sustainable Fisheries Division (SFD) for reinitiation of consultation on continued operation of the Pacific Coast groundfish fishery (PCGF) managed by the Pacific Coast Groundfish Fishery Management Plan (PCGFMP) under the Magnuson Stevens Act. This Letter of Concurrence concludes that the proposed action is not likely to adversely affect (NLAA) the Southern Resident killer whale (SRKW) (*Orcinus orca*) Distinct Population Segment (DPS) or its critical habitat designated under the Endangered Species Act (ESA).

This response to your request was prepared by NMFS pursuant to section 7(a)(2) of the ESA and implementing regulations at 50 CFR 402. On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the district court issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The district court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations are once again in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in the letter of concurrence would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

This letter underwent pre-dissemination review using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the Environmental

Consultation Organizer (https://www.fisheries.noaa.gov/resource/tool-app/environmental-consultation-organizer-eco). A complete record of this consultation is on file at NMFS WCR PRD in Seattle.

Consultation History

In a 2012 biological opinion, NMFS concluded that the ongoing implementation of the PCGF is likely to adversely affect green sturgeon, eulachon, humpback whales, Steller sea lions, and leatherback sea turtles, and is not likely to adversely affect the SRKW DPS, among other marine mammals and sea turtles (NMFS 2012). In 2016, NMFS reinitiated consultation on the PCGF for the southern DPS of eulachon, citing take exceedance, and completed the consultation in 2018 (NMFS 2018). In 2017, NMFS released a biological opinion that concluded that the ongoing implementation of the PCGF is likely to adversely affect, but not jeopardize, ESA-listed salmon (NMFS 2017a). In 2018, NMFS reinitiated consultation on humpback whales, citing exceedance of incidental take and changes to DPS delineations, and completed the consultation in 2020, which included a conference opinion on proposed critical habitat (NMFS 2020).

On August 2, 2021, NMFS issued a final rule revising the SRKW critical habitat designation by expanding it to include habitat along the U.S. West Coast, while maintaining the DPS' previously designated critical habitat in inland waters of Washington State (86 FR 41668). NMFS subsequently determined that reinitiation of the consultation on the groundfish fishery was necessary under implementing regulation 50 CFR 402.16 criterion (a)(4), referencing the new critical habitat designation.

In June 2022, NMFS' PRD and SFD began pre-consultation discussions and planned the development of a Chinook salmon bycatch report that would support an updated PCGFMP consultation for SRKWs. Following completion of the updated salmon bycatch report, in September 2022, we (NMFS PRD) received a request from NMFS SFD to reinitiate consultation on the continued operation of the PCGF under the PCGFMP for Southern Resident killer whales (Wulff 2022). The request included a detailed description of the fishery and a copy of the Draft Report on Chinook bycatch in West Coast commercial groundfish fisheries (Matson et al. 2022). On October 11, 2022, NMFS PRD determined that the reinitiation package was complete and initiated consultation.

For all other ESA-listed species covered, the 2012, 2018, and 2020 Opinions referenced above remain valid and all Terms and Conditions, Reasonable and Prudent Measures, and Conservation Measures remain in effect.

Proposed Action and Action Area

1.0 Proposed Federal Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). The proposed action is the continued operation of the Pacific Coast Groundfish Fishery as implemented under the Fishery Management Plan (FMP). The groundfish FMP is implemented through regulations that are generally recommended by the Pacific Fishery Management Council (Council) and adopted by

NMFS. We considered, under the ESA whether or not the proposed action would cause any other activities and determined that it would not.

The following discussion describes all the groundfish fisheries governed by the FMP that are the subject of this consultation. It provides an overview of all components of the groundfish fishery that provides context for understanding how the fisheries operate and for assessing the direct and indirect effects of the Federal actions covered by this consultation. The overview also provides historical information to provide a perspective on the expected changes in the fishery included in the proposed action. The discussion focuses on those attributes of the Pacific Coast groundfish fishery that influence the exposure of listed species to the fishery and potential outcomes including the following:

- Gear Type and Target Species—Configuration of gear and anticipated catch levels of target species, including the potential for direct interaction with listed species
- Seasonality and Geographic Extent—When and where the gear is deployed for comparison with the distribution of listed species and the intensity of effort
- Catch—Indirect effects of fishery catch and bycatch on listed salmon species.

Additional consideration is given to monitoring strategies, data sources, and management jurisdiction.

1.1 Action Area

Action area means all areas affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). For the Pacific Coast Groundfish Fishery the action area includes the Exclusive Economic Zone (EEZ) and state waters of the Pacific Ocean. Although the state-managed groundfish fisheries are not caused by the proposed action, vessels participating in federally-managed fisheries transit through state waters and land fish within the states. Thus, some effects of the federally-managed groundfish fishery occur in state waters. **Error! Reference source not found.** shows the area where fishing has occurred, and where the direct effects to the ESA-listed species are most likely to occur. It is reasonable to expect that future fishing will occur in the same areas.

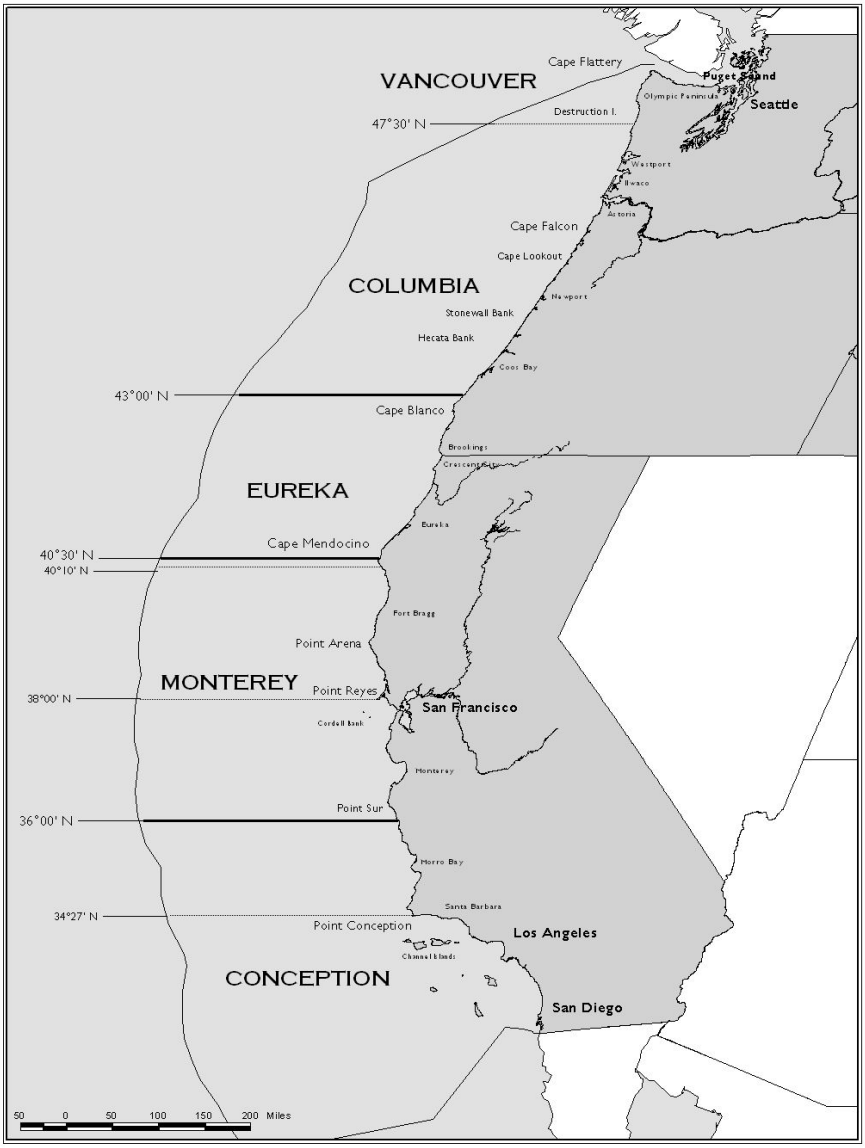

Figure 1. The fishery management area, showing major communities and groundfish management areas (PFMC 2022).

1.2 The Groundfish Fishery

The Pacific coast groundfish fishery is a year-round, multi-species fishery occurring seaward of Washington, Oregon, and California. The groundfish fishery includes vessels that use a variety of gear types to directly harvest groundfish or to land groundfish incidentally caught while targeting non-groundfish species. While no direct interactions of the groundfish fishery have been documented on SRKWs, the Pacific coast groundfish fishery may, however, affect SRKWs indirectly by reducing availability of their primary prey, Chinook salmon. The seasonality and geographic extent, including fishing depth and north/south distribution of the different target strategies and gears result in different indirect effects on SRKWs. This section presents an

overview of the groundfish species, the management structure, gear types used to harvest groundfish, seasonality and geographic extent of the fishery, and catch monitoring.

Fisheries that impact groundfish but are not directly regulated through the FMP are managed by the coastal states. These include state-managed nearshore fisheries which target some of the same species included in the FMP fisheries and that target species not included in the FMP and that incidentally catch species in the FMP. Examples of the latter include the California halibut fishery and the pink (ocean) shrimp fishery.

The FMP and its implementing regulations limit the retention of groundfish in these fisheries, and they require observer coverage to enforce those limits, but they do not directly regulate the harvest of the target species. Most nearshore fixed gear fishing regulated by the states occurs between 0 and 3 miles offshore. These state-managed fisheries are not part of this proposed action, as they are not directly managed under the FMP. In addition, they are not caused by the federally managed groundfish fisheries covered by the FMP. They are managed separately, have independent utility, and they do not depend on the federally managed fisheries for their justification.

1.2.1 Groundfish Species

The FMP includes more than 90 species. Commercial and recreational fisheries target fish such as Pacific whiting, sablefish, lingcod, rockfish, and flatfish species. Figure 2 shows annual total fleet-wide landings in federally-managed West Coast groundfish fisheries from 2002-2019. For species in the groundfish fishery other than whiting, annual catch limits (ACLs) are set and allocated to sectors of the fishery through a biennial process. An annual catch level for whiting is set through an international process under the Whiting Treaty between the US and Canada. A few target stocks are typically caught nearly up to their ACLs, but many species in the fishery are caught at levels significantly below their ACLs.

Different species of groundfish inhabit different habitats defined by substrate, depth, and other environmental characteristics (NMFS 2017b). The distribution of the fishing fleets is the result of a combination of factors; in general, it reflects the distribution of the species targeted by each fishery, as well as the regulatory constraints in place to manage those fisheries.

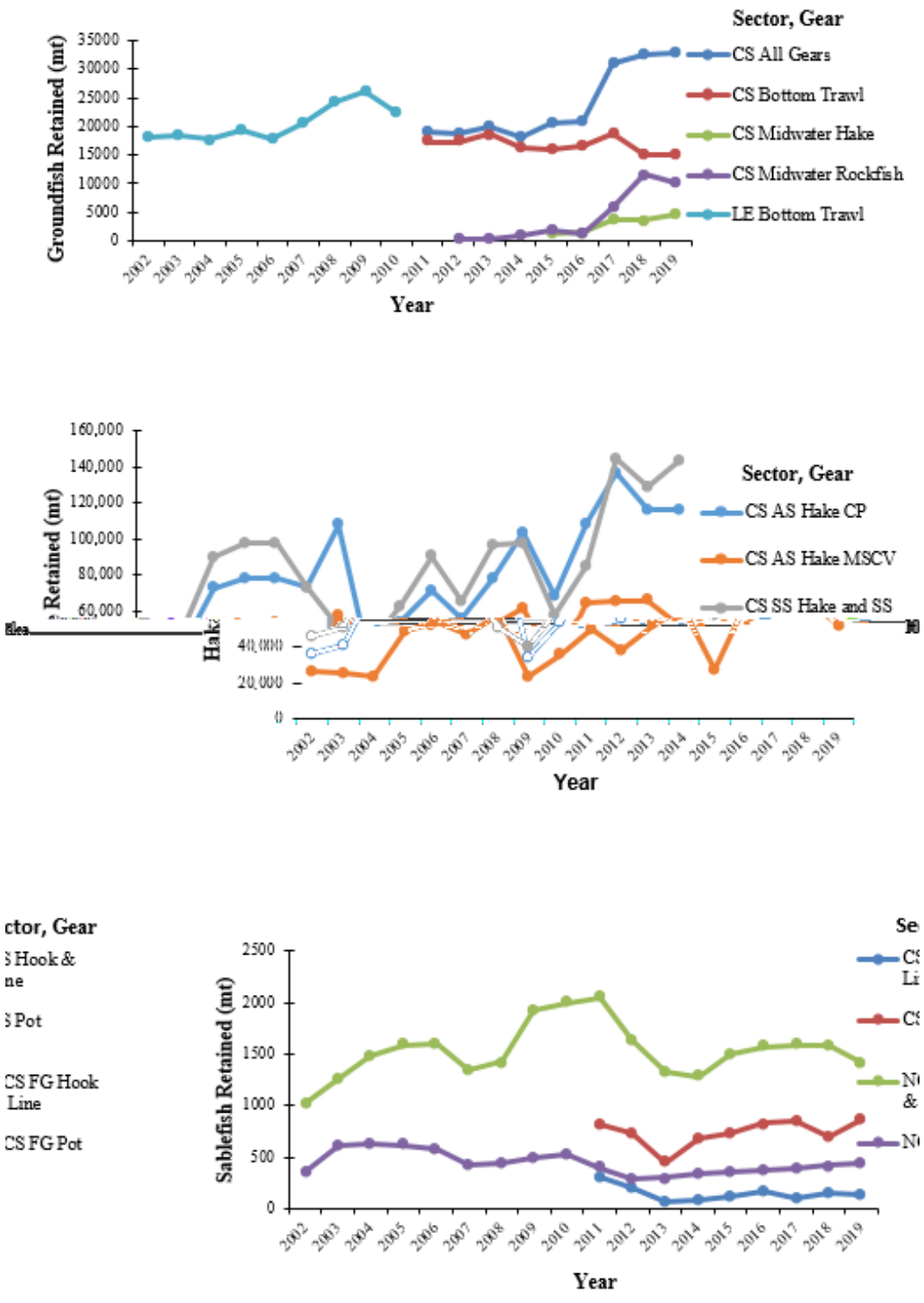

Figure 2. Annual total fleet-wide landings (mt) in federally-managed West Coast groundfish fisheries 2002-2019. Top panel shows shoreside FMP groundfish (not including hake) landings, middle panel shows hake landings, and bottom panel shows fixed-gear sablefish.

1.2.2 Current Management Structure and Fishing Gear

The groundfish fishery includes commercial, treaty tribal, and recreational gear components. Under the FMP, the groundfish fishery consists of four management components:

1. The Limited Entry (LE) component encompasses all commercial fishermen who hold a federal limited entry permit. The total number of limited entry permits available is restricted. Vessels with a LE permit are allocated a larger portion of the total allowable catch for commercially desirable species than vessels without a LE permit. The commercial groundfish fishery includes a LE permit program for a commercial non-tribal fleet that was established in 1994 for trawl, longline, and trap (or pot) gears. The LE fleet catches the majority of the commercial groundfish harvest.

2. The Open Access (OA) component encompasses commercial fishermen who do not hold a federal LE permit. The OA fishery takes groundfish incidentally or in small amounts. The OA fishery participants may use, but are not limited to longline, vertical hook-and-line, pot, setnet, trammel net, and non-groundfish trawl gear.

3. The Tribal component includes native tribal commercial fishers in Washington State that have treaty rights to fish groundfish. Participants in the tribal fishery use gear similar to that used in the non-tribal fisheries.

4. The Recreational component includes recreational anglers who target or incidentally catch groundfish species.

The groundfish fisheries can be divided into the groups shown in **Table 1**, based on permitting requirements, gear, and target strategy.

Table 1. Summary of gear and components by fishery managed under the FMP.

Fishery	Gear	Components
LE vessels registered to Federal LE groundfish permits (non-tribal)	**Trawl—At-sea Pacific whiting cooperatives**	**Catcher/processor cooperative** **Mothership sector cooperative**
	Trawl—Shorebased Individual Fishing Quota (IFQ) program	**Pacific whiting midwater trawl** **Non-whiting midwater trawl** **Bottom trawl** **Fixed gear (gear switching)**
	Fixed gear	**Sablefish tier limit fishery** **LE fixed gear (LEFG) trip limit fishery (a.k.a. zero tier or non-sablefish endorsed)**
Open access	**See text for description.**	**Directed OA** **Incidental OA**
Tribal	**Gear similar to LE fishery**	**Pacific whiting midwater trawl** **Non-whiting midwater trawl** **Bottom trawl** **Fixed gear**
Recreational	**Hook-and-line** **Spear**	**Commercial passenger vessels and private party vessels**

In 2022[1], 250 LE harvesting vessels were managed under the FMP. The harvesting vessels include vessels that harvest catch and deliver it to land based processing facilities and vessels that both harvest and process catch (catcher-processors). In addition, there are six mothership processors which receive whiting from catcher vessels and process them at sea. The number of vessels in the LE fisheries varies between years based on permits being transferred to multiple vessels, vessels in the sablefish tier fishery stacking[2] or unstacking permits, and permit owners removing their permits from vessels so that the permits are unused for some period (i.e., unidentified status). Each permit is endorsed for a particular gear type, and that endorsement cannot be changed. Therefore, the distribution of permits between LE trawl and fixed gears is fairly stable. The overall number of permits is reduced when multiple permits are combined to create a new permit with a longer vessel length endorsement. The distribution of permits often shifts among the three states. Effort in the fishery has declined significantly since the mid-1990s (Figure 3).

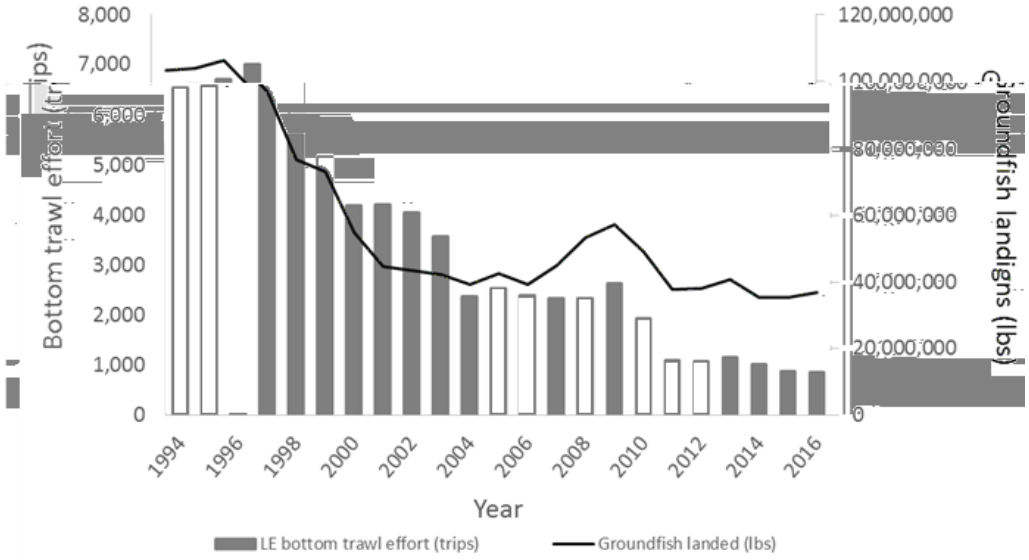

Figure 3. Non-whiting LE trawl trips (number) and groundfish landings by year.

Biennially, the Council reviews the groundfish harvest specification, considers new information, and then establishes specifications for the next two year period. NMFS published a proposed rule to set the harvest specifications and management measures for 2023-2024 on October 14, 2022 (87 FR 62676) and intends to publish the final rule in December 2022. An important reason for identifying fishery sectors relates to allocation of catch opportunity. Harvest levels or specifications for various groundfish stocks and stock complexes are referred to as annual catch limits (ACLs) and HGs. These may be coastwide specifications, or they may be subdivided geographically. Most of the ACLs are allocated to specific sectors of the fishery as described in the FMP.

[1] NMFS West Coast Region Pacific Coast Fisheries Permit System, queried August 17, 2022.
[2] Stacking is the practice of registering more than one LE permit for use with a single vessel.

Allocations may be “formal” or “informal.” Formal allocations are generally established to ensure that a sector can catch its portion of the ACL. Informal allocations are a function of particular management measures that constrain catch opportunities. In addition to allocations, managers also consider “set-asides”, portions of particular species’ ACLs that are set aside to prevent annual catch from exceeding the ACLs. Set-asides are established for research catch, incidental fisheries, tribal fisheries, and EFPs.

Additional information on groundfish stocks, landings and the management is available in the Stock Assessment and Fishery Evaluation (PFMC 2020a).

1.3 Overview of Trawl Fisheries

Beginning in 2011, West Coast groundfish fisheries have been managed under a catch share program that constrains both the number of vessels participating in the fishery and the amount of catch permitted by participating vessels. Catch shares consist of an IFQ program for the shorebased trawl fleet and harvester cooperatives for the at-sea mothership and catcher-processor fleets. The catch shares system divides the portion of the ACL allocated to the trawl fishery into shares controlled by individual fishermen or groups of fishermen (co-ops). The shares can be harvested largely at the fishermen's discretion. IFQ species and Pacific halibut catch are deducted from the fisherman's personal quota or the pooled quota (co-ops). Under catch shares, some management measures from the previous management structure remain in place; these measures include trip limits for non-IFQ species, size limits, and area restrictions.

The trawl fishery is divided into a number of sectors for management purposes. A portion of the fishery targets Pacific whiting, a midwater species. This portion of the fishery is divided into vessels that deliver to onshore processors (shoreside) and vessels that process at sea or deliver to vessels that process at sea (at-sea). Another portion of the fishery target bottom-dwelling groundfish species (bottom trawl). Finally, there is a developing fishery for non-whiting midwater groundfish species. This latter fishery is expected to expand in the future to a year-round fishery as restrictions put in place to allow testing under exempted fishing permits are moved into regulation.

It is assumed the whiting fishery will operate in the same geographical footprint as it has in recent years. The U.S. portion of the annual Pacific whiting total allowable catch (TAC) could go up to 600,000 metric tons, as the TAC has been trending higher in recent years. This TAC may be fully harvested.

For the non-Pacific whiting fishery, it is assumed the geographic distribution of the fleet and harvest levels will be similar to patterns seen in recent years, with the exception of additional effort in the trawl Rockfish Conservation Areas (RCA) off of Oregon and California which were opened beginning in 2020 as a result of Amendment 28 to the Pacific Coast Groundfish FMP. As overfished species are rebuilt, fishing is expected to resemble those historical patterns more closely than recent patterns, which reflect restrictions on fishing necessary for rebuilding the species.

1.3.1 Limited Entry - At-Sea Pacific Whiting Cooperatives

For the at-sea trawl fishery, the Pacific whiting primary season runs from May 1 to December 31, or until the sector allocations are taken. Allocations remaining on December 31 are not

carried into the new fishing year. Because many of the vessels are also used in the Alaska groundfish fishery and participate in the pollock B-season (June to October), much of the participation in the Pacific whiting fishery occurs in two separate timeframes, a spring season before the Alaska pollock fishery and a fall season. Most of the catcher-processor activity occurs from mid-May to early June and late September to late November. Most of the mothership activity occurs from May to early June and mid-September to mid-November. Generally, there is little or no fishing activity in the Pacific whiting at-sea fishery during July and August.

In 2022, there were 12 permitted catcher-processors, 6 permitted mothership vessels, and 44 LE catcher permits with mothership endorsements (mothership catcher vessel permits, 41 of which are registered to vessels to participate in the fishery).The at-sea fleet has the mobility to follow the movement of Pacific whiting. The catcher-processors are large vessels that have the capacity to target Pacific whiting at deeper depths than some of the smaller catcher vessels that harvest in the mothership or shoreside IFQ sectors. At times, the at-sea fleet has fished at depths greater than 200 fathoms, which may limit salmon bycatch. Since 1992, the at-sea fleet has been restricted from processing its catch south of 42° N. latitude (57 FR 14663).

Prior to 2009, the whiting sectors (including shoreside) operated without bycatch limits (1990 to 2006) for overfished species, or a whiting sector combined bycatch limit for overfished species (2007 to 2008). This led to a race for Pacific whiting until the allocation was reached, or until a bycatch cap for an overfished groundfish species resulted in closing the sectors to fishing. In 2009, sector-specific bycatch caps for overfished species were established, leading to sectors individually managing their fishing activity. From 1997 to 2010, the catcher-processor fleet operated under a voluntary co-op program through the Pacific Whiting Conservation Cooperative (PWCC). After 2011, the program became a mandatory catch share cooperative. In 2011, the mothership sector began operating under a single co-op agreement under the new catch share program.

With implementation of the catch share program under Amendment 20 in 2011, there were few changes to the management of the PWCC. Regulations at 660.160(h) were enacted so that if the co-op dissolves, the quota would be apportioned equally among current member vessels. For the mothership sector, the catch share program provided the opportunity for owners of mothership catcher vessel permits to form harvester co-ops. Each year, owners of such permits must choose whether to participate in a catcher vessel co-op and, if they reach that decision, they must identify the mothership to which they commit their deliveries. To date, the mothership catcher vessel permit holders have chosen to form a single co-op, and all have chosen to join that co-op. If the catcher vessels do not choose a co-op, they can participate in a non-co-op fishery, and they receive their respective allocations. However, a vessel with a mothership catcher vessel endorsed permit may not fish in both the co-op and non-co-op fisheries in the same year.

Under the typical co-op agreements, the primary goal is to minimize bycatch of all constraining species, with each fleet using real time monitoring to track location and catch amounts. For the mothership co-op, there are specific criteria in the co-op agreements for avoiding high bycatch, including area restrictions and moving protocols when specific base rates are exceeded.

On February 23, 2021, NOAA Fisheries published a final rule in the Federal Register (86 FR 10857) implementing salmon bycatch minimization measures to minimize incidental take of Endangered Species Act-listed salmon by vessels in the Pacific Coast groundfish fishery. As part

of the final rule, Pacific whiting sector co-ops are allowed to develop a Salmon Mitigation Plan (SMP), for NOAA Fisheries approval, to manage Chinook salmon bycatch. The SMP must detail how those vessels party to the SMP will avoid and minimize Chinook salmon bycatch, including the tools they will employ. Vessels that are party to an approved SMP will have automatic access to the Chinook salmon bycatch reserve[3] without the requirement for NOAA Fisheries to implement any inseason Chinook salmon bycatch minimization measures. NOAA Fisheries expects the SMP to promote reductions in Chinook salmon bycatch relative to what would have occurred in the absence of an SMP, because the SMP will require bycatch minimization measures for all vessels party to that SMP.

Both the mothership and catcher processor sectors use a private contracting service called Seastate for their data collection. Seastate uses electronically submitted observer data to calculate bycatch rates and provides the data back to the fleet within 24 hours to be used for bycatch avoidance. The Seastate service allows for information quick turnaround; it provides an avenue for vessels to work together to reduce bycatch, and it allows sharing of otherwise confidential data.

A number of non-whiting species are caught in this fishery. Bycatch of non-whiting species largely consists of spiny dogfish, yellowtail rockfish, widow rockfish, minor slope rockfish, thornyheads, sablefish, darkblotched rockfish, Pacific Ocean perch (POP), and arrowtooth flounder. Annual set-asides of the overall trawl allocations are established for most incidentally caught groundfish.

1.3.2 Limited Entry - Shorebased IFQ Program

The Shorebased IFQ program allows LE trawl permit holders to switch from trawl to fixed gears (longline and pot gear) to fish their individual quota (also referred to as Catch Share or CS fixed gear sector). From 2011-2018, 39 LE trawl vessels used fixed gear to fish for sablefish in the area north of 36° north latitude to the U.S.-Canada border. Fixed gears targeting sablefish are more selective than trawl gear. Sablefish are caught in deeper water, unlike nearshore groundfish species. Sablefish is the target of gear switching due to its high price per pound.

The shorebased IFQ fishery season for Pacific whiting is set using a framework for the area north of 40°30 N. Under the framework, the fishery opens on May 1 north of 42° N; April 1 between 42°and 40°30' N; and April 15 south of 40°30' N. The fishery harvests most of its Pacific whiting from mid-June through September, with smaller amounts being taken after September. The Pacific whiting shorebased IFQ fishery start date is aligned with the at-sea sector start date to allow access to non-Pacific whiting species one month earlier and equal access between the sectors to other midwater species such as widow rockfish.

The bottom trawl fishery is a year-round fishery in which vessels fish in a wide range of depths and deliver catch to shore-side processors. The peak of non-Pacific whiting groundfish catch (all gears) occurs in the spring, in either March or April; with a secondary, lower peak happening in October. Two important and valuable species in this fishery are sablefish and petrale sole.

[3] The Chinook salmon bycatch reserve is a pot of 3,500 fish to cover the whiting and non-whiting sectors in years of high bycatch.

Sablefish catch peaks in September and October, and petrale sole catch peaks in December and January. Since 2011, Petrale sole catch in January has been rising each year.

The season start date for the non-Pacific whiting midwater trawl fishery is currently May 15. To date, the non-Pacific whiting midwater trawl fishery has not yet established a clear seasonality.

1.3.3 Changes to Gear Limitations in Trawl Fishery

In December 2018, NMFS issued a final rule (83 FR 62269) revising Federal regulations that restrict the use and configuration of bottom and midwater trawl gear for vessels fishing under the Pacific Coast Groundfish Fishery's Trawl Rationalization Program. The gear restrictions were originally implemented to limit discarding and protect overfished rockfish species. These restrictions were no longer necessary because of changes to the fishery, including implementation of the Trawl Rationalization Program in 2011, and improved status of a number of overfished rockfish stocks. By eliminating these regulations, the action increases flexibility in how vessels can use and configure gear to increase access to target stocks and efficiency of fishing practices, while still limiting the catch of target and non-target discards to meet the conservation objectives of the Trawl Rationalization Program.

1.4 Overview of Fixed Gear Fisheries

In 2005, Limited Entry Fixed Gear (LEFG) fishing opportunity was constrained by measures needed to reduce the catch of overfished species, including canary rockfish coastwide, yelloweye rockfish north of 40°10′ N, latitude, and bocaccio and cowcod south of 40°10' N. latitude. Landing limits for the LEFG fleet north of 40°10' N. latitude provided vessels with access to continental slope and nearshore species and less access to continental shelf species. For waters south of 40°10′ N. latitude, landings limits were intended to draw vessels away from continental shelf species. Non-trawl RCAs are closed areas used to move fixed gear effort away from areas with higher yelloweye and canary rockfish abundance. The Cowcod Conservation Areas (CCAs) off the Southern California Bight were closed to commercial groundfish fishing to prevent vessels from fishing in areas of higher cowcod abundance. As many previously overfished rockfish have rebuilt, areas of the non-trawl RCA and the CCA are being reopened to fixed gear fishing.

Although the OA non-trawl fishery is managed separately from the LEFG fishery, overfished species protection measures are similar for both sectors. Similar to the LE fleet, greater landings limits are provided for continental slope and nearshore species, with closed seasons and lower limits for continental shelf species, including the same closed periods for lingcod as in the LEFG fisheries. The non-trawl RCA boundaries that apply to the LEFG fleet do not apply to a subset of the directed OA sector[4] as a result of a new management measure in the 2023-2024 Harvest Specifications.

1.4.1 Limited Entry Fixed Gear

Limited entry fixed gear (LEFG) vessels primarily target high-value sablefish with most landings historically occurring in Oregon and Washington. However, landings of sablefish vary

[4] Directed open access means that a fishing vessel is target fishing for groundfish under the requirements of 50 CFR 660 Subpart F and is only declared into an open access groundfish gear type or sector as defined at 50 CFR 660.13(d)(4)(iv)(A) and has not declared into any other gear type or sector.

depending on environmental conditions, and they have recently shown a southerly trend. California ports have had the greatest amount of LE, daily-trip-limit landings of sablefish in recent years, while Oregon had the most primary fishery landings.

The LEFG groundfish fishery consists of vessels fishing in the sablefish-endorsed tier fishery and the trip-limit (TL) fishery targeting nearshore species and non-nearshore species, including the TL fishery for sablefish. In the sablefish tier fishery, the permit holder of a sablefish-endorsed permit receives an annual share of the sablefish catch or "tier limits." Regulations allow for up to three sablefish-endorsed permits to be stacked on a single vessel. Vessels that are sablefish-endorsed generally fish deeper than 80 fathoms, and they land catch composed mostly of sablefish, with groundfish bycatch consisting primarily of spiny dogfish shark, Pacific halibut, rockfish species, and skates.

In 2022 there were 227 fixed gear permits, including 164 sablefish-endorsed and 59 non-sablefish endorsed permits. In addition, all LE fixed gear permits have gear endorsements (longline, pot/trap, or both). Of the sablefish endorsed permits, 132 were associated with longline gear only, 28 were associated with pot/trap gear only, and 4 were associated with both longline and pot/trap gear. The remaining 59 non-sablefish-endorsed permits were associated with longline gear.[5]

Vessels in the LEFG trip limit fishery fish under trip limits and generally target sablefish, thornyheads, and other groundfish species. These vessels primarily fish out of California ports. Fixed gear vessels are more prone to catch yelloweye rockfish (a once overfished species that is rebuilding) than trawl vessels, and, therefore, they have greater fishing restrictions on the continental shelf. LE, fixed-gear vessels may also participate in OA fisheries or in the LE trawl fishery. Like the LE trawl fleet, LEFG vessels deliver their catch to ports along the Washington, Oregon, and California coasts.

The primary season takes place from April 1 to December 31. Permit holders land their tier limits at any time during the nine-month season. Once the primary season opens, all sablefish landed by a sablefish-endorsed permit is counted toward attainment of its tier limit.

The TL fishery operates year-round (January to December) with most fishing activity occurring in the summer months. Landings have been highest from August through October, followed by the April to July period. The lowest number of landings occur between December and March. The LEFG trip limit vessels primarily fish out of California ports.

1.4.2 Open Access Fixed Gear

The Open Access (OA) sector consists of vessels that do not hold a Federal groundfish LE permit. They target groundfish (OA directed fisheries) or catch them incidentally (OA incidental fisheries) using a variety of gears. Vessels in this sector may hold Federal or state permits for non-groundfish fisheries. OA vessels must comply with cumulative trip limits established for the OA sector, and they are subject to the other operational restrictions imposed in the regulations, including general compliance with RCA restrictions.

[5] NMFS West Coast Region Pacific Coast Fisheries Permit System, queried August 17, 2022.

OA Fishermen use various non-trawl gears (including longline, trap or pot, setnet, stationary hook-and-line, vertical hook-and-line, and troll) to target particular groundfish species or species groups. Longline and hook and line gear are the most common OA gear types used by vessels directly targeting groundfish, and they are generally used to target sablefish, rockfish, and lingcod. Pot gear is used for targeting sablefish, thornyheads, and rockfish. The directed OA fishery is further grouped into the "dead" and/or "live" fish fisheries. In the live-fish fishery, groundfish are primarily caught with hook-and-line gear (rod-and-reel), LE longline gear, and a variety of other hook gears (e.g., stick gear). The fish are kept alive in a seawater tank onboard the vessel. Groundfish delivered live are primarily nearshore rockfish, but they also include thornyheads, sablefish, and lingcod.

For vessels targeting non-groundfish species, the groundfish catch is incidental to the target species. Only the groundfish catch is regulated under the Groundfish FMP. Incidental catch occurs in the following state-managed, non-groundfish trawl fisheries: California halibut, pink shrimp, ridgeback prawn, sea cucumber, and spot prawn. The fixed gear fisheries that take incidental amounts of groundfish include the following fisheries managed by the states (not part of the proposed action) or under other Federal FMPs: California halibut, coastal pelagic species, crab pot, fish pot, highly migratory species, Pacific halibut, salmon, sea urchin, and setnet fisheries. In summary, the incidental retention of groundfish is part of the OA fishery and is therefore included in the proposed action. The target fisheries listed above are not themselves part of the proposed action.

The OA sector is made up of many different gear types involved in directed and incidental catch, which makes it difficult to discern the location of effort. However, based on the diversity of this sector, it is reasonable to assume that effort is widespread across the West Coast. OA groundfish landings vary according to which non-groundfish fisheries are landing groundfish as bycatch. The number of OA vessels that land groundfish also varies with the changes in the non-groundfish fisheries and participation varies between years. Participation in recent years from 2016 to 2021 in the OA nearshore fixed gear fishery averaged 747.4 vessels (493.2 from CA, 224.5 from Oregon, and 29.7 from California). There is limited information on the distribution of effort by OA vessels beyond state-level data.

The fishery operates year-round (January to December). Assuming that landed catch represents directed OA, and that landed catch is a function of effort, then more OA-related fishing activity occurs during the spring, summer, and fall months than during winter months, although seasonal patterns have varied considerably among years, especially since 2011. In previous years, there was a more pronounced peak in effort and landings during August and September. Incidental fisheries vary with fishing seasons for the intended target species.

1.5 Tribal Groundfish Fisheries

Washington coastal tribes (Makah, Quileute, Hoh, and Quinault) possess treaty rights to harvest federally managed groundfish in their usual and accustomed fishing areas (U&As) within the EEZ, as described in decisions in *United States v. Washington* and associated cases. Under treaty arrangements, each tribe manages the fisheries prosecuted by its members. The FMP and its implementing regulations provide for allocations or set-asides of specific amounts of some species for the tribal fisheries to ensure implementation of treaty fishing rights. Those allocations

and set-asides are developed annually or biennially (depending on the species) in consultation with the tribes.

The individual tribes manage their fisheries, coordinating with NMFS and the Council. Treaty tribes participating in the groundfish fishery off Washington State have formal allocations for sablefish and Pacific whiting established through the Council. For other groundfish species without formal allocations, the tribes propose trip limits to the Council. The Council tries to accommodate the requested trip limits, while ensuring that catch limits for all groundfish species are not exceeded.

All four tribes have longline vessels in their fleets; only the Makah Tribe has trawlers. The Makah trawl vessels use both midwater and bottom trawl gear to target groundfish. The Makah Tribe also has the most longline vessels, followed by the Quinault, Quileute, and Hoh Tribes. Since 1996, a portion of the U.S. Pacific whiting TAC has been allocated to the West Coast treaty tribes fishing in the groundfish fishery. Tribal allocations have been based on discussions with the tribes regarding their intent for a specific fishing year. From 2010 to 2022 the tribal allocation has ranged from 17 to 26 percent of the U.S. Pacific whiting TAC.

The tribal whiting annual allocations are interim allocations not intended to set precedent for future allocations. Although the Quinault, Quileute, and Makah Tribes have expressed interest in the whiting fishery, to date, only the Makah Tribe has participated in the Pacific whiting fishery. Since 2012, whiting migration patterns have resulted in minimal tribal fisheries, in part because whiting distribution has been south of tribal U&A areas.

In addition to its participation in the whiting fishery, the Makah Tribe has a midwater trawl fishery that primarily targets yellowtail rockfish and a bottom trawl fishery that targets petrale sole. In developing its trawl fisheries, the Makah Tribe has implemented management practices that include test fishing to show tribal managers that the fishery can be conducted with gear and in areas without harming existing tribal fisheries. In the Makah bottom trawl fishery, the Tribe adopted small footrope to reduce rockfish bycatch and avoid areas where higher numbers of rockfish occur. In addition, the bottom trawl fishery is limited by overall footrope length to conduct a more controlled fishery. Harvest is restricted by time and area to focus on harvestable species while avoiding bycatch of other species. If bycatch of rockfish is above a set amount, the fishery is modified to stay within the bycatch limit. The midwater trawl fishery has similar control measures. A trawl area must first be tested to determine the incidence of overfished rockfish species before opening the area to harvest. Vessels receive guidelines for fishing techniques and operation of their net. Observers monitor fishing effort, and changes or restrictions are implemented, as needed, to stay within the bycatch limits.

Approximately one-third of the tribal sablefish allocation is taken during an open competition fishery, where vessels from all the four tribes have access to the overall tribal sablefish allocation. The open competition portion of the fishery tends to be taken during the same period as the main tribal commercial Pacific halibut fisheries in March and April. The remaining two-thirds of the tribal sablefish allocation are split between the tribes according to a mutually agreed-upon allocation scheme. Specific sablefish allocations are managed by the individual tribes. Participants in the halibut and sablefish fisheries tend to use hook and line gear, as required by the International Pacific Halibut Commission (IPHC).

The tribal non-whiting groundfish fishery typically shows a dome-shaped seasonal pattern; generally peaking between May and September. Historically the Pacific whiting tribal fishery tended to occur between June and September. However, there has been little activity in the tribal Pacific whiting fishery since 2011 so the pattern in recent years may not reflect what would occur under broader tribal participation as envisioned in the proposed action.

1.6 Recreational Fisheries

The states manage recreational fisheries in partnership with NMFS, with a distinction made between charter vessels (commercial passenger fishing vessels) and private party recreational vessels (individuals fishing from their own or rented boats). Federal and state management measures have been designed to limit catch of overfished species and provide fishing opportunity for anglers targeting nearshore groundfish species. The primary management tools have been seasons, bag limits, and closed areas. Gears used in the recreational fisheries include dip nets, throw nets, hook-and-line, dive/spears, and pots. In Oregon, starting in 2018, a longleader gear opportunity became available. Longleader gear has a minimum of 30 feet between the weight and the lowest hook. The gear is designed to target midwater rockfish species such as yellowtail and widow rockfish to move fishing pressure off nearshore rockfish species and to provide increased recreational fishing opportunities.

Recreational fisheries in Washington and California have shifted from year-round fisheries to seasonal fisheries with different open periods, depending on the target species. Recreational fishing in Oregon is open year-round, except when inseason closures are needed. Coastwide, the number of marine angler trips peak in the July-to-August period, but seasonal concentrations are more pronounced in Oregon and Washington where weather is more variable.

1.7 Essential Fish Habitat Conservation Areas (EFHCAs)

In March 2006, NMFS approved a plan to establish and protect more than 130,000 square miles off the United States West Coast as Essential Fish Habitat (EFH) for groundfish (72 FR 27408; Amendment 19 to the Pacific Coast Groundfish FMP). EFHCAs are geographic areas defined by coordinates expressed in degrees of latitude and longitude, wherein fishing by a particular gear type or types may be prohibited. EFHCAs are created and enforced to contribute to protection of West Coast groundfish EFH. NMFS works with the Council to review EFH components of the fishery management plans periodically and to revise these provisions based on available information.

NMFS published a final rule for Amendment 28 to the Pacific Coast Groundfish FMP (84 FR 63966, November 19, 2019). Amendment 28 made revisions to EFHCAs, and eliminated the trawl RCA off Oregon and California and replaced it with a tool called Block Area Closures (BACs). EFHCA changes included closure of most of the Southern California Bight to bottom trawl gear, as well as other changes, including re-opening of areas off Washington, Oregon and California. Areas that re-opened no longer have EFHCA or trawl RCA-related prohibitions, but may be closed by other restrictions (e.g. state rules, other groundfish conservation areas). EFHCAs that are closed prohibit bottom trawling (except demersal seine gear in areas off California). Nearshore areas (inside a boundary line approximating the 100 fm depth contour, formerly “shoreward of the trawl RCA”) would remain closed to large footrope trawl gear.

Amendment 28 added new protections for deep sea coral areas, modified areas that protect priority bottom habitat for groundfish, and reopened some areas that have been closed to bottom trawling. Amendment 28 closed the portion of the EEZ deeper than 3,500 m to all bottom contact gear, including bottom trawl gear, bottom long line gear, and pot/trap gear.

1.8 Geographic Extent and Depth Distribution

The groundfish fisheries operate coastwide in state and Federal waters. Groundfish fisheries managed under the FMP occur in the EEZ. Area closures have been a primary tool used in management of the fishery and have varied in number and size as management objectives evolve. Although most of the currently closed areas do not have non-groundfish bycatch reduction as an objective, an ancillary effect may be bycatch reduction. See Wulff (2022) for a description of the various types of closed areas that apply to all of the groundfish fisheries, as well as fishery-specific closed areas.

1.9 Catch Monitoring

Vessel monitoring systems (VMS) that automatically transmit position reports to NMFS are the primary management tool used to monitor commercial vessel compliance with time and area restrictions. All non-tribal commercial vessels are required to have an operational vessel monitoring system to fish in the groundfish fishery. In addition, each vessel operator is required to submit declaration reports to NOAA's Office for Law Enforcement that allows the vessel's position data to be linked to the type(s) of fishing gear and in some cases a target strategy. The Catch Share and At-sea Pacific whiting fisheries are subject to full observer coverage, though the shoreside and mothership sector participants can elect to use electronic monitoring in lieu of human observers. The Electronic Monitoring program has 100 percent electronic monitoring and a target of 30 percent human observation for scientific data collection. All other observed fisheries have less than 100 percent observer coverage.

The monitoring of fishing mortality varies between sectors based on effort and prevalence of bycatch. The greatest amount of monitoring occurs in the trawl fisheries and the least in the incidental OA and recreational fisheries. See Wulff (2022) for a description of monitoring practices by sector.

Background

The SRKW DPS was listed as endangered under the ESA in 2005 (70 FR 69903, November 18, 2005), with a Final Recovery Plan released in 2008 (NMFS 2008). The final rule for the SRKW listing and the Recovery Plan identified several potential factors that may have caused their decline or may be limiting recovery. The three primary threats include quantity and quality of prey (primarily age 3+ Chinook salmon; Ford et al. 1998, Ford and Ellis 2006, Hanson et al. 2010, Ford et al. 2016, Hanson et al. 2021), toxic chemicals which accumulate in top predators, and disturbance from sound and vessel traffic. A recent 5-year review under the ESA completed in 2021 concluded that the ESA-listed SRKW DPS should remain listed as endangered and includes recent information on the population, threats, and new research and publications (NMFS 2021a). As noted in the reinitiation memo, NMFS published a final rule to revise SRKW critical habitat in 2021 (86 FR 41668; August 2nd, 2021) and this rule maintains the previously designated critical habitat in inland waters of Washington (Puget Sound; see 71 FR 69054

November 29, 2006) and expands it to include six additional coastal critical habitat areas off the coast of Washington, Oregon, and California (an additional approximately 15,910 sq. miles). The three physical or biological essential features of the newly designated critical habitat areas are identical to those identified for critical habitat designated in Puget Sound.

Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b). When evaluating whether the proposed action is not likely to adversely affect listed species or critical habitat, NMFS considers whether the effects are expected to be completely beneficial, insignificant, or discountable. Completely beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Effects are considered discountable if they are extremely unlikely to occur.

Fisheries conducted under the proposed action may affect SRKWs and their critical habitat directly, through interactions with vessels and gear, and indirectly, by reducing prey availability through bycatch of Chinook salmon (*Oncorhynchus tshawytscha*), the whales' primary prey. This section evaluates the effects of the proposed action on the SRKW DPS and its critical habitat. While the request for reinitiation focuses on the newly designated critical habitat, we have also updated the analysis for the SRKW DPS as there is new information available and a new analysis on Chinook salmon bycatch. The critical habitat effects draw from the SRKW DPS analysis related to prey. NMFS has also incorporated analyses from the 2017 Reinitiation of Section 7 Consultation Regarding the Pacific Fishery Management Council's (PFMC) Groundfish Fishery Management Plan (NMFS 2017a) as well as the recent internal NMFS report on Chinook salmon bycatch rates produced by NMFS' Sustainable Fisheries Division and Northwest Fisheries Science Center (NWFSC) (Matson et al. 2022) to inform this analysis of impacts to SRKW prey availability by the PCGFMP.

We first describe the spatial and temporal overlap of the fisheries with SRKWs to provide a context for assessing the action's effects on SRKWs and their critical habitat. Seasonal timing and general locations of the fisheries are included in the description of the proposed action. Spatial and temporal data for SRKWs include multiple data sets based on opportunistic sightings, acoustic detections, and satellite tag deployments which are considered together to provide the most comprehensive picture of SRKW movements. Second, we discuss the potential for direct effects through vessel and gear interactions. Finally, we assess the indirect effects on SRKWs from the reduction of prey by the PCGF by analyzing the short-term (annual) effects and discussing potential long-term effects. We have not identified any other potential effects from the proposed action.

1.0 Spatiotemporal overlap of the PCGF with SRKW

1.1 PCGF Action Area and Fishing Seasons

The PCGF action area includes the U.S. Exclusive Economic Zone (EEZ) and State waters of the Pacific Ocean (Washington, Oregon, and California), including the Salish Sea. As a whole, the fisheries operate primarily within 60 nm of shore near the edge of the continental shelf or 100 fathom isobath (NMFS 2017a), thereby overlapping directly with SKRW coastal critical habitat (86 FR 41668, August 2nd, 2021).

The Pacific whiting fishery accounts for a majority of the Chinook salmon bycatch, so we focus our analysis of SRKW impacts here. Most of the commercial Pacific whiting effort occurs north of the 40 degree latitude line, and is concentrated off the coast of Oregon. The at-sea whiting sector (midwater trawl) consists of the catcher-processer and the mothership sectors. The at-sea primary season runs from May 1 to December 31, or until the sector allocations are taken. However, much of the at-sea whiting fishery occurs from May to early June, and from September to November. The primary season for the Pacific whiting shoreside sector (midwater trawl) runs from May through October, with most of the harvest occurring in October (Renko 2016; Matson et al. 2022).

The non-Pacific whiting sectors include the bottom trawl and fixed gear fisheries, which target sablefish, Petrale sole, and rockfish, among others. The bottom trawl fishery accounts for the next largest component of Chinook salmon bycatch of the non-Pacific whiting fisheries. The primary season for the bottom trawl fishery occurs in the spring (March-April), with a second, lower peak in October. The primary season for the fixed gear fishery (longline, pot/trap) occurs from April to December (as now established under Amendment 30), with the primary fishery being the LEFG sablefish fishery, though other fisheries can occur year-round. Additionally, four Washington coastal tribes possess treaty rights to federally managed groundfish in their U&As within the U.S. EEZ. Tribal fisheries comprise primarily non-whiting, fixed gear fisheries, although one tribe (Makah) participates in the Pacific whiting trawl fishery. Finally, recreational fisheries occur along the coast, with a seasonal concentration of effort during the summer (July-August).

We focus our assessment of PCGF and SRKW overlap on the non-treaty at-sea and shorebased Pacific whiting fisheries given that a majority of the Chinook salmon bycatch occurs in those sectors (85%). However, we recognize that the non-whiting sectors (bottom trawl, midwater rockfish, fixed gear, and treaty) contribute a small portion of the effort and Chinook salmon bycatch in the fishery and will be discussed accordingly.

1.2 SRKW Geographic Range and Distribution

SRKWs occur throughout the coastal waters of Washington, Oregon, and Vancouver Island and are known to travel as far south as central California and as far north as Southeast Alaska (NMFS 2008; Hanson et al. 2013; Carretta et al. 2022). SRKWs are highly mobile and can travel up to 86 miles (160 km) in a single day (Erickson 1978; Baird 2000), with seasonal movements likely tied to the migration of their primary prey, salmon. During the spring, summer, and fall months, the whales spend a substantial amount of time in the inland waterways of the Strait of Georgia, Strait of Juan de Fuca, and Puget Sound (Bigg 1982; Ford et al. 2000; Krahn et al.

2002; Hauser et al. 2007). During fall and early winter, SRKWs, and J pod in particular, expand their routine movements into Puget Sound, likely to take advantage of chum, coho, and Chinook salmon runs (Osborne 1999; Hanson et al. 2010; Ford et al. 2016). On average, all three pods have been observed in inland waters more often in May/June through September (Olson et al. 2018) than at other times of year. All three pods generally remain in the Salish Sea through October and make frequent trips to the outer coasts of Washington (Ford et al. 2000; Hanson and Emmons 2010; Whale Museum unpublished data).

Although SRKW seasonal movements are somewhat predictable, there is large inter-annual variability in a) seasonal arrival time and b) days present in inland waters from spring through fall (Olson et al. 2018; see Figure 3.3 from NMFS 2021b). In recent years, SRKWs have been arriving in the Salish Sea later in the season (Ettinger et al. 2022) and have been spending fewer days inland annually (Hanson and Emmons 2010; Whale Museum unpublished data; Ettinger et al. 2022). Presence of SRKW within the central Salish Sea is tracked through a large database maintained by the Whale Museum which compiles, and evaluates for accuracy, opportunistic sightings and hydrophone detections of SRKW within inland Washington and Southern British Columbia waters from multiple sources.

We do not expect fishery impacts to SRKW prey within the Salish Sea (see Effects Section 3.1.5 and 5.0). However, we rely on this rich dataset to inform SRKW occurrence with the assumption that when the whales are not in the Salish Sea, they are likely occupying coastal waters of the U.S., and therefore potentially overlapping with the PCGF.

Recent studies have established patterns of occurrence along the U.S. West Coast when SRKW are not in the Salish Sea and the results are reviewed in the Biological Report supporting the coastal critical habitat designation in 2021 (NMFS 2021b). There have been 49 confirmed opportunistic sightings of SRKWs between 1986-2016 off the coastal areas of Washington, Oregon, and California (NMFS 2021b). Of these 49 confirmed sightings, more than half (26) occurred off the Washington coast and 9 of the 49 occurred from May to October, with no coastal opportunistic sightings in November and December (refer to Table 2.2a in PFMC 2020b). Satellite tags deployed from 2012-2016 between the months of December and May provide limited information on the potential overlap between SRKWs and the PCGF. The tagging effort showed that K/L pods occurred almost exclusively on the continental shelf during that time, primarily on the Washington coast, with a hot spot area between Grays Harbor and the Columbia River and off Westport with peak detections in spring months (NMFS 2021b; Hanson et al. 2017, 2018). Conversely, J pod remained primarily in the Salish Sea during that time. Additionally, there were acoustic detections of SRKWs off the Washington coast in all months of the year (refer to Figure 2.2g in PFMC 2020b; also see Emmons et al. 2021), suggesting that SRKWs may be present in Washington coastal waters at nearly any time of year, and in other coastal waters more often than previously believed (Hanson et al. 2013, 2017, 2018). However, in some years there is a concentration of detections between February and May, as well as primarily nearshore sites as compared to midshelf and offshore locations (Emmons et al. 2021). Further, K and L pods have also been detected via acoustic recordings off the coast of Oregon in January-March, May, and December, and off the coast of California in January, February, May, and December (Hanson et al. 2013; NWFSC unpubl. data).

SRKWs have also been observed in Canadian coastal waters in recent years when not in the Salish Sea. Of 72 total opportunistic coastal sightings of SRKWs from 1982-2016, 19 occurred off the coast of British Columbia. These primarily occurred April-October, with one sighting in December and January each.

1.3 Predicted overlap

As described above, much more is known about SRKW spatiotemporal patterns in the Salish Sea than in coastal waters, primarily during the summer months. These data can inform us of when SRKWs are not in coastal waters, with the conservative assumption that when SRKWs are not encountered in the Salish Sea, they are instead occupying U.S. coastal waters of the PCGF action area (primarily for K and L pods; see Effects Section 1.2). That said, it is possible that when SRKWs are not occupying the Salish Sea or U.S. coastal waters of the action area, they may instead be in Canadian waters (e.g. southwest Vancouver Island). Given the large inter-annual variability in the SRKW seasonal distribution, we cannot predict the whales' movements in future years. Therefore, we take a conservative approach and assume that SRKWs, particularly K and L pods, will likely have more years where they spend less time in the Salish Sea (similar to what has been observed in recent years since 2017; Olson et al. 2018; Ettinger et al. 2022), and more time in the U.S. coastal waters of the action area where the potential for overlap with the PCGF may occur.

To assess overlap between SRKWs and the PCGF, we used three geographic strata: the U.S. EEZ north of Cape Falcon ("North of Falcon" or NOF), the area between Cape Falcon and Cape Blanco, and the area between Cape Blanco and Cape Mendocino (see Figure 1 in the Proposed Action and Action Area section above). South of Cape Mendocino we do not expect predictable overlap between the PCGF and SRKW because current data suggest SRKWs spend little time in that area, and because Chinook salmon bycatch is minimal and uncertain in that area.

It is likely that the whales could occur in the NOF area during the Pacific whiting fishing season (typically May-June and August-December) because the whales have been detected or observed in this area in every month of the year (see Effects Section 1.2). However, peak SRKW detections in the NOF region occur in the late winter and spring months with large inter-annual variability, so direct overlap with the fishery may be low and variable. It is also reasonable to assume that overlap may be minimal with the PCGF, given both are targeting different species available in the area. As discussed above, the at-sea whiting effort is bimodal with a peak in May and October, with the majority of Chinook salmon bycatch occurring from August-December (but focused in October). We assume the highest potential of impact to SRKWs by the at-sea whiting sector would occur late in the season, given the highest bycatch and reduced SRKW occurrence in the Salish Sea during this time, and coastal detections from satellite tags during December. The shorebased whiting effort is typically highest in September-October and therefore may have lower potential of direct overlap with SRKWs as compared to the at-sea sector, as SRKWs typically occupy the Salish Sea during this time. Further, salmon bycatch in the whiting sectors tends to occur primarily near the continental shelf and deeper offshore areas, whereas bottom trawl activity tends to occur in more nearshore areas (see NMFS 2017 Figures 1-4, 1-5, and 1-6). There may be higher potential for direct overlap of SRKWs and the bottom trawl fishery, given higher prevalence of both in nearshore areas and the spring season peak. Similar to the whiting sectors, the fixed gear sablefish fisheries tend to occur in deeper (greater

than 80 fathoms) and offshore areas where SRKW are less likely to occur (Emmons et al. 2021; NMFS 2021b).

Most of the PCGF whiting effort occurs on the coast of Oregon (Cape Falcon to Cape Blanco); however, we expect less overlap with SRKW in that region given that only 12 of the 72 total opportunistic sightings have occurred in that region, and acoustic detections place SRKWs primarily in Washington coastal waters (including northern Oregon near the Columbia River) in the NOF region. Some PCGF whiting effort also occurs on the northern California coast (Cape Blanco to Cape Mendocino). Of the 72 total opportunistic sightings of SRKWs, 15 have occurred in California. The sablefish fixed gear fisheries occur in Washington, Oregon, and California. We will summarize trends in Chinook salmon bycatch in these regions (Section 3.2), and weigh those potential impacts accordingly in our final determination.

In summary, results from opportunistic sightings, satellite tagging, and acoustic recorders suggest SRKWs may be present in Washington coastal waters at nearly any time of year (Hanson et al. 2017, NMFS 2021b; also see Effects Section 1.2), although the available data are limited and there can be large inter-annual variability in the distribution and time spent in coastal waters. While there has been less research effort on the Oregon and California coasts, we know that SRKWs, particularly K and L pods, do occur there in the winter and spring months. Therefore, there is the potential that SRKWs may overlap with the PCGF in any particular year in any particular location on the U.S. West Coast. Although there is limited information on the exact locations of the fishing vessels and SRKWs when the whales are in coastal waters, and the vessels are likely spread out, we can assume that in years when the whales spend less time in the Salish Sea, there may be an increased likelihood of an overlap between PCGF vessels and SRKWs in the U.S. coastal waters of the action area. Given that SRKWs have been observed less often in the Salish Sea in spring months compared to summer months, and peak acoustic detections in the NOF area have occurred in spring months, we assume the whales are more likely to be in coastal areas in spring months than in summer months and that is the most likely period when SRKWs and fisheries may co-occur or overlap. However, given the higher bycatch rates in the fall and early winter months, we give that time period scrutiny as well.

2.0 Direct effects: vessel and gear interactions

Fisheries may potentially affect killer whales directly through several mechanisms, including vessel collisions, physical disturbance, acoustic disturbance, entanglement in nets or lines, and pollution from exhaust or spills. Vessel traffic and fishing effort associated with the proposed action are anticipated to be similar to past levels over the broad expanse of the West Coast, and fishing vessels and gear would have a short-term presence in any specific location. Given the relatively low potential for overlap between the fisheries and SRKWs (described above), the slow-moving and transitory nature of fishing vessels, and that the fisheries and SRKW target different species, the risk of direct impacts due to vessels and gear is extremely low. Further, there is no potential for direct vessel or gear effects on SRKWs when the whales occur in the Salish Sea or the coastal waters of Canada because the PCGF does not operate there. Vessel strikes or reports of entanglement for killer whales are rare and have not been observed in association with the PCGF and are therefore considered extremely unlikely for all gear types in this fishery, including trawl, pot/trap, longline, hook and line. While sablefish pot/trap gear poses a known risk to humpback whales due to a record of entanglement and spatiotemporal overlap (NMFS 2020), no

killer whales have been reported to be entangled in PCGF pot/trap gear, and above we describe the minimal overlap between SRKW and the fishery. However, given that killer whales worldwide are known to remove fish caught on longline hooks (a gear type included under the PCGFMP), potentially making them more susceptible to entanglement or other types of human-interaction, here we further consider potential gear effects.

Broadly, killer whale interactions with fishing gear have been observed and are well documented (e.g. Yano and Dalheim 1995; Dahlheim et al. 2022); however, entanglements are rare (for a summary of known killer whale fishery interactions on the West Coast, see Section 2.4.3 in NMFS 2022). A recent report summarized PCGF killer whale sightings and interactions through the West Coast Groundfish Observer Program (WCGOP) (Jannot et al. 2022). There were 71 killer whale interactions and 588 sightings from 2002-2019, all of which occurred in Southern California (no ecotype identified), and none of which resulted in mortality or serious injury (Jannot et al. 2022). There are no documented interactions of SRKW with PCGF vessels or gear from observer programs or the stranding network.

Fatal fisheries interactions are infrequent for all killer whales (see Raverty et al. 2020), and the majority of reported killer whale entanglements to date that have been identified on the West Coast are from the transient ecotype (including a recent entanglement in unidentified gear on the coast of Oregon, which was not recovered but identified genetically as a transient killer whale through tissue remaining on the ropes; Kim Parsons, pers. comm.). While there is a potential for undetected cases, the known total fishery mortality and serious injury for SRKWs is zero (Carretta et al. 2022).

NMFS, through its List of Fisheries (LOF), monitors and categorizes bycatch of marine mammals in all U.S. commercial fisheries according to relative risks of mortality and serious injury (M/SI)[6]. The LOF lists the fisheries by categories (I, II, and III) according to the relative levels of interactions (frequent, occasional, and remote likelihood of interaction or no known interactions, respectively) with marine mammals. Commercial fishers in all categories participating in U.S. fisheries are required to report incidental marine mammal injuries and mortalities (with the exception of tribal treaty fisheries, but tribes often voluntarily report such interactions). The current LOF classifies the "WA/OR/CA sablefish pot" fisheries as Category II fisheries (i.e., occasional interactions that result in M/SI) due to incidental takes of humpback whales (87 FR 23122, April 19, 2022). The remaining fisheries within the PCGFMP are classified as Category III fisheries (i.e. remote likelihood of, or no known, interaction).

Entanglements of marine mammals in fishing gear must be reported in accordance with the MMPA. MMPA Section 118 established the Marine Mammal Authorization Program (MMAP) in 1994. Under MMAP all fishers are required to report any incidental taking (injuries or mortalities) of marine mammals during fishing operations. Any animal that ingests fishing gear or is released with fishing gear entangled, trailing, or perforating any part of the body is

[6] Marine mammals stocks are defined under the MMPA, which may not necessarily coincide with ESA-listed populations of marine mammals.

considered injured, and must be reported[7]. While depredation has been observed in the Northern Resident killer whale population (Muto et al. 2022), this behavior has not been reported or observed in the SRKW population. Nonetheless, we plan to continue monitoring efforts in the PCGF with observer programs, which will allow us to identify a problem early on if SRKW depredation starts. Based on the low potential for direct overlap of PCFG vessels and SRKW and that no such interaction has ever been observed in association with the PCGF, it is extremely unlikely that the proposed action will result in interactions with SRKWs; potential direct effects are, therefore, discountable.

3.0 Indirect effects: prey reduction

We evaluated the potential indirect effects of the PCGFMP on SRKWs based on the best available science regarding the whales' diet and distribution and the reduction in Chinook salmon caused by the PCGF. Along with other available information, we relied on the 2017 biological opinion for Chinook salmon (NMFS 2017a) as well as the recent NMFS report on Chinook bycatch prepared to support this evaluation (Matson et al. 2022). Similar to past biological opinions where we assessed the effects of salmon fisheries on SRKWs (NMFS 2019, 2021c, 2022), our analysis of the continued operations of the PCGFMP focuses on effects to Chinook salmon availability because the best available information indicates that SRKWs prefer Chinook salmon (as described below in Effects Section 3.1). Additionally, this approach provides a conservative estimate of potential effects of the action on SRKWs because the total abundance of all salmon and other potential prey species is orders of magnitude larger than the total abundance of Chinook salmon. This analysis considers whether effects of PCGF prey reduction may impact the fitness of individual whales or affect survival and recovery.

To date, the available data and analyses have not supported an analytical approach that statistically quantifies effects of changes in Chinook salmon abundance to SRKW survival and recovery (i.e., mortality and reproduction). However, please see NMFS 2021c and NMFS 2022 for a detailed description of recent work by an Ad Hoc Workgroup under the PFMC focused on the relationship between Chinook salmon abundance and SRKW demographics (PFMC 2020b). In the absence of a predictive analytical tool to evaluate this relationship, we use a weight-of-evidence approach to consider all of the information we have--identifying a variety of metrics or indicators with varying degrees of confidence (or weight)--in order to assess the impacts of the proposed action for the foreseeable future. We evaluated the potential annual effects as well as time-lagged and long-term effects of changes in prey availability from the proposed action described further below.

3.1 Annual effects

Here we assessed the short-term (or annual) effects of the proposed action on prey availability by assessing patterns of Chinook salmon bycatch attributed to the PCGF over the last 10 years (2011-2020), with some recent data from 2021. We also considered information to help put bycatch in the context of potential impacts to the SRKW prey base, such as bycatch geographic and temporal trends and age and genetic distribution of Chinook salmon bycatch. We conducted

[7] Reporting requirements and procedures at 50 CFR 229.6; see https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-authorization-program#reporting-a-death-or-injury-of-a-marine-mammal-during-commercial-fishing-operations.

this weight-of-evidence approach using the following steps: (1) consider the coastwide average and maximum annual Chinook salmon abundance reductions by sector over the last 10 years, (2) assess the spatial and temporal distribution of Chinook salmon bycatch by sector, and (3) assess the age and genetic distribution of Chinook salmon bycatch by geographic area and sector. In this short-term analysis, we assume that the range of Chinook salmon bycatch experienced from 2011-2021 is likely representative of the range of bycatch we expect to see in future years under the PCGFMP. This ten year timeframe reflects the range of fishing activity expected in the PCGF described in the proposed action, particularly for Pacific whiting, as this timeframe includes both high abundance and low abundance years. Additionally, the trawl sectors of the PCGF are managed in catch share programs where participation is capped, so effort is relatively static year to year, and we expect the analysis provided here is applicable to future effort under the proposed action.

3.1.1 Coastwide annual reductions in prey abundance

Over the last 10 years, the PCGF has taken an average of 7,032 Chinook salmon per year as bycatch across all sectors, with a low of 3,156 in 2020 (due to COVID-19 impacts to fishing) and a high of 15,262 in 2014 (Figure 1) (also see Table 1 from Matson et al. (2022)). These totals include all ages of Chinook salmon, including younger fish that are less frequently targeted by SRKW as discussed below (Effects Section 3.1.4). The whiting sectors (catcher-processor, mothership, and shorebased whiting) account for an average of 85% of the total bycatch, with an annual average of 6,053 Chinook salmon caught per year. The bottom trawl sector accounts for an average of 8% of the total bycatch, with an annual average of 475 Chinook salmon caught per year, but in some years catching up to or approximately 1,000 Chinook salmon (see Table 1 from Matson et al. 2022).

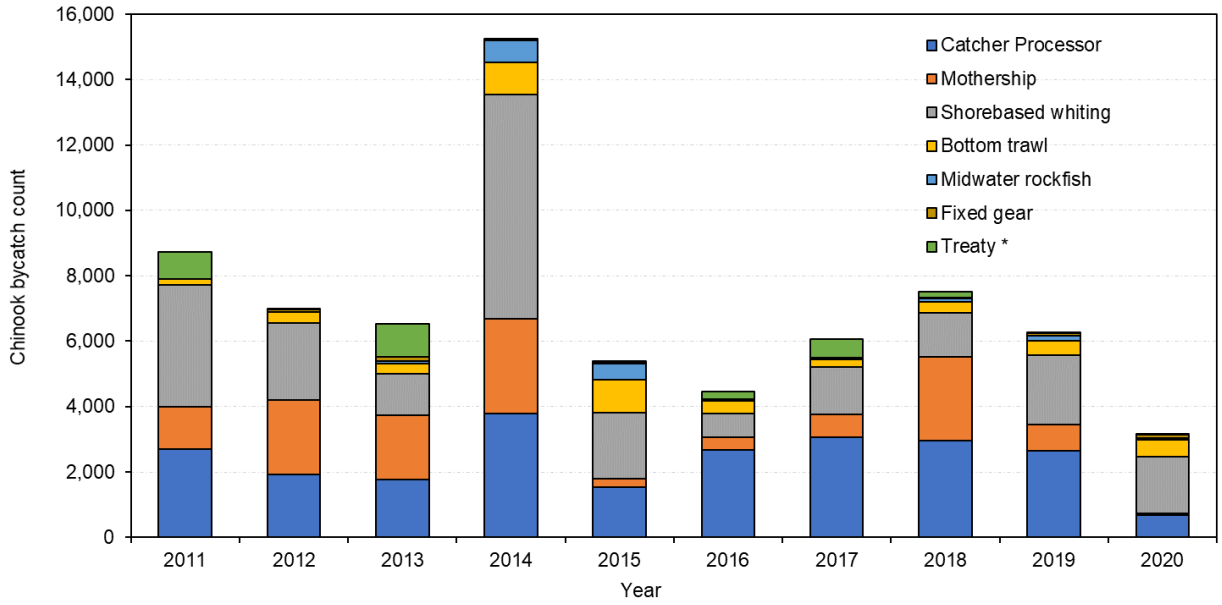

Figure 1. Chinook salmon bycatch in groundfish fisheries from 2011 to 2020, with annual distribution among sectors. Figure from Matson et al. (2022), recreated from Matson and Hooper 2021. *Treaty bycatch from 2011-2015 includes whiting only (bottom trawl values were unavailable during that period), and from 2016 forward includes whiting plus bottom trawl.

The regulations implementing PCGFMP at 50 CFR 660 establish a guideline on the amount of Chinook salmon bycatch allowed in the PCGF (see NMFS 2017a and PFMC 2022). For the whiting sectors, the guideline is 11,000 Chinook salmon, and for the bottom trawl, midwater non-whiting, LE and OA fixed gear, and recreational fisheries the guideline is 5,500 Chinook salmon (NMFS 2017a). If this guideline is exceeded, fisheries may have access to a Reserve of additional bycatch (3,500 additional Chinook) if certain management measures have been in place (NMFS 2017a). In the last 16 years, the fisheries have exceeded the salmon guideline twice, with 13,240 Chinook caught in 2005 (Renko 2016) and 15,262 caught in 2014 (Matson et al. 2022). There are several explanations for the high variability in Chinook salmon bycatch rates across years, including fishery effort and attainment, seasonality, depth, and latitude, with significant interannual variation and no clear emergence of "hot spots" (Matson and Hooper 2021). Additionally, a recent study identified a potential novel predictor of extreme bycatch events (EBCEs), which appeared to occur with decreasing severity and likelihood at higher rates of groundfish landings per unit effort (Matson and Hooper 2021). Given the occurrence of these events in the past, it is probable that they may happen in the future. Using "likely" bycatch rates (up to the 80^{th} quantile), conservative modeling scenarios from the 2017 salmon biological opinion suggest that, if a more northerly distribution of the whiting fleet occurs, then exceedance of the salmon guideline is unlikely to occur (NMFS 2017a). However, using the same bycatch rates but assuming a more southerly distribution of the whiting fleet, exceedance of the salmon guideline could occur more frequently (NMFS 2017a). Under the more southerly scenarios, the bycatch is expected to occur in the area between Cape Falcon and Cape Blanco (NMFS 2017a, c). As described above, although this region is important critical habitat for SRKW, potential impacts in this region present less concern to SRKW than other regions, and are weighted less heavily in this weight-of-evidence approach. For the purposes of this analysis and as described in the proposed action and elsewhere, we assume that the fisheries would be managed to stay within the bycatch guidelines, and thus the Reserve would be accessed only as a safety net to minimize disruption to the fishery where actions that were already actively being taken to reduce bycatch were insufficient (i.e., "the Reserve would not be an entitlement or a de facto increase in the guidelines…") (NMFS 2017a). While years of extremely large bycatch events, particularly in the NOF region, could potentially present concern for SRKW, there are extensive in-season measures for monitoring salmon bycatch and mechanisms to avoid exceedance of the thresholds if projected (see NMFS 2017a Terms and Conditions for further details).

3.1.2 Geographic distribution of bycatch

We summarized patterns of Chinook salmon bycatch using the three geographic strata described in Effects Section 1.3: north of Cape Falcon (NOF, representing the Washington coast), Cape Blanco to Cape Falcon (representing the Oregon coast), and Cape Mendocino to Cape Blanco (representing the northern California coast). Across all sectors, most of the Chinook salmon bycatch occurs in Oregon from Cape Blanco to Cape Falcon (this analysis; also see Matson and Hooper 2021), with variation among sectors. The at-sea whiting sectors take close to 2,000 Chinook salmon per year off the Oregon coast, with much lower bycatch rates in NOF or off of the northern California coastline (Figure 2) (see Table 2 from Matson et al. (2022)).

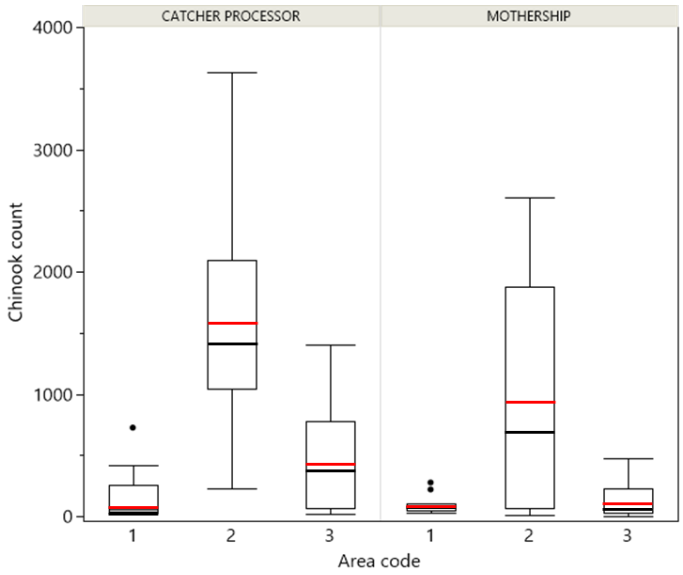

Figure 2. Boxplots of annual means (red lines), medians (black lines), interquartile ranges (IQR, boxes), min and max values, for annual Chinook bycatch counts in the **catcher-processor** and **mothership** at-sea whiting sectors, between 2011 and 2021. Variability shown is among years. Area ranks (x-axis) are from North to South: 1 = North of Cape Falcon, OR, 2 = Cape Falcon, OR to Cape Blanco, OR, 3 = Cape Blanco, OR to Cape Mendocino. Figure from Matson et al. (2022).

The shorebased whiting sector takes approximately 1,000 Chinook salmon per year in NOF and off the Oregon coast, with much lower bycatch rates in northern California (Figure 3) (see Table 5 from Matson et al. (2022)).

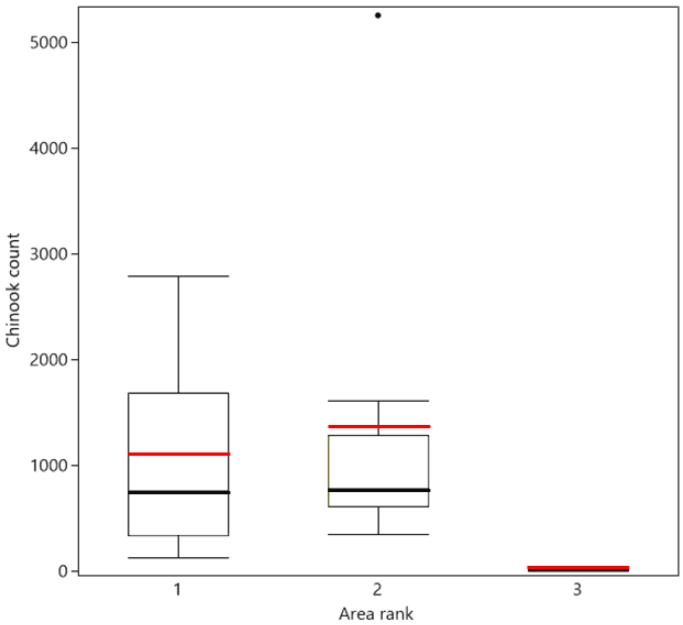

Figure 3. Boxplots of annual means (red lines), medians (black lines), interquartile ranges (IQR), minimum and maximum values, for annual Chinook bycatch counts in the **shorebased whiting** sector (including both human and electronic observation), by area, in the West Coast bottom trawl Fishery, between 2011 and 2020. Variability shown is among years. Area ranks on the x-axis are from North to South, as follows: 1 = North of Cape Falcon, OR, 2 =

Cape Falcon, OR to Cape Blanco, OR, 3 = Cape Blanco, OR to Cape Mendocino, CA. Combined area metrics from source report not shown here. Figure from Matson et al. (2022).

By contrast, the bottom trawl sector takes approximately 100 Chinook salmon as bycatch in each of the three areas per year, contributing relatively little to the overall bycatch rates in the PCGF, even in higher outlying years (Figure 4) (see Table 9 from Matson et al. (2022)).

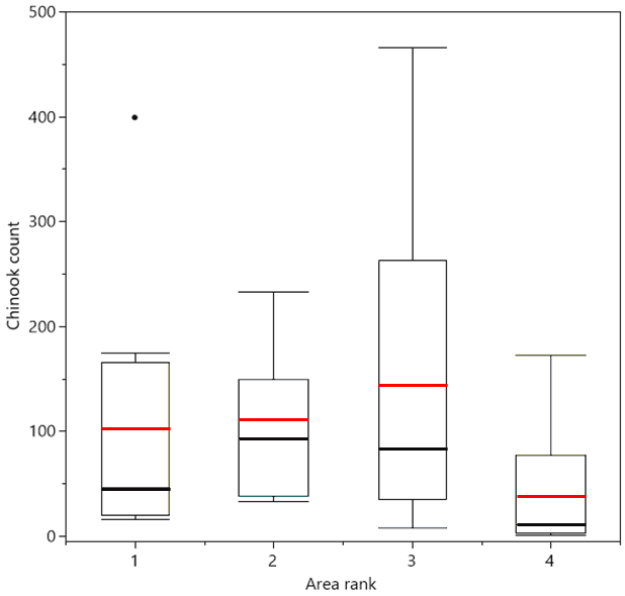

Figure 4. Boxplots of annual means (red lines), medians (black lines), interquartile ranges (IQR), minimum and maximum values, for annual Chinook bycatch counts using **bottom trawl** gear, by area, in the West Coast bottom trawl Fishery, between 2011 and 2020. Variability shown is among years. Area ranks on the x-axis are from North to South, as follows: 1 = North of Cape Falcon, OR, 2 = Cape Falcon, OR to Cape Blanco, OR, 3 = Cape Blanco, OR to Cape Mendocino, CA, and 4 = South of Cape Mendocino, CA. Figure from Matson et al. (2022).

As seen in the boxplots above, there is significant year-to-year variation in the amount of bycatch that occurs in the PCGF. However, for any one sector, bycatch in a single region has stayed below 4,000 fish in a year. Thus, while total bycatch is generally under 8,000 fish and has reached over 11,000 fish in limited cases, the bycatch is spread across the U.S. West Coast, with generally the most bycatch occurring in the Cape Blanco to Cape Falcon region.

As described in Effects Section 1.2, much has been learned about the SRKW coastal distribution since the last ESA consultation for the PCGF in 2012. Previous work has established the NOF region as important SRKW habitat. Most coastal sightings of SRKW are along the Washington coast, and acoustic recorders and satellite tags have identified strong site fidelity for this region. As such, emphasis has been placed on this area in recent fisheries management measures. For example, in 2021 the PFMC adopted a new amendment (Amendment 21) to their Fishery Management Plan (FMP) to address effects of Council-area ocean salmon fisheries on the Chinook salmon prey base of SRKWs. The amendment was based on recommendations from a Workgroup charged with conducting a risk assessment to assess the effects of ocean salmon fisheries on SRKWs and proposing conservation measures or management tools to limit impacts to the prey base (PFMC 2020b). As adopted, Amendment 21 establishes a threshold representing a low pre-fishing Chinook salmon abundance in the NOF area (including the EEZ and state

ocean waters), below which the Council and States will implement specific management measures (NMFS 2021c). Although all coastal critical habitat areas are important to consider for the SRKW prey base, we weigh impacts in the NOF region more heavily given their more frequent and longer term residence in that area. See Tables 1C and 2C below for a breakdown of Chinook salmon bycatch counts for the last 10 years by region for the at-sea and shorebased whiting sectors.

3.1.3 Seasonal distribution of bycatch

There is significant seasonal variation in Chinook salmon bycatch attributed to the PCGF. In the at-sea whiting sectors, there is a bimodal distribution of bycatch, with a small peak in the late spring, and a larger peak (containing most of the bycatch) during the late fall/early winter months (Figure 5). As such, the cumulative bycatch accumulation curve tends to stay relatively low until late September when it exponentially increases until the end of the year (Figure 6, bottom boxes). The rate of Chinook salmon bycatch throughout the year is a function of whiting attainment, which shows a similar trend of stagnation during the summer months (when the fleets direct effort towards the Alaska Pollock fishery) and exponential accumulation during the latter part of the year (Figure 6, top boxes). However, nearly half of the whiting attainment occurs in the earlier part of the year, suggesting higher salmon bycatch rates per metric ton of whiting in the latter part of the year.

Due to confidentiality requirements, bycatch rates in the shorebased whiting and bottom trawl sectors are summarized by season rather than by month, with broadly defined "summer" months comprising May-October and "winter" comprising November-April. Chinook salmon bycatch in the shorebased sector occurred predominantly during the summer months (87 percent of annual), while operating year-round with relatively consistent effort (Figure 7). The underlying seasonal distribution is similar to the at-sea sectors, with October being a typical peak month for Chinook bycatch counts and rates among all three whiting sectors (Renko 2016). By contrast, bycatch in the bottom trawl sector occurred predominantly during the winter season, with more variation across years (Figure 8).

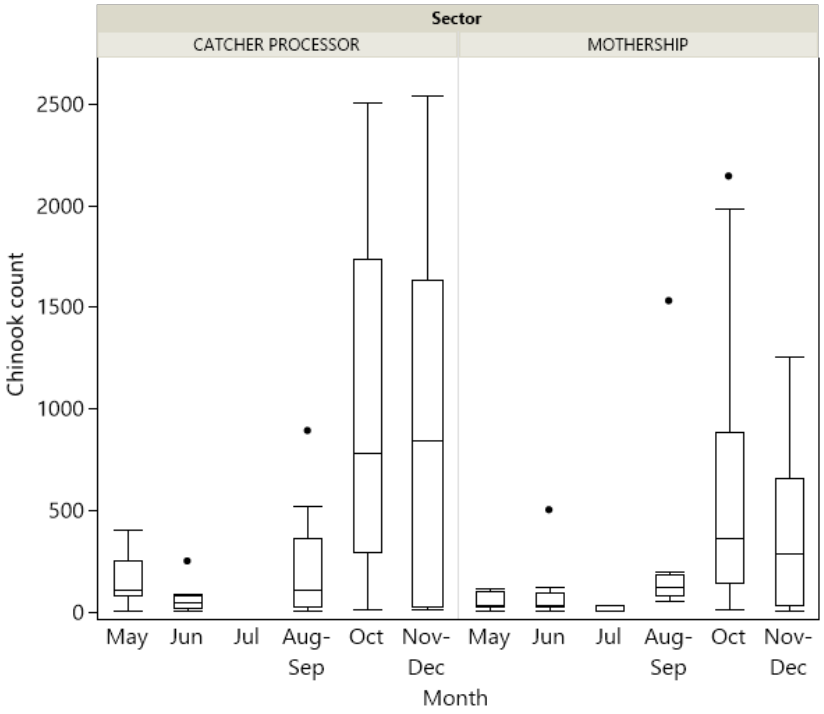

Figure 5. Boxplot of seasonal (monthly) Chinook bycatch in the **catcher-processor** (CP) and **mothership** (MS) at-sea whiting sectors, over years 2011-2021, showing median and IQR for each year and season, with variation among areas. Figure from Matson et al. (2022).

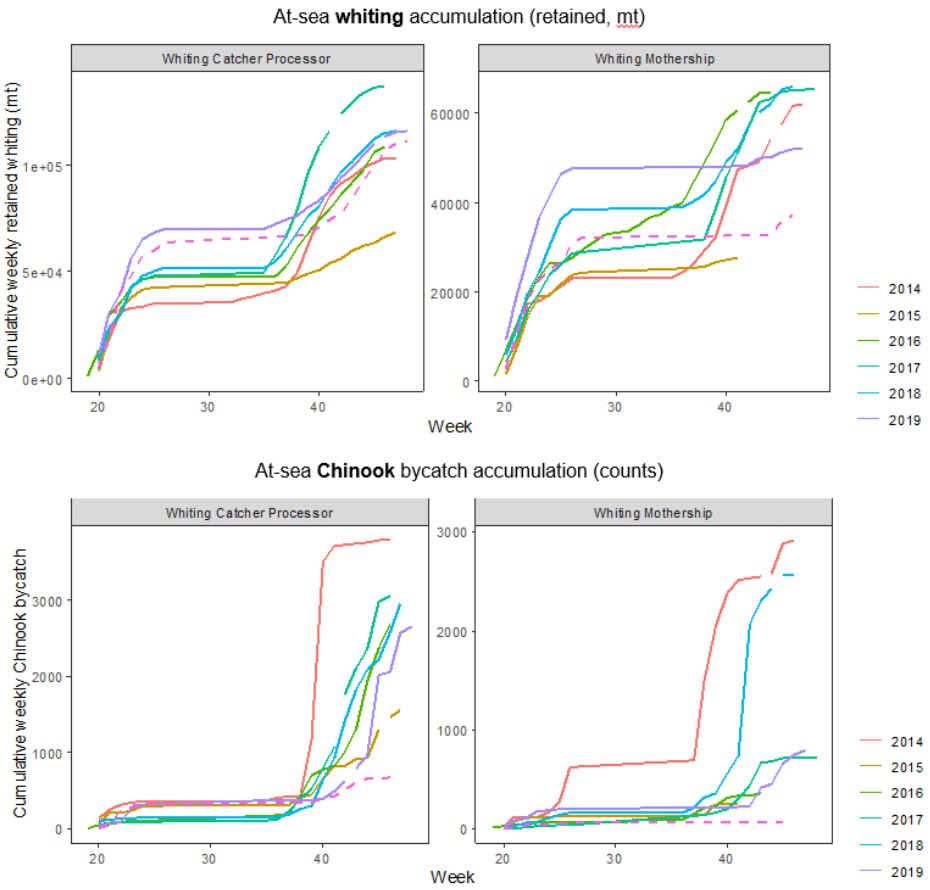

Figure 6. Accumulation curves among years show different temporal patterns for whiting catch and Chinook bycatch in the **at-sea**, non-treaty sectors from 2014-2020. The x-axis is represented by weeks of the year, with week 20 falling in mid-May and week 40 falling in early October. The bulk of Chinook bycatch appears to occur in the second wave of fishing effort, even though the first wave often takes roughly half the whiting for the year. Year 2020 is represented by the pink dashed line (reprinted from Matson and Hooper 2021, internal NMFS WCR report).

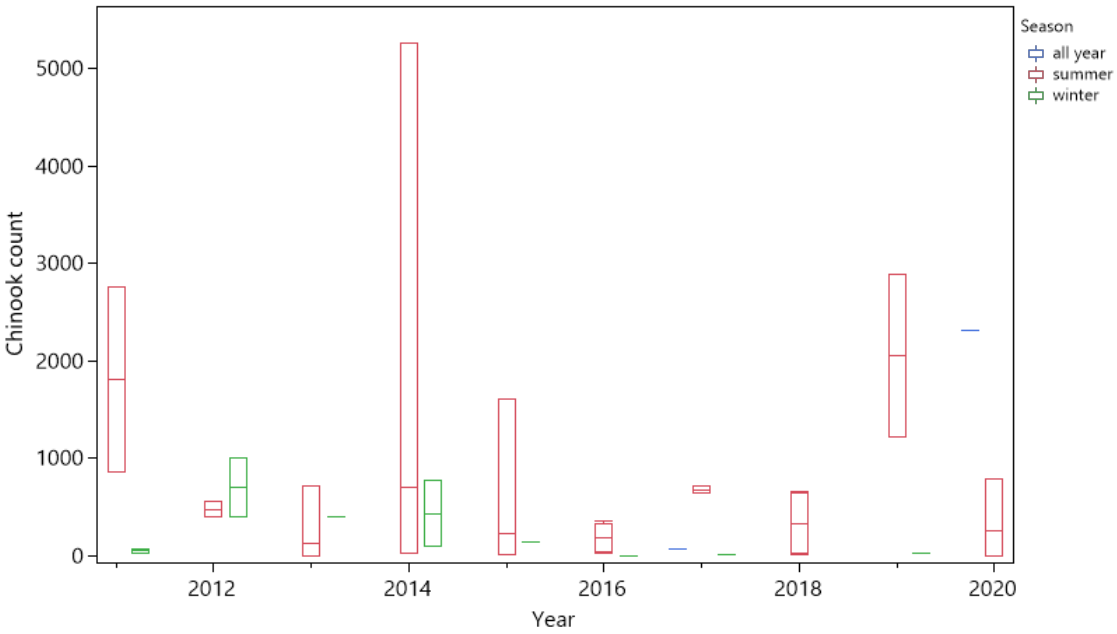

Figure 7. Boxplot of Chinook bycatch in the **shorebased** whiting sector, showing median and IQR for each year and season, with variation among areas. This expression of seasonality is influenced by wide, two-season bin boundaries in annual reports to efficiently manage confidentiality requirements across sectors. Blue lines show median Chinook count all year (could not be stratified), only for the Cape Blanco to Cape Mendocino area (only in 2017 and 2020); this conciliatory aggregation of seasons was made in the FOS report to preserve confidentiality. Figure from Matson et al. (2022).

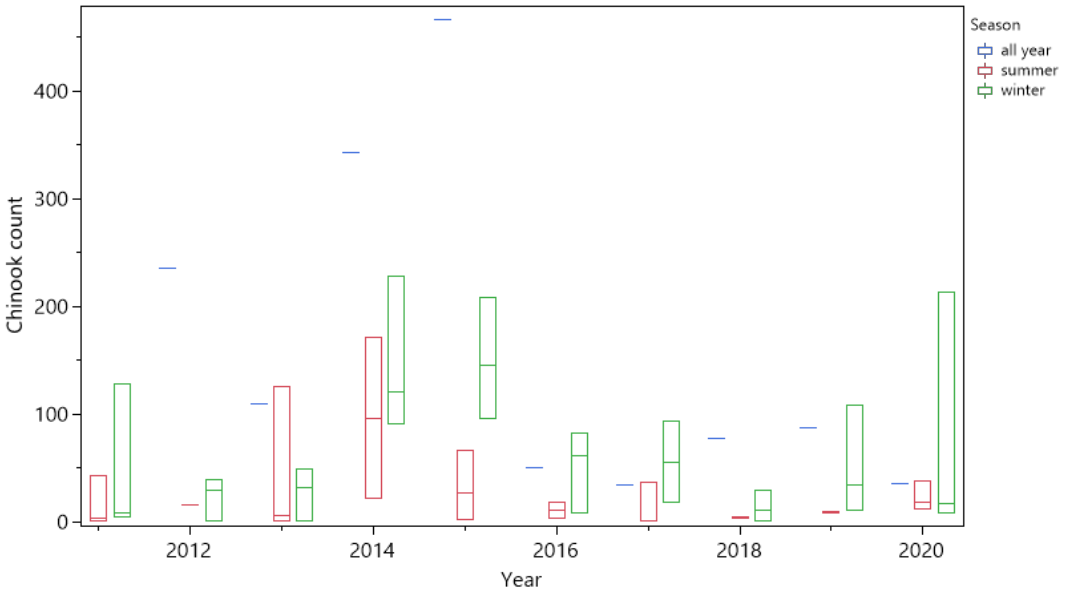

Figure 8. Boxplot of Chinook bycatch in the groundfish **bottom trawl** sector, showing median and IQR for each year and season, with variation among areas. Median Chinook count is consistently higher, to varying degree, in winter over summer, consistent with previous reports. The blue lines show median Chinook count all year, only for the Cape Blanco to Cape Mendocino area; this conciliatory aggregation of seasons was made in the FOS report to preserve confidentiality. Figure from Matson et al. (2022).

As discussed in Effects Section 1.2, in general, SRKWs occupy the Salish Sea during the summer and fall months and coastal waters during the winter months. Overlap with the PCGF is

most likely to occur during the winter and early spring months when SRKWs spend more time on the coast, particularly in the NOF region. With most of the Chinook salmon bycatch occurring in October, the impact of prey removal is anticipated to be minimal, given that SRKWs are often found in the Salish Sea during this time. However, given that SRKWs have been detected on the Washington coast in all months of the year, there is the possibility of overlap with the fishery at any time during the year, albeit with expected minimal impact given the relatively low numbers of Chinook salmon bycaught in this area. Given the low number of overall Chinook salmon taken by the PCGF, removals are unlikely to be experienced or detected by SRKWs later in time, even if they transit fishery areas following prey removal via bycatch.

3.1.4 Age distribution of bycatch

Chinook salmon aged 3+ are the preferred prey of SRKWs (Ford et al. 1998, Ford and Ellis 2006, Hanson et al. 2010, Ford et al. 2016, Hanson et al. 2021), and it has been previously reported that a majority of Chinook salmon bycatch in the PCGF shorebased whiting sector are younger, i.e. subadults or juveniles (NWFSC 2012, NMFS 2012). In a recent report developed to support the analysis for this consultation, Matson et al. (2022) provide an updated assessment of the age distribution of Chinook bycatch in the dominant groundfish fishery sectors for the last 10 years, and here we focus on bycatch of age 3+ Chinook salmon. For a discussion of potential long-term impacts from bycatch of subadults and juveniles, see Effects Section 3.2.

Matson et al. (2022) used fork lengths from Chinook salmon bycaught in the at-sea whiting fishery from 2012 to 2021 (collected for biological sampling by the WCGOP) to predict age in months using the von Bertalanffy growth function (VBGF) and stock aggregate parameter values provided in McHugh et al. (2015). For each of the three geographic regions, Matson et al. (2022) weighted the stock-specific predicted ages according to model-based proportional ESU/stock composition distributions using values adapted from Moran et al. (2021) (see Matson et al. 2022 Appendix) for each geographic region. Here we report the proportion of sampled fish determined to be 36 months old or greater, which is expected to be the target prey age range for SRKW. For a full description of the methods and area-specific ESU/stock compositions, please see Matson et al. (2022).

Overall, from 2012 to 2021, age 3+ Chinook salmon bycatch in the at-sea sectors ranged from 1.1% to 84.1%, with considerable spatial variation across the three geographic regions (Table 1A). Mean estimated proportions of age 3+ bycaught Chinook were considerably (10x) higher in the NOF region (0.362), compared with either the area between Cape Falcon and Cape Blanco (0.032), or south of Cape Blanco (0.063). At the same time, annual Chinook bycatch counts showed an opposite pattern, with median and mean annual bycatch counts that are between 10 and 20 times smaller in NOF than the area between Cape Falcon and Cape Blanco (Effects Section 1.3.2, Table 1C). The combination of these two opposing spatial patterns means that the comparatively large proportion of 3+ year old Chinook in at-sea bycatch in the NOF region still results in a low number of age 3+ fish that were bycaught (e.g., average of 56.8 per year, see Table 1D). Therefore, though the proportion of age 3+ in the bycatch can be greatest in NOF, this coupled with the smaller overall bycatch values compared to other regions, leads to similar age 3+ bycatch counts across the three geographic regions (Table 1D).

In the shorebased whiting sector, from 2012 to 2021, age 3+ Chinook salmon bycatch ranged from 2.7% to 69.5%, with similarly higher mean proportions of adults caught in the NOF region (0.293) as compared to the area between Cape Falcon and Cape Blanco (0.111) (Table 2A). This amounts to an average of 177.7 (NOF) and 134.6 (Cape Falcon to Cape Blanco) age 3+ fish taken as bycatch per year.

Coastwide, the whiting sectors of the PCGF take approximately 480 age 3+ Chinook salmon per year (excluding shorebased whiting bycatch from the South of Blanco region due to data limitations) (Tables 1D and 2D). While the amount, proportion of age 3+, and geographic location of Chinook salmon bycatch is variable across years and can be relatively high in some years (Figure 1, Tables 1-2), we expect future bycatch to be within the range analyzed here.

For context, in the NOF region from 2012 to 2020, an annual average of 240 age 3+ Chinook salmon were bycaught in the at-sea and shorebased whiting sectors combined, with a low of 123 and a high of 394. This is an extremely small amount of prey relative to the total amount of Chinook salmon available to SRKW in the NOF region. For example, using the Fishery Regulation Assessment Model (FRAM) used by the PFMC to estimate fishery-dependent ocean abundances of Chinook salmon (PFMC 2008), we estimated the pre-fishing abundance of age 3-5 Chinook in the NOF region from 2012-2018 (FRAM base period Round 7.1.1, March 2022). On average, there was approximately 970,967 adult Chinook available to SRKW in NOF, ranging from a low of 662,003 to a high of 1,324,310. That means that the prey reduction attributed to the whiting sectors of the PCGF in the NOF region amounted to 0.011% - 0.037% of prey removed per year from 2012-2018. It should be noted that these are approximate, static values of abundance that do not take into account fishing mortality nor change in abundance over time. However, we believe it accurately represents the relatively small number of age 3+ Chinook salmon taken as bycatch compared to the approximate availability of prey to SRKW in the NOF region.

Table 1. Proportion of bycaught Chinook salmon, sampled from the **at-sea** whiting fishery, by year and area, (A) estimated to be at or greater than 36 months predicted age with summary metrics of central tendency and variability, (B) numbers of fish sampled for biological data per area and year, (C) Chinook bycatch counts by area and year, and (D) estimated counts of fish age 36 months or greater (D=A*C). Table from Matson et al. (2022); see Methods section for further details on age estimations.

A. Proportion of sampled fish estimated to be at or greater than 36 months predicted age.

Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Median	Mean	Stdev	CV
N. of Falcon	0.267	0.382	0.587	0.422	0.841	0.259	0.156	0.144	0.400	0.159	0.325	0.362	0.220	60.9%
Falcon to Blanco	0.031	0.033	0.031	0.045	0.104	0.022	0.018	0.012	0.012	0.014	0.027	0.032	0.027	85.2%
S. of Blanco	0.164	0.037	0.079	0.054	0.107	0.020	0.017	0.011	0.011	0.127	0.046	0.063	0.054	86.7%

B. Numbers of fish sampled for biological data per area and year.

Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Median	Mean	Stdev	CV
N. of Falcon	250	77	33	72	60	68	229	116	41	19	70	97	80.10	83.0%
Falcon to Blanco	1746	1140	2176	455	647	1541	1585	1082	141	522	1111	1104	656.73	59.5%
S. of Blanco	20	325	189	224	733	102	742	230	224	57	224	285	255.28	89.7%

C. Chinook bycatch counts by area and year.

Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Median	Mean	Stdev	CV
N. of Falcon	468.2	166.6	75.6	120.4	119.0	164.0	407.0	253.3	81.2	55.0	142.2	191.0	142.5	74.6%
Falcon to Blanco	3727.5	2824.8	6233.0	1210.4	1302.8	3397.6	3513.9	2789.9	239.3	1479.7	2807.3	2671.9	1713.3	64.1%
S. of Blanco	39.0	749.1	379.0	478.0	1630.0	207.0	1602.1	396.0	415.0	106.0	405.5	600.1	571.5	95.2%

D. Estimated counts of fish age 36 months or greater by area and year.

Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Median	Mean	Stdev	CV

N. of Falcon	125.0	63.6	44.4	50.8	100.1	42.5	63.5	36.5	32.5	8.7	47.6	56.8	33.9	59.7%
Falcon to Blanco	115.6	93.2	193.2	54.5	135.5	74.7	63.3	33.5	2.9	20.7	69.0	78.7	57.6	73.2%
S. of Blanco	6.4	27.7	29.9	25.8	174.4	4.1	27.2	4.4	4.6	13.5	19.6	31.8	51.3	161.2%

Table 2. Proportion of bycaught Chinook salmon, sampled from the **shorebased** whiting fishery, by year and area, (A) estimated to be at or greater than 36 months predicted age with summary metrics of central tendency and variability, (B) numbers of fish sampled for biological data per area and year, (C) Chinook bycatch counts by area and year, and (D) estimated counts of fish age 36 months or greater (D=A*C). Table from Matson et al. (2022); see Methods section for further details on age estimations.

A. Proportion of sampled fish estimated to be at or greater than 36 months predicted age.

Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Median	Mean	Stdev	CV
N. of Falcon	0.126	0.332	0.344	0.410	0.695	0.208	0.223	0.153	0.278	0.165	0.251	0.293	0.169	57.4%
Falcon to Blanco	0.128	0.073	0.078	0.148	0.272	0.054	0.044	0.027	0.189	0.101	0.090	0.111	0.075	67.6%

B. Numbers of fish sampled for biological data per area and year.

Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Median	Mean	Stdev	CV
N. of Falcon	1064	447	1216	899	264	904	785	1403	1230	466	902	868	379	43.6%
Falcon to Blanco	665	616	2241	854	458	416	476	589	236	62	533	661	598	90.4%

C. Chinook bycatch counts by area and year.

Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Median	Mean	Stdev	CV
N. of Falcon	1361.9	179.5	744.8	377.9	273.3	771.3	667.9	627.1	1300.0	NA	667.9	700.4	413.5	59.0%
Falcon to Blanco	959.1	1074.9	6003.3	1602.1	441.2	663.9	660.1	1514.3	418.3	NA	959.1	1481.9	1748.4	118.0%

D. Estimated counts of fish age 36 months or greater by area and year.

Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Median	Mean	Stdev	CV
N. of Falcon	171.6	59.6	256.2	154.9	190.0	160.4	148.9	95.9	361.4	NA	160.4	177.7	88.3	49.7%
Falcon to Blanco	122.8	78.5	468.3	237.1	120.0	35.8	29.0	40.9	79.1	NA	79.1	134.6	140.6	104.4%

3.1.5 Genetic stock composition of bycatch

In 2018, NMFS and WDFW, with input from co-managers, developed a priority stock report identifying the important Chinook salmon stocks along the West Coast. The list was created using information on (1) Chinook salmon stocks found in SRKW diet through fecal and prey scale/tissue samples, (2) SRKW body condition over time through aerial photographs, and (3) SRKW spatial and temporal overlap with Chinook salmon stocks ranging from southeast Alaska to California (NMFS and WDFW 2018). Although a variety of stocks are important to SRKW, we can evaluate relative importance of the Chinook salmon stocks bycaught in the PCFG. Figure 9 shows the predicted proportional composition estimates of Chinook ESU/aggregate stock bycatch by region for the at-sea whiting fishery. Composition estimates were provided by Dr. Paul Moran, NMFS Northwest Fisheries Science Center; stock aggregate translations were provided by Jon Carey, NMFS Northwest Region.

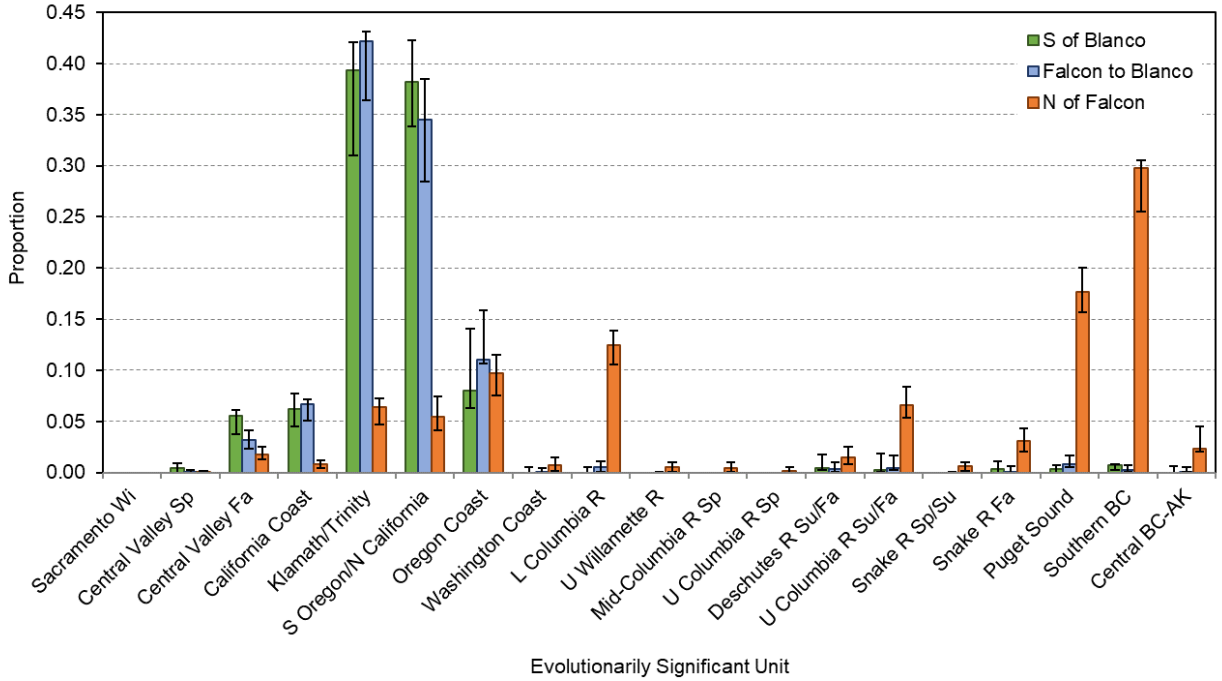

Figure 9. Predicted area-specific Chinook ESU/stock composition by GSI/ESU, aggregate stock names and corresponding proportional composition estimates for the at-sea whiting fishery, with corresponding uncertainty (95% prediction intervals). Composition estimates provided by Dr. Paul Moran, NMFS Northwest Fisheries Science Center; reprinted, adapted from Moran et al. (2021).

Stock composition of bycatch largely follows latitudinal trends, in that Chinook salmon are generally caught closer to their river of origin (as delineated by the three geographic strata shown in Figure 9) than in areas farther away from their river of origin. Of interest to SRKW are the Puget Sound and Southern BC ESUs, which are high priority prey sources as determined by fecal and diet samples, and degree of overlap with salmon migration patterns (NMFS and WDFW 2018). For example, Fraser River Chinook salmon are known to be an important stock group for SRKW, and they make up a portion of the Southern BC ESU shown in Figure 9. However, despite the ESU representing nearly 30% of the bycaught Chinook salmon in the NOF region, given the low number of Chinook bycaught in NOF, it amounts to an average of less than 60 fish from that ESU taken per year by the at sea sector in the NOF region (see Table 1C). Similarly,

the Puget Sound ESU represents approximately 18% of the bycaught Chinook salmon in the NOF region (Figure 9), amounting to an average of 34 fish from this ESU taken by the at-sea sector per year (see Table 1C). Additionally, Columbia River stocks also rank relatively high for SRKW (NMFS and WDFW 2018), and in the NOF region they can account for approximately 20% of the bycatch (Figure 9), or less than 40 fish taken per year in the NOF region (see Table 1C) (see also Table A.1 from Matson et al. (2022) for the predicted ESU/stock composition along with FRAM stock aggregate translations).

3.1.6 Summary of annual effects

Bycatch of Chinook salmon in the PCGF has the potential to cause short-term impacts to SRKW through immediate reduction of their primary prey source. However, we believe the short term impact is insignificant to SRKW, given a) the low numbers of Chinook taken relative to their availability in coastal waters (Effects Sections 3.1.1, 3.1.2), b) the even lower number of age 3+ Chinook taken (Effects Section 3.1.4), c) the low probability of overlap given SRKW distribution patterns (Effects Sections 3.1.2, 3.1.3) and the fact that the whales and the fishery are targeting different species, and d) relatively low bycatch of priority Chinook stocks. Even if there is not direct overlap between mobile SRKWs and mobile fishing vessels, the total prey removal attributed to the PCGF is minimal and is unlikely to be experienced or detected by SRKWs later in time, even if they transit fishery areas following prey removal via bycatch.

3.2 Time-lagged and long-term effects

When considering future impacts to SRKW and their prey base, a certain proportion of the subadults and juveniles bycaught in the fishery might have survived to become future SRKW prey. If we apply annual natural mortality rates to the proportion of young Chinook salmon (less than 36 months) taken as bycatch in the PCGF, we can calculate the number of adult equivalents that are removed as bycatch in the PCGF. For example, the Pacific Salmon Commission Chinook Technical Committee (CTC) asserts that natural mortality of Chinook salmon from age 1 to age 2 is 40%, and from age 2 to age 3 is 30% (CTC 2022). These estimates do not include fishing mortality because Chinook salmon of this size are typically too small to have recruited into the fishery. As such, less than 70% percent of the age 2 Chinook bycaught in the PCGF would survive another year to age into the SRKW prey base, or less than 42% of the age 1 Chinook would survive another two years to age into the SRKW prey base. Using bycatch rates from whiting sectors (at-sea + shorebased) from 2012-2020 in the NOF region, this amounts to an average of 426-710 adult equivalents that would age into the SRKW prey base in 1-2 years following capture by the PCGF. However, an undetermined amount of these fish would also be caught by Chinook salmon fisheries on the West Coast, or caught as bycatch in groundfish fisheries in future years, and there is more uncertainty in predicting future overlap of SRKWs with the small number of subadult and juvenile Chinook taken each year. Therefore, NMFS anticipates that the reduction in Chinook salmon associated with the proposed fishing would result in an insignificant reduction in adult equivalent prey resources for SRKWs in future years.

In 2017, NMFS assessed the impact of the PCGF on Chinook salmon and found that the fisheries were expected to Likely Adversely Affect, but not jeopardize listed ESUs in the action area (NMFS 2017a). NMFS determined that “in all but one case, mortality to listed Chinook and coho ESUs anticipated under the proposed action represents a small fraction of the various species’ abundances” (NMFS 2017a). Climate change impacts were also considered (NMFS 2017a).

Additionally, management measures to keep bycatch within the guidelines, along with monitoring, reporting, and evaluation requirements, assure that the long term viability of the ESUs are not likely to be jeopardized by the proposed action.

4.0 Synthesis of Effects to SRKW DPS

In Effects Sections 2.0 and 3.0 we have analyzed the direct and indirect effects of the PCGF on the SRKW DPS. While direct effects could include vessel and gear interactions, given the low probability of SRKWs interacting with active fishing vessels and their gear we determine direct effects to be discountable. Indirect effects to SRKWs could occur via reduction of their primary prey source, Chinook salmon, as bycatch in the fishery. Both the short- and long-term reductions of Chinook are very small and unlikely to be detected by the whales given the comparatively large availability of prey in coastal waters covered by the action area. Direct prey removal of age 3+ Chinook salmon is even lower, and occurs primarily in times and areas not expected to overlap with SRKWs. Removal of priority Chinook stocks is also low. Overall, bycatch of Chinook salmon in the PCGF as described here, in the biological opinion for salmon (NMFS 2017a), and in Matson et al. (2022) is not expected to impact the behavior, health, or body condition of individual SRKWs. As such, we do not expect Chinook salmon bycatch in the PCGF to rise to the level of take of individual SRKWs, and determine indirect effects to be insignificant.

5.0 Effects on SRKW critical habitat

SRKW have critical habitat designated in inland waters of Washington State, and coastal waters along the U.S. West Coast from the border of Canada and Washington, to Point Sur, California. Based on the natural history of the SRKWs and their habitat needs, NMFS identified three physical or biological features essential to conservation in designating critical habitat: (1) Water quality to support growth of the whale population and development of individual whales, (2) Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth, and (3) Passage conditions to allow for migration, resting, and foraging. The proposed action has the potential to affect features (2) prey quantity/availability and (3) passage conditions in coastal critical habitat only. We do not expect the proposed fisheries to impact in any potential way feature (1) water quality because fishing vessels do not carry large amounts of oil, making the risk from spills minor and because of the minimal direct overlap with SRKWs. Based on timing and distribution of the fishery and seasonal movement patterns of the SRKW, we expect direct overlap of mobile SRKWs and mobile fishing vessels in open coastal waters to be low and fishing vessel activities are not expected to affect passage. We also do not expect the proposed fisheries to impact inland critical habitat, given that a) PCGF vessels do not operate in inland waters of Washington, and b) impacts of prey removal due to bycatch are so small that they are unlikely to have any discernable impact to the SRKW prey quantity/availability feature in the U.S. Salish Sea (e.g. Puget Sound stocks represent 7.5% of coastwide bycatch in the at-sea whiting sector, amounting to approximately 277 fish (see Table 1 in Matson et al. (2022)).

As described in Section 3.0, reduction of prey in coastal critical habitat due to the PCGF is expected to be very small. While Chinook bycatch averages approximately 7,000 fish per year, which equates to a much smaller number of adults and adult equivalents in future years, these

effects are distributed along the entire U.S. West Coast, making impacts unlikely to be detected by SRKW and similarly not result in a detectable impact to prey quantity/availability. Therefore, similar to the analysis above, the potential impacts are insignificant.

Conclusion

Based on this analysis, NMFS concludes that the proposed action is not likely to adversely affect the Southern Resident killer whale DPS and its designated critical habitat.

Reinitiation of Consultation

Reinitiation of consultation is required and shall be requested by NMFS SFD, where discretionary Federal involvement or control over the action has been retained or is authorized by law and (1) the proposed action causes take; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the written concurrence; or (4) a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR 402.16). This concludes the ESA consultation.

Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. As such, informal consultation offers action agencies such as NMFS an opportunity to address their conservation responsibilities under section 7(a)(1). Here we suggest conservation recommendations related to a) gear identification to support NMFS' ability to attribute gear to specific fisheries, and b) monitoring and reporting efforts to support NMFS' ability to respond to potential future marine mammal interactions.

Conservation recommendations included in the 2012 opinion (NMFS 2012), 2018 eulachon reinitiation biological opinion (NMFS 2018), and 2020 humpback whale reinitiation biological opinion (NMFS 2020) remain in effect for all other species. Here we propose conservation recommendations that would allow NMFS to maintain the insignificant impact and low risk to the SRKW DPS and its critical habitat by the PCGF as determined by this consultation, as well as benefit other listed species.

We recognize and appreciate that Term and Condition 1 from the 2020 humpback whale reinitiation biological opinion is ongoing. On November 16, 2022, NMFS hosted a West Coast Sablefish Pot Gear Marking Workshop that engaged the fishing industry in a feasibility study to develop recommendations for additional gear marking options as well as options to reduce entanglement risk. A forthcoming feasibility report will summarize the findings and methods for better identification of entanglement origin gear, which will support more effective fishery responses to entanglements, and ultimately reduce risk to species. We recommend continued consideration of robust line marking in all fixed gear fisheries under the PCGFMP, including any that may use monofilament lines, which have been implicated in whale entanglements. We also recommend continued efforts to improve robust marking on buoys and other surface gear, given

the relatively low identification rate of the origins of reported entanglements despite the prominence of buoys and surface gear in those entanglements.

We also recommend that NMFS work with the WCGOP and PFMC to consider implementing systematic data collection and reporting on nonlethal marine mammal interactions with gear, where and when possible. NMFS PRD is especially interested in depredation occurrences for killer whales and would like to work with NMFS SFD, the WCGOP, and the PFMC on developing methods for continuing to track this issue. We also recommend that additional data sources be used to identify marine mammal depredation where possible, such as photographs and electronic monitoring records. In addition to observer program considerations, we recommend that NMFS encourage industry members to self-report depredation occurrences when possible, and provide guidance for useful data sources such as photographs of the dorsal fin and saddle patch, in the case of killer whales.

Please direct questions regarding this letter to Dr. Megan Wallen, NMFS West Coast Region, Protected Resources Division (megan.wallen@noaa.gov or 206-473-0812).

cc: Keeley Kent, NMFS SFD
Administrative File: 151422WCR2022PR00197

References

Baird, R. W. 2000. The killer whale. In: *Cetacean societies: Field studies of dolphins and whales*. Eds: Mann, J., Connor, R. C., Tyack, P. L., & Whitehead, H. University of Chicago Press. pp. 127-153.

Bigg, M. 1982. An assessment of killer whale (*Orcinus orca*) stocks off Vancouver Island, British Columbia. Report of the International Whaling Commission, 32(65), 655-666.

Carretta, J. V., Oleson, E. M., Forney, K. A., Muto, M. M., Weller, D. W., Lang, A. R., Baker, J., Hanson, B., Orr, A. J., Barlow, J., Moore, J. E., and Brownell Jr., R. L. 2022. U.S. Pacific marine mammal stock assessments: 2021. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-663. 395p. https://doi.org/10.25923/246k-7589.

CTC. 2022. Pacific Salmon Commission Joint Chinook Technical Committee Report: 2021 Exploitation Rate Analysis. TCCHINOOK-2022-03. June 27, 2022.

Dahlheim, M. E., Cahalan, J., and Breiwick, J. M. 2022. Interactions, injuries, and mortalities of killer whales (*Orcinus orca*) observed during fishing operations in Alaska. *South African Journal of Higher Education*, 36(1), 79-94.

Emmons, C. K., Hanson, M. B., and Lammers, M. O. 2021. Passive acoustic monitoring reveals spatiotemporal segregation of two fish-eating killer whale Orcinus orca populations in proposed critical habitat. *Endangered Species Research*, 44, 253-261.

Erickson, A. W. 1978. Population studies of killer whales (*Orcinus orca*) in the Pacific Northwest: a radio-marking and tracking study of killer whales. September 1978. U.S. Marine Mammal Commission, Washington, D.C.

Ettinger, A. K., Harvey, C. J., Emmons, C., Hanson, M. B., Ward, E. J., Olson, J. K., & Samhouri, J. F. 2022. Shifting phenology of an endangered apex predator mirrors changes in its favored prey. *Endangered Species Research*, 48, 211-223.

Ford, J.K., Ellis, G.M., Barrett-Lennard, L.G., Morton, A.B., Palm, R.S. and Balcomb III, K.C. 1998. Dietary specialization in two sympatric populations of killer whales (*Orcinus orca*) in coastal British Columbia and adjacent waters. *Canadian Journal of Zoology*, 76(8), 1456-1471.

Ford, J. K. B., G. M. Ellis, and K. C. Balcomb. 2000. Killer Whales: The Natural History and Genealogy of Orcinus orca in British Columbia and Washington State. Second edition. University of British Columbia Press, Vancouver, British Columbia.

Ford, J. K. B. and G. M. Ellis. 2006. Selective foraging by fish-eating killer whales *Orcinus orca* in British Columbia. *Marine Ecology Progress Series*, 316, 185–199.

Ford, M. J., J. Hempelmann, B. Hanson, K. L. Ayres, R. W. Baird, C. K. Emmons, J. I. Lundin, G. S. Schorr, S. K. Wasser, and L. K. Park. 2016. Estimation of a killer whale (*Orcinus orca*) population's diet using sequencing analysis of DNA from feces. *PLoS ONE*, 11(1), 1-14.

Hanson, M.B., Baird, R.W., Ford, J.K., Hempelmann-Halos, J., Van Doornik, D.M., Candy, J.R., Emmons, C.K., Schorr, G.S., Gisborne, B., Ayres, K.L. and Wasser, S.K. 2010. Species and stock identification of prey consumed by endangered southern resident killer whales in their summer range. *Endangered Species Research*, 11(1), 69-82.

Hanson, M. B., and C. K. Emmons. 2010. Annual Residency Patterns of Southern Resident Killer Whales in the Inland Waters of Washington and British Columbia. Revised Draft - 30 October 10. 11p.

Hanson, M. B., C. K. Emmons, E. J. Ward, J. A. Nystuen, and M. O. Lammers. 2013. Assessing the coastal occurrence of endangered killer whales using autonomous passive acoustic recorders. *The Journal of the Acoustical Society of America*, 134(5):3486–3495.

Hanson, M. B., E. J. Ward, C. K. Emmons, and M. M. Holt. 2018. Modeling the occurrence of endangered killer whales near a U.S. Navy Training Range in Washington State using satellite-tag locations to improve acoustic detection data. Prepared for: U.S. Navy, U.S. Pacific Fleet, Pearl Harbor, HI. Prepared by: National Oceanic and Atmospheric Administration, Northwest Fisheries Science Center under MIPR N00070-17-MP-4C419. 8 January 2018. 41p.

Hanson, M. B., E. J. Ward, C. K. Emmons, M. M. Holt, and D. M. Holzer. 2017. Assessing the movements and occurrence of Southern Resident Killer Whales relative to the U.S. Navy's Northwest Training Range Complex in the Pacific Northwest. Prepared for: U.S. Navy, U.S. Pacific Fleet, Pearl Harbor, HI. Prepared by: National Oceanic and Atmospheric Administration, Northwest Fisheries Science Center under MIPR N00070-15-MP-4C363. 30 June 2017. 32p.

Hanson, M.B., Emmons, C.K., Ford, M.J., Everett, M., Parsons, K., Park, L.K., Hempelmann, J., Van Doornik, D.M., Schorr, G.S., Jacobsen, J.K. and Sears, M.F. 2021. Endangered predators and endangered prey: Seasonal diet of Southern Resident killer whales. *PloS One*, 16(3), e0247031.

Hauser, D. D. W., M. G. Logsdon, E. E. Holmes, G. R. VanBlaricom, and R. W. Osborne. 2007. Summer distribution patterns of Southern Resident Killer Whales (*Orcinus orca*): core areas and spatial segregation of social groups. *Marine Ecology Process Series*, 351, 301-310.

Jannot, J. E., K. A. Somers, V. J. Tuttle, J. Eibner, K. E. Richerson, J. T. McVeigh, J. V. Carretta, N. C. Young, and J. Freed. 2022. Marine Mammal Bycatch in U.S. West Coast Groundfish Fisheries, 2002–19. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-176. https://doi.org/10.25923/h6gg-c316

Krahn, M. M., P. R. Wade, S. T. Kalinowski, M. E. Dahlheim, B. L. Taylor, M. B. Hanson, G. M. Ylitalo, R. P. Angliss, J. E. Stein, and R. S. Waples. 2002. Status Review of Southern Resident Killer Whales (Orcinus orca) under the Endangered Species Act. December 2002. U.S. Dept. Commer., NOAA Tech. Memo., NMFS-NWFSC-54. 159p.

Matson, S.E. and Hooper. 2021. Bycatch of ESA-listed salmon in the groundfish fishery: Guide to current reporting, tracking and bycatch analytical efforts, with preliminary spatial characterization/analysis. NMFS internal report. West Coast Region, Sustainable Fisheries Division, Groundfish Branch, Seattle.

Matson, S.E., Moran, P., and Carey, J. 2022. Chinook salmon bycatch in West Coast commercial groundfish fisheries to inform the Southern Resident killer whale ESA Consultation. NMFS internal report. West Coast Region, Sustainable Fisheries Division, Groundfish Branch, Seattle. 37p.

McHugh, P., Johnson, G., and Schaffler, J. 2015. Chinook FRAM Base Period Documentation: Growth Functions. Agenda Item D.2, Attachment 2, Pacific Fisheries Management Council. November 2015. https://www.pcouncil.org/documents/2015/11/agenda-item-d-2-attachment-2-2.pdf/

Moran, P., Tuttle, V.J., Bishop, S. and LaVoy, L. 2021. Compositional forecasting of Chinook Salmon Evolutionarily Significant Units in bycatch for Pacific Hake fisheries. bioRxiv.

Muto, M. M., V. T. Helker, B. J. Delean, N. C. Young, J. C. Freed, R. P. Angliss, N. A. Friday, P. L. Boveng, J. M. Breiwick, B. M. Brost, M. F. Cameron, P. J. Clapham, J. L. Crance, S. P. Dahle, M. E. Dahlheim, B. S. Fadely, M. C. Ferguson, L. W. Fritz, K. T. Goetz, R. C. Hobbs, Y. V. Ivashchenko, A. S. Kennedy, J. M. London, S. A. Mizroch, R. R. Ream, E. L. Richmond, K. E. W. Shelden, K. L. Sweeney, R. G. Towell, P. R. Wade, J. M. Waite, and A. N. Zerbini. 2022. Alaska marine mammal stock assessments, 2021. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-441, 295p.

NMFS. 2008. Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*). National Marine Fisheries Service, Seattle, Washington. 251p.

NMFS. 2012. Continuing Operation of the Pacific Coast Groundfish Fishery. December 7, 2012. NMFS Consultation No. NWR-2012-876. 199p.

NMFS. 2017a. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion – Reinitiation of Section 7 Consultation Regarding the Pacific Fisheries Management Council's Groundfish Fishery Management Plan. December 11, 2017. NMFS Consultation No.: WCR-2017-7552. 313p.

NMFS. 2017b. Salmon bycatch in the Pacific Coast Groundfish Fisheries. Prepared by NMFS Sustainable Fisheries Division, West Coast Region. October 2016. 82p.

NMFS. 2017c. Alternatives for Salmon Bycatch Management in the Pacific Coast Groundfish Fisheries. Prepared by NMFS Sustainable Fisheries Division, West Coast Region. PFMC Agenda Item I.1.a, NMFS Report 1. March 2017. 111p.

NMFS. 2018. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion - Continuing Operation of the Pacific Coast Groundfish Fishery (Reinitiation 2018). NMFS, West Coast Region, Portland, OR. Consultation No.: WCR-2018-8635. October 12, 2018. 55p.

NMFS. 2019. Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response Consultation on the Delegation of Management Authority for Specified Salmon Fisheries to the State of Alaska. NMFS Consultation No.: WCR-2018-10660. April 5, 2019. 443p.

NMFS. 2020. Endangered Species Act (ESA) Section 7(a)(2) Biological and Conference Opinion on Continuing Operation of the Pacific Coast Groundfish Fishery (Reinitiation of consultation #NWR-2012-876) – Humpback whale (*Megaptera novaeangliae*). NMFS Consultation Number: WCRO-2018-01378. October 26, 2020. 83p.

NMFS. 2021a. 5-Year Review: Summary and Evaluation of Southern Resident Killer Whales (*Orcinus orca*). National Marine Fisheries Service, West Coast Region, Seattle, WA. December, 2021. 103 pages.

NMFS. 2021b. Revision of the Critical Habitat Designation for Southern Resident killer whales: Final Biological Report (to accompany the Final Rule).

NMFS. 2021c. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Conference Opinion Biological Opinion on the Authorization of the West Coast Ocean Salmon Fisheries Through Approval of the Pacific Salmon Fishery Management Plan Including Amendment 21 and Promulgation of Regulations Implementing the Plan for Southern Resident Killer Whales and their Current and Proposed Critical Habitat. NMFS Consultation Number: WCRO-2019-04074. April 21, 2021. 190p.

NMFS. 2022. Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Impacts of the Role of the BIA Under its Authority to Assist with the Development of the 2022-2023 Puget Sound Chinook Harvest Plan, the Role of the U.S. Fish and Wildlife Service in Activities Carried out under the Hood Canal Salmon Management Plan and in Funding the Washington Department of Fish and Wildlife under the Sport Fish Restoration Act in 2022-23, and the Role of the National Marine Fisheries Service in authorizing fisheries consistent with management by the Fraser Panel and Funding Provided to the Washington Department of Fish and Wildlife for Activities Related to Puget Sound Salmon Fishing in 2022-2023. NMFS Consultation Number: WCRO-2022-01000. May 13, 2022. 451p.

NMFS and WDFW. 2018. Southern Resident Killer Whale Priority Chinook Stocks Report. June 22, 2018. 8p. https://media.fisheries.noaa.gov/dam-migration/srkw_priority_chinook_stocks_conceptual_model_report___list_22june2018.pdf.

NWFSC. 2012. Risk assessment of U.S. West Coast groundfish fisheries to threatened and endangered marine species. Northwest Fisheries Science Center, NMFS. 2725 Montlake Blvd. E, Seattle, Washington. January 13, 2012. 272p.

Olson, J. K., J. Wood, R. W. Osborne, L. Barrett-Lennard, and S. Larson. 2018. Sightings of southern resident killer whales in the Salish Sea 1976-2014: the importance of a long-term opportunistic dataset. *Endangered Species Research*, 37, 105-118.

Osborne, R. W. 1999. A historical ecology of Salish Sea "resident" killer whales (*Orcinus orca*): With implications for management. Doctoral dissertation. University of Victoria, Victoria, British Columbia. 277p.

PFMC. 1997. Pacific Whiting Allocation And Seasons Environmental Assessment And Regulatory Impact Review Of The Anticipated Biological, Social And Economic Impacts Of A Proposal To Allocate Pacific Whiting Among Non-Tribal Sectors And To Establish A Framework For Modifying Season Opening Dates. February 1997. Pacific Fishery Management Council.

PFMC. 2008. *Fisheries Regulation Assessment Model (FRAM) An Overview for Coho and Chinook v 3.0.* (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

PFMC. 2020a. Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council Portland, OR. November 2020. 351 p. Available at: https://www.pcouncil.org/documents/2020/09/status-of-the-pacific-coast-groundfish-fishery-stock-assessment-and-fishery-evaluation-september-2020.pdf/.

PFMC 2020b. Pacific Fishery Management Council Salmon Fishery Management Plan Impacts to Southern Resident Killer Whales. Risk Assessment. May 2020. Ad-Hoc SRKW Workgroup. 165p.

PFMC. 2022. Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery, Pacific Fishery Management Council. Portland, OR. August 2022. 146p. Available at: http://www.pcouncil.org/groundfish/fishery-management-plan/.

Renko, R. 2016. Salmon bycatch in the Pacific Coast Groundfish Fisheries. Prepared by National Marine Fisheries Service, Sustainable Fisheries Division, West Coast Region. October 2016. 82p.

Somers, K.A., J.E. Jannot, K.E. Richerson, V.J. Tuttle, & J.T. McVeigh. 2021. Fisheries Observation Science Program Coverage Rates, 2002-2020. U.S. Department of Commerce, NOAA Data Report NMFS-NWFSC-DR-2021-02 Available at: https://repository.library.noaa.gov/view/noaa/32074.

Somers, K.A., C.E. Whitmire, E. Steiner, J.E. Jannot, K. Richerson, V.J. Tuttle, and J.T. McVeigh. 2021. Fishing Effort in the 2002-2019 U.S. Pacific Coast Groundfish Fisheries. West Coast Groundfish Observer Program. National Marine Fisheries Service, NWFSC, 2725 Montlake Blvd E., Seattle, WA 98112.

Wulff, R. 2022. Memo for the Reinitiation of Endangered Species Act 7(a)(2) consultation on continued operation of the groundfish fishery under the Pacific Coast Groundfish Fishery Management Plan and the effects of the fishery on Southern Resident killer whales. September 28, 2022.

Yano, K. and Dahlheim, M. E. 1995. Behavior of killer whales *Orcinus orca* during longline fishery interactions in the southeastern Bering Sea and adjacent waters. *Fisheries Science*, 61(4), 584-589.