Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Conference Opinion

Consultation on Implementation of the Pacific Fishery Management Council Salmon Fishery Management Plan in 2020 for Southern Resident Killer Whales and their Current and Proposed Critical Habitat

NMFS Consultation Number: *WCRO-2019-04040*

Action Agency: National Marine Fisheries Service

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Current or Proposed Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Current or Proposed Critical Habitat?
Southern Resident Killer Whale DPS (*Orcinus orca*)	Endangered	Yes	No	Yes	No

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By:

For Barry A. Thom
Regional Administrator

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List of Acronyms

ACOE	ARMY CORP OF ENGINEERS
BC	BRITISH COLUMBIA
CA	CALIFORNIA
CFR	FEDERAL CODE OF REGULATIONS
CO	CENTRAL OREGON
dB	DECIBELS
DDT	DICHLORODIPHENYLTRICHLOROETHANE
DFO	DEPARMENT OF FISHERIES AND OCEANS CANADA
DNA	DEOXYRIBONUCLEIC ACID
DPER	DAILY PREY ENERGY REQUIREMENT
DPS	DISTINCT POPULATION SEGMENT
DTAG	DIGITAL ACOUSTIC RECORDING TAG
EAR	ECOLOGICAL ACOUSTIC RECORDER
EFH	ESSENTIAL FISH HABITAT
ESA	ENDANGERED SPECIES ACT
ESU	EVOLUTIONARY SIGNIFICANT UNIT
EEP	EXEMPTED FISHING PERMIT
EEZ	EXCLUSIVE ECONOMIC ZONE
FY	FISCAL YEAR
FMP	FISHERY MANAGEMENT PLAN
FRAM	FISHERY REGULATION ASSESSMENT MODEL
HPA	HYDRAULIC PROJECT APPROVAL
ITS	INCIDENTAL TAKE STATEMENT
KHZ	KILOHERTZ
KM	KILOMETER
KMZ	KLAMATH MANAGEMENT ZONE
KRFC	KLAMATH RIVER FALL CHINOOK
LCR	LOWER COLUMBIA RIVER
LOF	LIST OF FISHERIES
MCB	MID-COLUMBIA RIVER BRIGHTS
M/SI	MORTALITY AND SERIOUS INJURY
MI	MILES
MMAP	MARINE MAMMAL AUTHORIZATION PROGRAM
MMPA	MARINE MAMMAL PROTECTION ACT
MSA	MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT
NFWF	NATIONAL FISH AND WILDLIFE FOUNDATION
NMFS	NATIONAL MARINE FISHERIES SERVICE
NO	NORTH OREGON
NOAA	NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NOF	NORTH OF FALCON
NRKW	NORTHERN RESIDENT KILLER WHALE
NWFSC	NORTHWEST FISHERY SCIENCE CENTER
OR	OREGON
PAH	POLYCYCLIC AROMATIC HYDROCARBON
PAL	PASSIVE AQUATIC LISTENER

PBF	PHYSIOLOCAL OR BIOLOGICAL FEATURES
PCB	POLYCHLORINATED BIPHENYL
PCE	PRIMARY CONSTITUENT ELEMENT
PFMC	PACIFIC FISHERY MANAGEMENT COUNCIL
PHOS	PROPORTION OF HATCHERY-ORIGIN FISH ON SPAWNING GROUND
PNI	PROPORTIONATE NATURAL INFLUENCE
PST	PACIFIC SALMON TREATY
RPA	REASONABLE AND PRUDENT ALTERNATIVE
RPM	REASONABLE AND PRUDENT MEASURE
SAFE	STOCK ASSESSMENT AND FISHERY EVALUATION
SCH	SPRING CREEK HATCHERY
SHB	STATE HOUSE BILL
SEAK	SOUTHEAST ALASKA
SF	SAN FRANCISCO
SOF	SOUT OF FALCON
SRFC	SACRAMENTO RIVER FALL CHINOOK
SRKW	SOUTHERN RESIDENT KILLER WHALE
SSC	SCIENTIFIC AND STATISTICAL COMMITTEE
STT	SALMON TECHNICAL TEAM
SWFSC	SOUTHWEST FISHERY SCIENCE CENTER
SWVCI	SOUTHWEST VANCOUVER ISLAND
UCR	UPPER COLUMBIA RIVER
URB	UP RIVER BRIGHT
VSP	VIABLE SALMON POPULATION
WA	WASHINGTON
WDFW	WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
μPA	MICROPASCAL

1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3, below.

1.1. Background

The National Marine Fisheries Service (NMFS) prepared the biological and conference opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), and implementing regulations at 50 CFR 402, as amended.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (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 NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the Protected Resources Seattle, WA office.

1.2. Consultation History

- NMFS consulted on the effects of the fisheries managed by NMFS and the Pacific Fishery Management Council (PFMC or Council) under the Pacific Coast Salmon Fishery Management Plan (FMP) ("Council salmon fisheries") under the ESA in 2009 (NMFS 2009) and concluded that the fisheries did not jeopardize the survival and recovery of the ESA-listed Southern Resident killer whales (SRKWs) (*Orcinus orca*) Distinct Population Segment (DPS). Since NMFS completed the 2009 consultation, a substantial amount of new information has become available on SRKWs and their primary prey, Chinook salmon.
- On March 6, 2019, NMFS provided guidance to the PFMC related to effects of the Council salmon fisheries on SRKWs (Agenda Item D.1.a, Supplemental NMFS Report 4). In the letter, NMFS announced our plan to re-initiate ESA consultation on the Council salmon fisheries and invited the Council to help reassess the effects of Council salmon fisheries on SRKWs.
- On April 12, 2019, NMFS reinitiated consultation (memo from R. Wulff to C. Yates) to consider the effects of Council-managed fisheries under the Pacific Coast Salmon FMP on the SRKWs.
- Because the reinitiation would not be complete prior to the start of the 2019 fisheries, NMFS assessed the Council's alternative sets of management measures for the 2019 fisheries with respect to their potential effects on SRKW and presented that assessment to the Council as it considered these alternatives (Agenda Item F.1.e, Supplemental NMFS Report 1, April 2019). NMFS considered the Council's recommended set of management measures in conjunction with its approval and implementation of those measures and concluded implementation of the measures would not likely jeopardize SRKW, and did not represent an irreversible or irretrievable commitment of resources (NMFS 2019).
    - A central aspect of both of these assessments was the current understanding of how the proposed 2019 Council salmon fisheries could affect the species named

on the draft list of priority SRKW Chinook salmon prey stocks (NOAA and WDFW 2018). NMFS considered all the information currently available to assess these impacts including: estimated percent reductions in prey availability from the Council's three fishery alternatives compared to past percent reductions from 1992 – 2016 (using a similar Fishery Regulation Assessment Model (FRAM) based retrospective analysis to that used in previous fisheries Endangered Species Act section 7 consultations); estimates of total Chinook abundance in coastal waters (from central British Columbia (BC) southward to California) and inland waters (including waters in the Strait of Juan de Fuca, Puget Sound, Georgia Strait and Johnstone Strait) derived using the Chinook FRAM; Supplemental STT Report 2; 2019 pre-season translated forecasts of abundance for each priority Chinook salmon prey stock that contributes to the Council salmon fisheries; and the contribution rates of the priority Chinook salmon prey stocks to total catch (both current predicted contribution and historical contribution) in the Council salmon fisheries.

  - NMFS did not anticipate that any of the three 2019 Council fishery alternatives would pose an unacceptable risk to the whales' recovery. Our conclusion was based on the facts that 1) we did not anticipate relatively low Chinook salmon abundance coupled with relatively large percent reductions from any of the three alternatives, and 2) we did not anticipate the Council fisheries to substantially reduce the availability of the relatively low abundance priority Chinook salmon stocks.

- In April 2019, the Council formed the ad-hoc SRKW workgroup (Workgroup) to reassess the effects of Council-area ocean salmon fisheries on the Chinook salmon prey base of SRKW, and depending on the results, develop a long-term approach that could include proposed conservation measure(s) or management tool(s) to limit PFMC salmon fishery impacts to prey availability for SRKW relative to implementing the FMP.

- The Workgroup focused on developing a risk assessment to help inform the Council of potential impacts on SRKW as a result of implementing the FMP (Agenda Item E.3.a, SRKW Workgroup Report 1) and met numerous times during the course of 2019 and early 2020. All meetings were open to the public. A detailed list of Workgroup meetings and presentations can be found online at: [SRKW and Fisheries Interaction Workgroup.]

- The Workgroup has provided draft documents and progress reports to the Council as work progressed. At the November 2019 Council meeting, the Workgroup provided an updated draft risk assessment, and after thorough review, the Scientific and Statistical Committee (SSC) provided an SSC report in support of the analytical methods and materials used to date by the Workgroup. Since November, the Workgroup met three times to refine the risk assessment and has since completed the technical work and analysis. The Workgroup considers the risk assessment a final draft, with the exception of including an executive summary and minor editing. In March 2020, the Council adopted the risk assessment as a final draft pending these additional pieces. A final risk assessment is expected at the June 2020 Council meeting.

- The Workgroup was also directed by the Council to draft recommendations for Council consideration if needed based on the results of the risk assessment, which the Workgroup began but has not yet completed. Once this process is complete, the Workgroup will present its recommendations to the Council, and the Council could use them to adopt changes to the FMP and/or regulations to further protect Southern Resident killer whales. NMFS would consider such measures in a future long-term biological opinion.

1.3. 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).

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

The proposed action analyzed in this opinion is NMFS's approval and implementation of the annual management measures that the Council has recommended for ocean salmon fisheries in the year 2020 within the U.S. Pacific Coast Region Exclusive Economic Zone (EEZ) (i.e., 3-200 nautical miles off the West Coast states of California, Oregon, and Washington) (FIGURE 1). These fisheries are authorized under the provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and include commercial, recreational, and treaty Indian fisheries. The fisheries primarily use hook and line gear, which target coho and Chinook salmon. Pink salmon are caught in odd-numbered years but at much lower numbers than Chinook and coho salmon. The management measures typically apply from May 1 of the current year through April 30 of the following year. The PFMC adopts management measures each year at its April meeting, and recommends these measures to the Secretary of Commerce (Secretary). NMFS, upon approving these measures to determine if they are consistent with the MSA, the ESA, the Pacific Salmon Treaty (PST), and exercise of Indian fishing rights, and other applicable law publishes them in a final rule. (See, e.g. 84 FR 19729, May 6, 2019). Because the Secretary, acting through NMFS, has the ultimate authority for the FMP and its implementation, NMFS is both the action agency and the consulting agency for this consultation on the effects of the fishery on Southern Resident Killer Whales and their proposed critical habitat.

The PFMC develops its recommended annual management measures to be consistent with its FMP, which provides a framework for developing these measures. The FMP specifies conservation objectives for each salmon stock impacted in the fishery. Chinook and coho salmon stocks caught in these fisheries come from numerous rivers and streams in the three West Coast states and southern British Columbia. Catches of other salmon species are inconsequential (low hundreds of fish or less each year) to very rare (PFMC 2020b). In the event this situation should change, management objectives for these species could be developed and incorporated by plan amendment. Because a number of stocks impacted in the fishery are listed under the ESA and/or are subject to management under the PST, the FMP objectives for these stocks are designed to be consistent with those laws. Other stocks are managed solely to meet MSA standards. The PFMC has developed, and NMFS has approved, control rules limiting harvest for three ESA-listed stocks (Lower Columbia River Chinook, Lower Columbia River coho and Sacramento River Winter Run Chinook salmon). Additional ESA-listed stocks are managed consistent with reasonable and prudent alternatives and/or terms and conditions described in previous biological opinions (see Table 1 below). Chinook salmon stocks off Southern Oregon, Northern California, and Central Oregon are largely grouped into stock complexes managed to achieve objectives for two indicator stocks that are the primary drivers of these fisheries:

Sacramento River Fall Chinook (SRFC) and Klamath River Fall Chinook (KRFC) salmon. Chinook salmon stocks caught in the northern portion of the EEZ are mostly ESA-listed, or are included in the Far North Migrating Chinook salmon complex. Conservation objectives for the stocks in this complex are those applicable under the PST. Coho salmon stocks impacted by the fisheries are largely managed consistent with the ESA or PST requirements.

Table 1. NMFS ESA determinations regarding Evolutionarily Significant Units (ESUs) and DPSs affected by PFMC salmon directed fisheries and the duration of the 4(d) Limit determination or biological opinion (BO). (Only those decisions currently in effect are included).

Date (Decision type)	Duration	Citation	Species Considered
Salmonid Species			
March 8, 1996 (BO)	until reinitiated	NMFS 1996	Snake River spring/summer and fall Chinook, and sockeye
April 28, 1999 (BO)	until reinitiated	NMFS 1999	S. Oregon/N. California Coasts coho Central California Coast coho Oregon Coast coho
April 28, 2000 (BO)	until reinitiated	NMFS 2000	Central Valley Spring-run Chinook California Coastal Chinook
April 30, 2001 (BO)	until reinitiated	NMFS 2001a	Upper Willamette River Chinook Columbia River chum Ozette Lake sockeye Upper Columbia River spring-run Chinook Ten listed steelhead DPSs
September 14, 2001 (BO, 4(d) Limit)	until withdrawn	NMFS 2001b	Hood Canal summer-run chum
April 29, 2004 (BO)	until withdrawn	NMFS 2004	Puget Sound Chinook
June 13, 2005 (BO)	until reinitiated	NMFS 2005a	California Coastal Chinook
April 27, 2012 (BO)	until reinitiated	NMFS 2012	Lower Columbia River Chinook
April 9, 2015 (BO)	until reinitiated	NMFS 2015a	Lower Columbia River coho
March 3, 2018 (BO)	until reinitiated	NMFS 2018a	Sacramento River winter-run Chinook
Non Salmonid species			
April 30, 2007 (BO)	until reinitiated	NMFS 2007	North American Green Sturgeon
April 30, 2011 (BO)	until reinitiated	NMFS 2010a	Puget Sound/Georgia Basin Rockfish
April 30, 2011 (BO)	until reinitiated	NMFS 2010	Pacific Eulachon

The PFMC develops its annual management measures to meet the applicable conservation objectives for all salmon stocks. The abundance of a given salmon stock can vary dramatically from one year to the next, and under the FMP's objectives, the allowed fishery impact on any particular stock takes into account its forecasted abundance for that year. Because the fisheries contain a mix of stocks, fisheries are managed to meet the objectives for the least abundant stocks for the year and significant numbers of more abundant stocks may go unharvested in the EEZ. Thus, the overall scope¸ duration, and spatial scale of the annual ocean salmon fisheries, within the U.S. Pacific Coast Region EEZ, depends on varying salmon stock abundances and the spatial distribution of constraining stocks.

Most of the stocks impacted in the PFMC salmon-directed fisheries are also taken in other more terminal area marine and freshwater fisheries. The conservation standards in the FMP are a mix of ocean and total (ocean and freshwater) fishing-related impact objectives. Therefore, the PFMC's analysis includes assumptions regarding harvest of salmon species in all salmon-directed fisheries along the west coast, including Southeast Alaskan (SEAK) and Canadian fisheries, as well as more terminal fisheries in state waters (i.e., marine, estuarine, and freshwater areas) in determining whether conservation objectives are met.

Fishery impacts are managed in the PFMC fisheries using a variety of harvest controls, such as time and area closures, catch quotas, and landing limits. Where fisheries utilize catch quotas, the fishery will close if they reach the limit before the end of the scheduled open period. A detailed description of the specific fishery locations and historical catch and effort data is provided in the annual Review of Ocean Salmon Fisheries, available on the PFMC's website (https://www.pcouncil.org/safe-documents-3/). The fishing periods and locations may be modified in-season consistent with codified regulations and the FMP in response to changes in accrual of expected harvested catch, fishing effort, or weather conditions to ensure achievement of the FMP management objectives and in consideration for safety concerns.

As mentioned previously, the PFMC's salmon-directed fisheries are managed consistent with the provisions of the PST, which also governs fisheries in SEAK, those off the coast of British Columbia, and fisheries in Puget Sound, the Columbia River and the Oregon Coast. Canadian and SEAK salmon fisheries impact salmon stocks from the states of Washington, Oregon, and Idaho as well as salmon originating in SEAK and Canadian waters. As described above, fisheries off the U.S. West Coast and in inland waters harvest salmon originating in U.S. West Coast and Canadian waters. The PST provides a framework for managing salmon fisheries in those waters of the U.S. and Canada that fall within the PST's geographical scope. The overall purpose of the fishing regimens, is to accomplish the conservation, production, and harvest allocation objectives set forth in the PST (https://www.psc.org/publications/pacific-salmon-treaty/). The PST provides for the U.S. and Canada to each manage their own fisheries to achieve domestic conservation and allocation priorities, while remaining within the overall limits agreed to under the PST. In 2018, U.S. and Canadian representatives reached agreement to amend versions of five expiring Chapters of Annex IV (Turner and Reid 2018); both countries have since executed this agreement.

The new PST Agreement includes reductions in harvest impacts for all Chinook fisheries within its scope and refines the management of coho salmon caught in these areas. The new Agreement includes reductions in the allowable annual catch of Chinook salmon in the SEAK and Canadian West Coast of Vancouver Island and Northern British Columbia fisheries by up to 7.5 and 12.5 percent, respectively, compared to the previous agreement. The level of reduction depends on the Chinook abundance in a particular year. This comes on top of the reductions of 15 and 30 percent for those same fisheries that occurred as a result of the prior 10-year agreement (2009 through 2018). Harvest rates on Chinook salmon stocks caught in southern British Columbia and U.S. salmon fisheries, including those under the jurisdiction of the PFMC are reduced by up to 15% from the previous agreement (2009 through 2018). Beginning in January 2020 this will result in an increased proportion of abundances of Chinook salmon migrating to waters more southerly. Although provisions of the updated agreement are complex, they were specifically designed to reduce fishery impacts in all fisheries to respond to conservation concerns for a number of U.S. and Canadian stocks.

In 2019, NMFS consulted on impacts to ESA-listed species from several U.S. domestic actions associated with the new PST agreement (NMFS 2019c) including federal funding of a conservation program for critical Puget Sound salmon stocks and SRKW prey enhancement. The 2019 opinion (NMFS 2019c) included a programmatic consultation on the PST funding initiative, which is an important element of the environmental baseline in this opinion. In Fiscal Year 2020 Congress appropriated $35.1 million dollars for implementation of U.S. domestic activities associated with implementation of the new PST agreement, of which $5.6 million is being used for increased hatchery production to support prey abundance for SRKW and $13.5 million is being used in support of Puget Sound Critical Stock Conservation and Habitat Restoration and Protection, consistent with the funding initiative. The beneficial effects of these activities (i.e., increases in the abundance of Chinook salmon available as prey to SRKW, hatchery conservation programs to support critical Puget Sound Chinook populations, and improved habitat conditions for those populations) are expected to begin in the next 3-5 years. Subsequent specific actions (i.e., hatchery production programs) will undergo separate consultations, tiered from the programmatic consultations (NMFS 2019c) to assess effects for site-specific actions. The harvest management provisions of the new Agreement and the appropriations to initiate the conservation activities are in place now and will be taken into account in this biological opinion. The effects of the conservation activities will be important to the analysis of the impacts of PFMC fisheries over the long term to SRKW. Additional detail on the activities associated with the PST funding initiative are described in more detail in the Environmental Baseline.

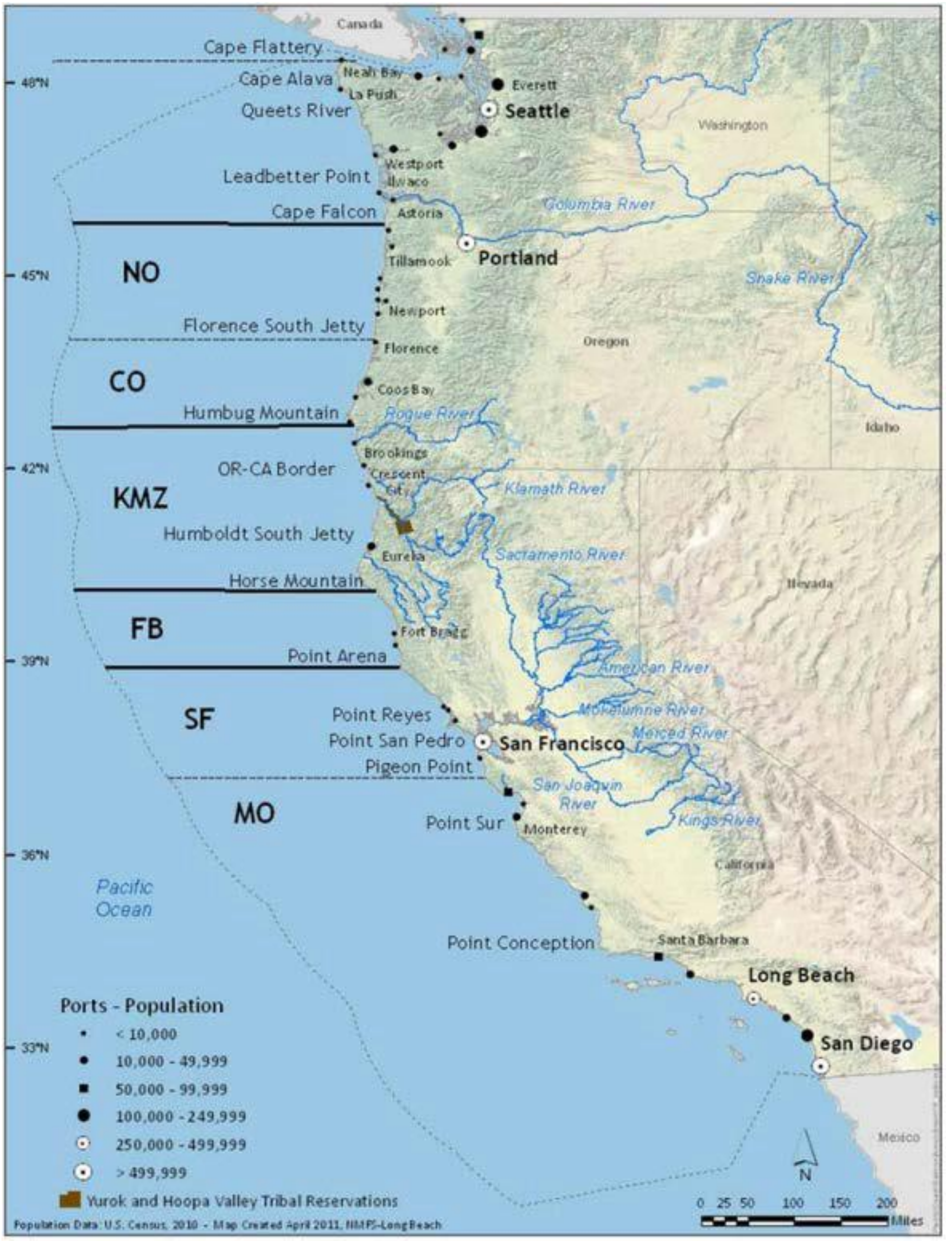


Figure 1.Map of major management boundaries in common use since 2000. North Oregon (NO), Central Oregon (CO), Klamath Management Zone (KMZ), Fort Bragg, San Francisco (SF) Monterey.

As a result of the 2020 preseason planning process to develop management measures consistent with the MSA, ESA, the updated PST, exercise of Indian fishing rights, and other applicable law as described above; the Council has recommended the following set of fishing regulations to NMFS for approval and publication in the Federal Register in early May 2020:

Washington and Northern Oregon (north of Cape Falcon)

North of Cape Falcon (Figure 1), the overall non-Indian total allowable catch is 54,000 Chinook salmon coastwide and 28,500 marked hatchery coho. Non-Indian ocean commercial fisheries in this area include traditional, but reduced, seasons in the spring (May-June) for Chinook salmon and a summer season (July – mid-September) for Chinook and coho salmon (see Appendix A,

Figure A.1). These fisheries will have access to 27,640 Chinook salmon, and a hatchery coho salmon quota of 2,000. The recreational fishery in this area opens with an all-salmon-except-coho fishery on June 20, transitioning to an all-species fishery on June 29 and continuing to September 30 or when achieving Chinook or coho salmon quotas (see Appendix A, Figure A.2). Recreational fisheries in this area will have access to 26,360 Chinook salmon, and a hatchery coho salmon quota of 26.

Tribal ocean fisheries north of Cape Falcon are similar in structure to past years, with a spring season targeting Chinook salmon and a summer fishery for all species. Quotas include 35,000 Chinook and 16,500 coho salmon.

Southern Oregon and California (south of Cape Falcon)

Fisheries south of Cape Falcon (in northern Oregon) (Figure 1) consist of modest Chinook salmon fisheries, particularly in California.

Commercial fisheries in the area from Cape Falcon to Humbug Mt. (Figure 1; Appendix A, Figure A.1) will open in late April and will continue into early May, with a brief reopening at the end of May. The area will be open again in early June through July and most of August. This area will also be open continuously in September and October with weekly limits in place. The area from Humbug Mt., Oregon to the Oregon/California border (also known as the Oregon portion of the Klamath Management Zone) (Figure 1) will be open in late April and continue into early May, with a brief reopening at the end of May. The area will be open again in early June through July with monthly catch quotas and weekly limits in place. The area from the Oregon/California border to Horse Mt., California, (Figure 1) will be closed to conserve Klamath River fall Chinook, which are classified as overfished.

In California, Chinook salmon seasons in the Fort Bragg area (Horse Mt. to Point Arena) (Figure 1; Appendix A, Figure A.1) will be open ten days in August and for the month of September. The San Francisco area (Point Arena to Pigeon Point) (Figure 1) will be open intermittently from May to July, for most of August, and for all of September. The Monterey area (Pigeon Point to the Mexico border) (Figure 1) will also be open for Chinook salmon intermittently from May to July and for most of August. There will also be a season from Point Reyes to Point San Pedro (a subset of the San Francisco area) (Figure 1) consisting of three openings in October ranging from two to five days each.

Recreational fisheries from Cape Falcon to Humbug Mt. (Figure 1, Appendix A, Figure A.2) will allow Chinook salmon retention from now through October. Coho fisheries consist of a hatchery (mark-selective) quota fishery of 22,000 in mid-summer and a non-mark-selective quota fishery of 3,000 in September. Fisheries from Humbug Mt, Oregon to the Oregon/California border (Figure 1) will be open from late June through early August. The area from the Oregon/California border to Horse Mountain, California (Figure 1) will be open from early June through early August.

In California, Chinook salmon seasons in the Fort Bragg (Horse Mt.to Point Arena) and San Francisco (Point Arena to Pigeon Point) areas will open on May 1 and will continue until early November, The Monterey (Pigeon Point to Mexico Border) area, will open on May 1 and continue until early October (Appendix A).

We will evaluate the effects of this suite of recommended management measures for 2020 in this opinion.

2. ENDANGERED SPECIES ACT: BIOLOGICAL AND CONFERENCE OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1. Analytical Approach

This biological and conference opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological and conference opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The proposed critical habitat for SRKWs uses the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition does not change the scope of our analysis and in this opinion we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
- Evaluate cumulative effects.

- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species, or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2. Rangewide Status of the Species and Critical Habitat

This opinion examines the status of the species (SRKWs) that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the essential features that help to form that conservation value.

2.2.1 Status of Southern Resident Killer Whales (SRKWs)

The SRKW DPS, composed of J, K, and L pods, was listed as endangered under the ESA on November 18, 2005 (70 FR 69903). A 5-year review under the ESA completed in 2016 concluded that SRKWs should remain listed as endangered and includes recent information on the population, threats, and new research results and publications (NMFS 2016c). NMFS considers SRKWs to be currently among eight of the most at-risk species as part of the Species in the Spotlight initiative[1] because of their endangered status, declining population trend, and they are high priority for recovery based on conflict with human activities and recovery programs in place to address threats. The population has relatively high mortality and low reproduction unlike other resident killer whale populations that have generally been increasing since the 1970s (Carretta et al. 2019).

The limiting factors described in the final recovery plan included reduced prey availability and quality, high levels of contaminants from pollution, and disturbances from vessels and sound (NMFS 2008e). This section summarizes the status of SRKWs throughout their range and summarizes information taken largely from the recovery plan (NMFS 2008e), most recent 5-year review (NMFS 2016c), the PFMC SRKW Ad Hoc Workgroup's report (PFMC 2020a), as well as newly available data.

2.2.1.1 Abundance, Productivity, and Trends

Killer whales – including SRKWs - are a long-lived species and sexual maturity can occur at age 10 (review in NMFS (2008e)). Females produce a small number of surviving calves (n < 10, but

[1] https://www.fisheries.noaa.gov/resource/document/species-spotlight-priority-actions-2016-2020-southern-resident-killer-whale

generally fewer) over the course of their reproductive life span (Bain 1990; Olesiuk et al. 1990). Compared to Northern Resident killer whales (NRKWs), which are a resident killer whale population with a sympatric geographic distribution ranging from coastal waters of Washington State and British Columbia north to Southeast Alaska, SRKW females appear to have reduced fecundity (Ward et al. 2013;Vélez-Espino *et al.* 2014), and all age classes of SRKWs have reduced survival compared to other fish-eating populations of killer whales in the Northeast Pacific (Ward et al. 2013).

Since the early 1970s, annual summer censuses in the Salish Sea using photo-identification techniques have occurred (Bigg et al. 1990; Center for Whale Research annual photographic identification catalog, 2019). The population of SRKW was at its lowest known abundance in the early 1970s following live-captures for aquaria display (n = 68). The highest recorded abundance since the 1970s was in 1995 (98 animals), though the population declined from 1995-2001 (from 98 whales in 1995 to 81 whales in 2001). The population experience a growth between 2001 and 2006 and have been generally declining since then. However, in 2014 and 2015, the SRKW population increased from 78 to 81 as a result of multiple successful pregnancies (n = 9) that occurred in 2013 and 2014. At present, the SRKW population has declined to near historically low levels (Figure 2). As of April 2020, the population is 72 whales (one whale is missing and presumed dead since the 2019 summer census). The previously published historical estimated abundance of SRKW is 140 animals (NMFS 2008e). This estimate (~140) was generated as the number of whales killed or removed for public display in the 1960s and 1970s (summed over all years) added to the remaining population at the time the captures ended.

Figure 2 Population size and trend of Southern Resident killer whales, 1960-2019. Data from 1960-1973 (open circles, gray line) are number projections from the matrix model of Olesiuk et al. (1990). Data from 1974-2019 (diamonds, black line) were obtained through photo-identification surveys of the three pods (J, K, and L) in this community and were provided by the Center for Whale Research (unpublished data) and NMFS (2008e). Data for these years represent the number of whales present at the end of each calendar year.

Based on an updated pedigree from new genetic data, many of the offspring in recent years were sired by two fathers, meaning that less than 30 individuals make up the effective reproducing portion of the population. Because a small number of males were identified as the fathers of many offspring, a smaller number may be sufficient to support population growth than was previously thought (Ford et al. 2011b; Ford et al. 2018). However, the consequence of this means inbreeding may be common amongst this small population, with a recent study by Ford et al. (2018) finding several offspring resulting from matings between parents and their own offspring. The fitness effects of this inbreeding remain unclear and are an effort of ongoing research (Ford et al. 2018).

Seasonal mortality rates among Southern and Northern Resident whales may be highest during the winter and early spring, based on the numbers of animals missing from pods returning to inland waters each spring and standings data. Olesiuk et al. (2005) identified high neonate mortality that occurred outside of the summer season, and multiple new calves have been documented in winter months that have not survived the following summer season (CWR unpublished data). Stranding rates are higher in winter and spring for all killer whale forms in Washington and Oregon (Norman et al. 2004).

The NWFSC continues to evaluate changes in fecundity and mortality rates, and has updated the population viability analyses conducted for the 2004 Status Review for SRKWs and the 2011 science panel review of the effects of salmon fisheries (Krahn et al. 2004; Hilborn et al. 2012; Ward et al. 2013). According to the updated analysis, the model results now suggests a downward trend in population size projected over the next 50 years. As the model projects out over a longer time frame (50 years) there is increased uncertainty around the estimates. The downward trend is in part due to the changing age and sex structure of the population. If the population of SRKW experiences demographic rates (e.g. fecundity and mortality) that are more similar to 2016 than the recent 5-year average (2011-2016), the population will decline faster as shown in Figure 3 (NMFS 2016c). There are several demographic factors of the SRKW population that are cause for concern, namely (1) reduced fecundity, (2) a skewed sex ratio toward male births in recent years, (3) a lack of calf production from certain components of the population (e.g. K pod), (4) a small number of adult males acting as sires (Ford et al. 2018) and (5) an overall small number of individuals in the population (review in NMFS 2016c).

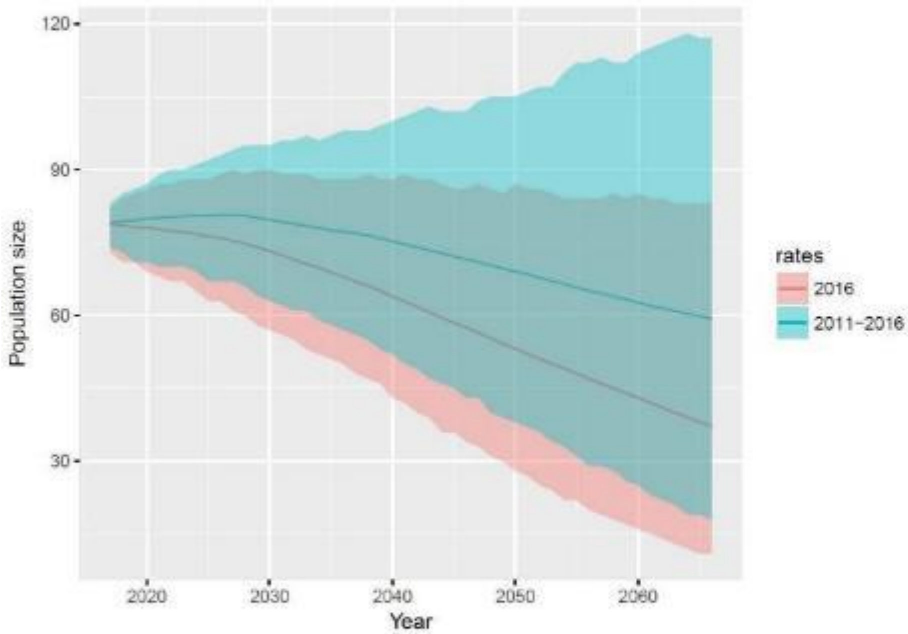


Figure 3. Southern Resident killer whale population size projections from 2016 to 2066 using two scenarios: (1) projections using demographic rates held at 2016 levels, and (2) projections using demographic rates from 2011 to 2016. The pink line represents the projection assuming future rates are similar to those in 2016, whereas the blue represents the scenario with future rates being similar to 2011 to 2016 (Figure 2, NMFS (2016c)).

Because of the whales’ small population size, the population is also susceptible to increased risks of demographic stochasticity – randomness in the pattern of births and deaths among individuals in a population. Several sources of demographic variance (e.g. differences between individuals or within individuals) can affect small populations and contribute to variance in a population’s growth and increased extinction risk. Sources of demographic variance can include environmental stochasticity, or fluctuations in the environment that drive changes in birth and death rates, and demographic heterogeneity, or variation in birth or death rates of individuals because of differences in their individual fitness (including sexual determinations). In combination, these and other sources of random variation combine to amplify the probability of extinction, known as the extinction vortex (Gilpin and Michael 1986; Fagan and Holmes 2006; Melbourne and Hastings 2008). The larger the population size, the greater the buffer against stochastic events and genetic risks.

Population-wide distribution of lifetime reproductive success can be highly variable, such that some individuals produce more offspring than others to subsequent generations, and male variance in reproductive success can be greater than that of females (e.g. Clutton-Brock 1988; Hochachka 2006). For long-lived vertebrates such as killer whales, some females in the population might contribute less than the number of offspring required to maintain a constant population size (n = 2), while others might produce more offspring. The smaller the population, the more weight an individual's reproductive success has on the population’s growth or decline (Coulson et al. 2006). For example, from 2010 through July 2019, only 15 of the 28 reproductive aged females successfully reproduced, resulting in 16 calves. There were an additional 10 documented non-viable calves, and likely more undocumented, born during this period (CWR unpubl. data). A recent study indicated pregnancy hormones (progesterone and testosterone) can be detected in SRKW feces and have indicated several miscarriages, particularly in late pregnancy (Wasser et al. 2017). The fecal hormone data have shown that up to 69 percent of the detected pregnancies do not produce a documented calf (Wasser et al. 2017). Recent aerial imagery corroborates this high rate of loss (Fearnbach and Durban unpubl. data). The congruence between the rate of loss estimates from fecal hormones and aerial photogrammetry suggests the majority of the loss is in the latter half of pregnancy when photogrammetry can detect anomalous shape after several months of gestation (Durban et al. 2016).

2.2.1.2 Geographic Range and Distribution

SRKWs occur throughout the coastal waters off Washington, Oregon, and Vancouver Island and are known to travel as far south as central California and as far north as Southeast Alaska (NMFS 2008e; Carretta et al. 2019; Ford et al. 2017) (Figure 4). SRKW are highly mobile and can travel up to approximately 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, SRKWs have typically spent 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). Although seasonal movements are somewhat predictable, there can be large inter-annual variability in arrival time and days present in inland waters from spring through fall, with late arrivals and fewer days present in recent years (Hanson and Emmons 2010; The Whale Museum unpubl. data).

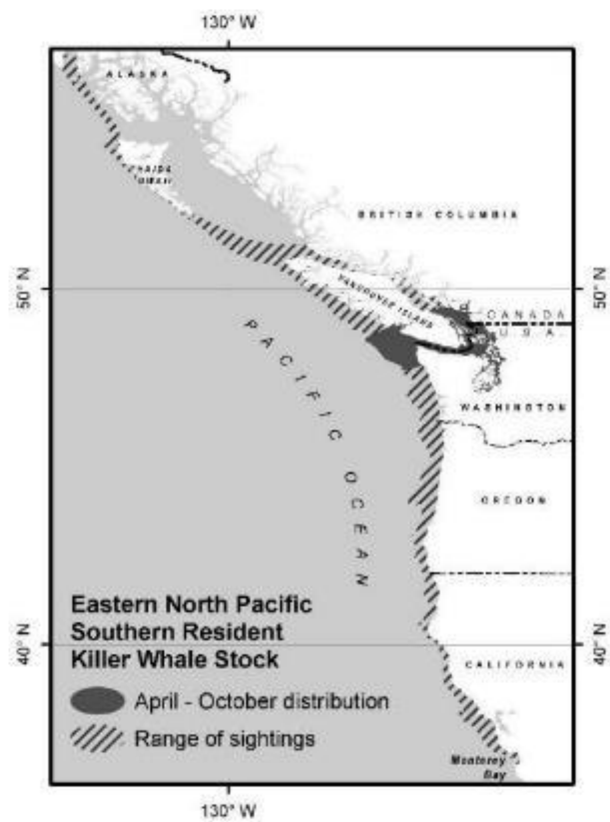


Figure 4. Approximate April – October distribution of Southern Resident killer whales (shaded area) and range of sightings (diagonal lines) (reprinted from Carretta et al. (2019)).

Land- and vessel-based opportunistic and survey-based visual sightings, satellite tracking, and passive acoustic research conducted have provided an updated estimate of the whales' coastal range that extends from the Monterey Bay area in California, north to Chatham Strait in southeast Alaska. Since 1975, confirmed and unconfirmed opportunistic SRKW sightings from the general public or researchers have been collected off British Columbia, Washington, Oregon, and California. Because of the limitations of not having controlled and dedicated sampling efforts, these confirmed opportunistic sightings have provided only general information on the whales' potential geographic range during this period of time (*i.e.,* there are no data to describe the whales' general geographic range prior to 1975). Together, these SRKW sightings have confirmed their presence as far north as Chatham Strait, southeast Alaska and as far south as Monterey Bay, California (NMFS 2019d).

As part of a collaborative effort between NWFSC, Cascadia Research Collective and the University of Alaska, satellite-linked tags were deployed on eight male SRKW (three tags on J pod members, two on K pod, and three on L pod) from 2012 to 2016 in Puget Sound or in the coastal waters of Washington and Oregon (Table 2). The tags transmitted multiple locations per day to assess winter movements and occurrences of SRKW (Hanson et al. 2017).

Over the course of the study, the satellite tagging resulted in data range of duration days, from 3 days to 96 days depending on the tag, of monitoring with deployment durations from late December to mid-May (Table 2). The winter locations of the tagged whales included inland and coastal waters. The inland waters range occurs across the entire Salish Sea, from the northern end of the Strait of Georgia and Puget Sound, and coastal waters from central west coast of Vancouver Island, British Columbia to northern California (Hanson et al. 2017). J pod had high use areas (defined as 1 to 3 standard deviations) in the northern Strait of Georgia and the west entrance to the Strait of Juan de Fuca where they spent approximately 30 percent of their time there (Figure 5). K/L pods occurred almost exclusively on the continental shelf during December to mid-May, primarily on the Washington coast, with a continuous high use area between Grays Harbor and the Columbia River and off Westport and spending approximately 53 percent of their time there (Figure 6) (Hanson et al. 2017, 2018). The tagging data provide general information on the home range and overlap of each pod from 2012 to 2016.

Satellite tagging can also provide details on preferred depths and distances from shore. Approximately 95 percent of the SRKW locations were within 34 km of the shore and 50 percent of these were within 10 km of the coast (Hanson et al. 2017). Only 5 percent of locations were greater than 34 km away from the coast, but no locations exceeded 75 km. Most locations were in waters less than 100m in depth.

Table 2**.** Satellite-linked tags deployed on Southern resident killer whales 2012-2016. (Hanson et al. 2018). This was part of a collaborative effort between NWFSC, Cascadia Research Collective, and the University of Alaska.

Whale ID	Pod association	Date of tagging	Duration of signal contact (days)
J26	J	20 Feb. 2012	3
L87	J	26 Dec. 2013	31

Whale ID	Pod association	Date of tagging	Duration of signal contact (days)
J27	J	28 Dec. 2014	49
K25	K	29 Dec. 2012	96
L88	L	8 Mar. 2013	8
L84	L	17 Feb. 2015	93
K33	K	31 Dec. 2015	48
L95	L	23 Feb. 2016	3

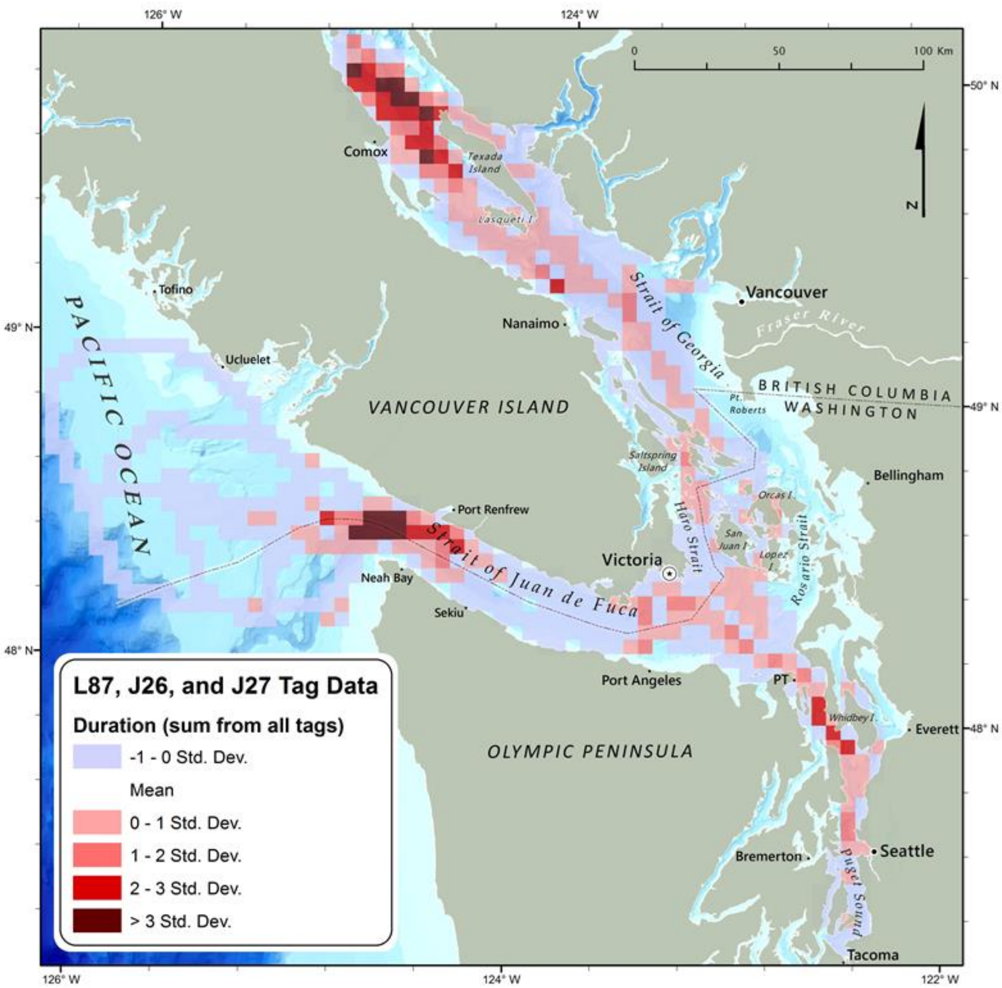


Figure 5 Duration of occurrence model output for J pod tag deployments (Hanson et al. 2017). “High use areas” are illustrated by the 0 to > 3 standard deviation pixels.

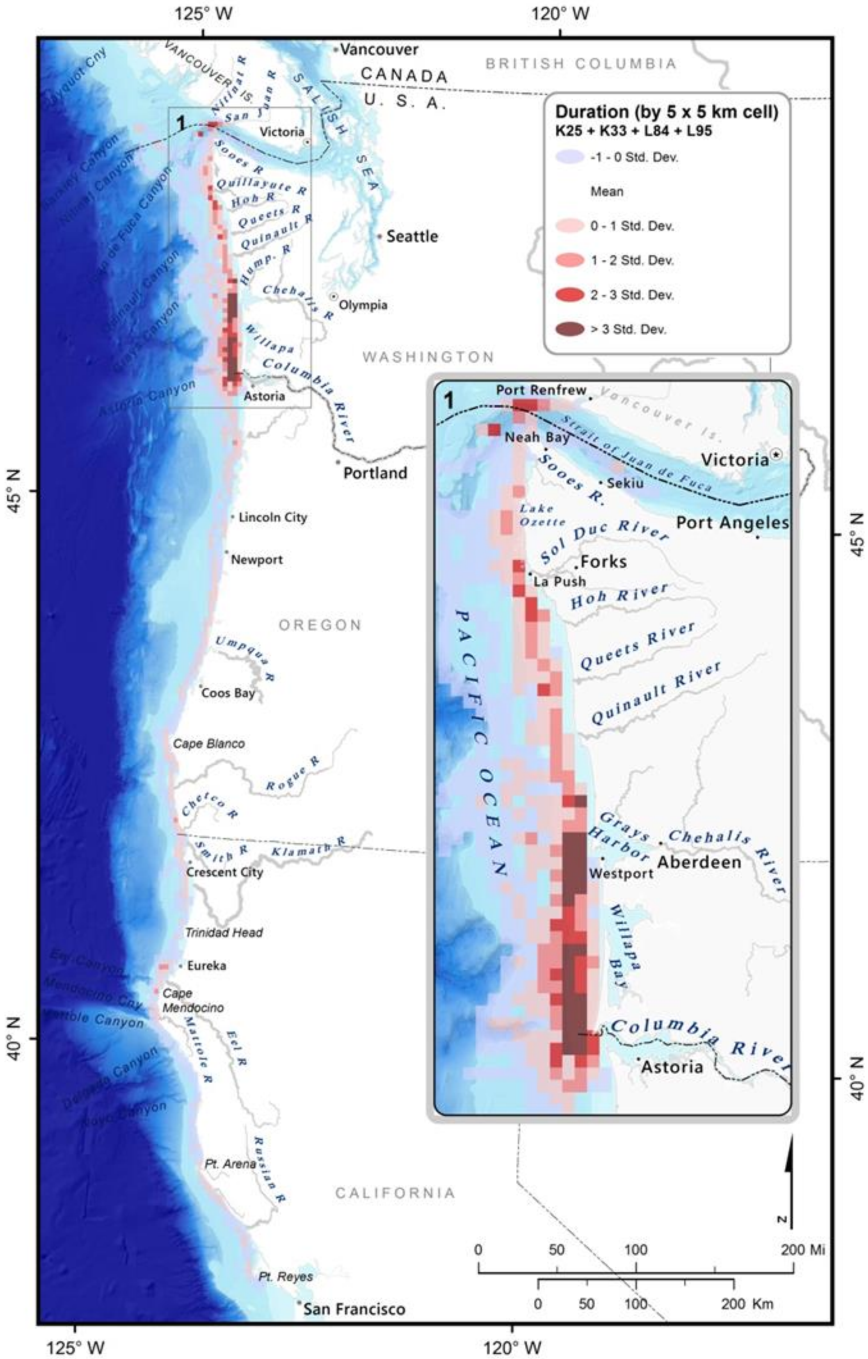


Figure 6 Duration of occurrence model for all unique K and L pod tag deployments (Hanson et al. 2017). "High use areas" are illustrated by the 0 to > 3 standard deviation pixels.

Passive acoustic recorders were deployed off the coasts of California, Oregon and Washington in most years since 2006 to assess their seasonal uses of these areas via the recording of stereotypic calls of the SRKW (Hanson et al. 2013; Emmons et al. 2019). Passive aquatic listeners (PALs) were originally deployed from 2006 – 2008. Since 2008, four to seventeen Ecological Acoustic Recorders (EARs) have been deployed. From 2006 – 2011, passive acoustic listeners and recorders were deployed in areas thought to be of frequent use by SRKWs based on previous sightings, where enhanced productivity was expected to be concentrated, and in areas with a reduced likelihood of fisheries interactions (Figure 7; Hanson et al. (2013)). The number of recorder sites off the Washington coast increased from 7 to 17 in the fall of 2014 and locations were selected based on "high use areas" identified in the duration of an occurrence model (Figure 8), and sites within the U.S. Navy's Northwest Training Range Complex (NWTRC) in order to determine if SRKWs used these areas in other seasons when satellite-linked tags were not deployed (Hanson et al. 2017; Emmons et al. 2019). "High use areas" for the SRKW in winter were determined to be primarily located in three areas 1) the Washington coast, particularly between Grays Harbor and the mouth of the Columbia River (primarily for K/L pods); 2) the west entrance to the Strait of Juan de Fuca (primarily for J pod); and 3) the northern Strait of Georgia (primarily for J pod). It is important to note that recorders deployed within the NWTRC were designed to assess spatial use off Washington coast and thus the effort was higher in this area (i.e. the number of recorders increased in this area) compared to off Oregon and California.

There were acoustic detections off Washington coast in all months of the year (Figure 9), with greater than 2.4 detections per month from January through June and a peak of 4.7 detections per month in both March and April, indicating that the SRKW 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. 2017). Acoustic recorders were deployed off Newport, Fort Bragg, and Port Reyes between 2008 through 2013 and SRKW were detected 28 times (Emmons et al. 2019).

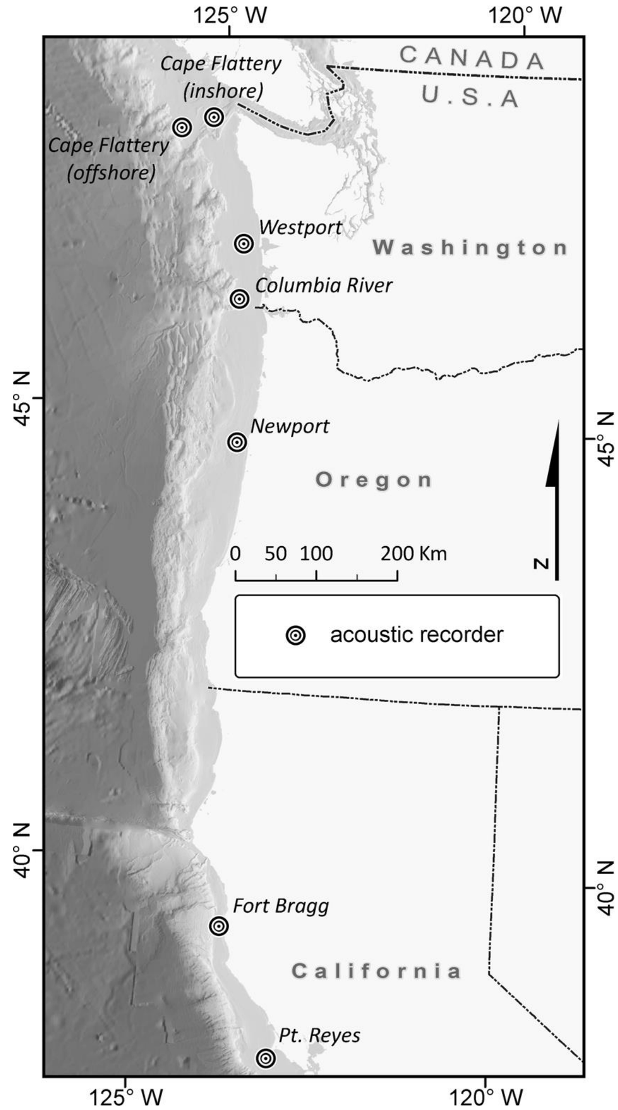


Figure 7. Deployment locations of acoustic recorders on the U.S. west coast from 2006 to 2011 (Hanson et al. 2013).

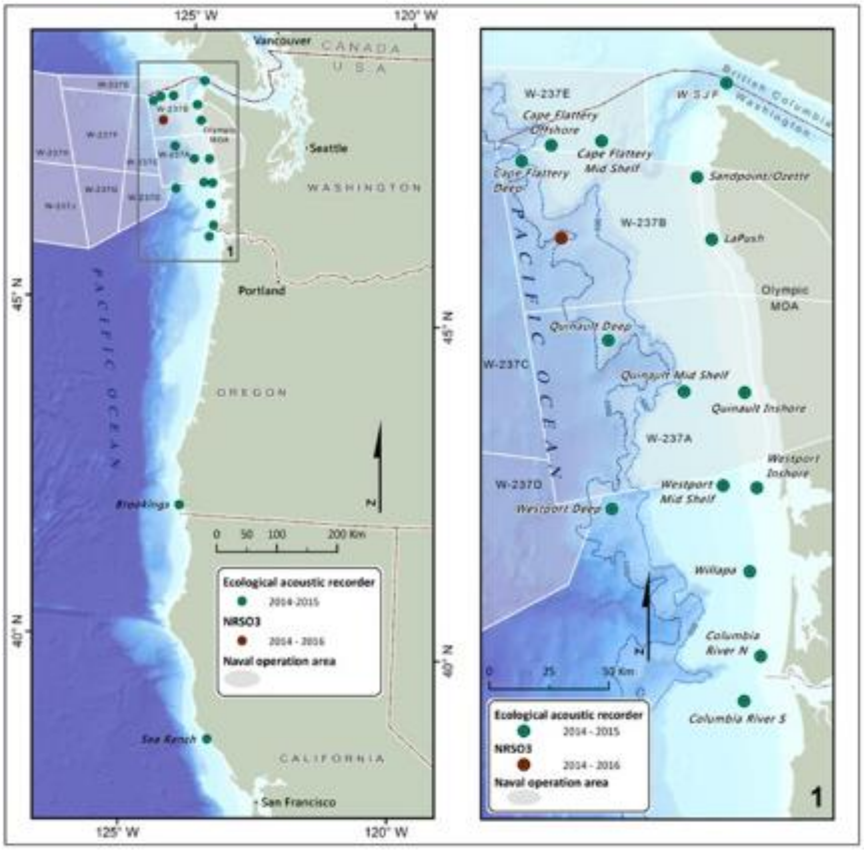


Figure 8. Locations of passive acoustic recorders deployed beginning in the fall of 2014 (Hanson et al. 2017).

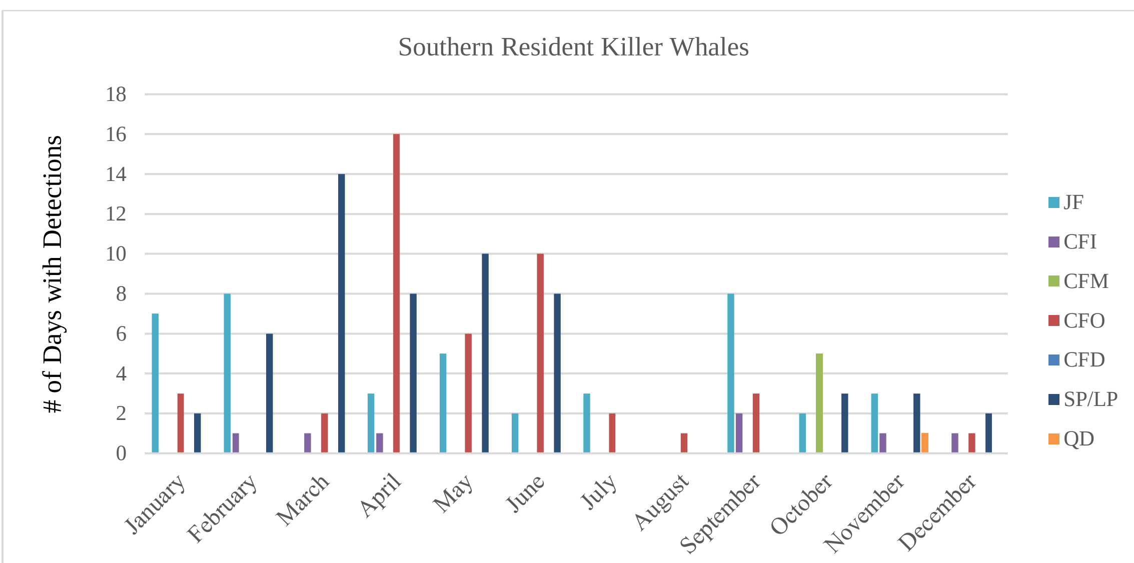


Figure 9. Counts of detections at each northern recorder site by month from 2014-2017 (Emmons et al. 2019). Areas include Juan de Fuca (JF); Cape Flattery Inshore (CFI); Cape Flattery Mid Shelf (CFM); Cape Flattery Offshelf (CFO); Cape Flattery Deep(CFD); Sand Point and La Push (SP/LP); and Quinault Deep (QD).

In a recent study, researchers collected data using an autonomous acoustic recorder deployed at Swiftsure Bank from August 2009 to July 2011 to assess how this area is used by Northern Resident and Southern Residents as shown in Figure 10 (Riera et al. 2019). SRKW were detected on 163 days with 175 encounters (see Figure 11 for number of days of acoustic detections for each month). All three pods were detected at least once per month except for J pod in January and November and L pod in March. K and L pods were heard more often (87 percent of calls and 89 percent of calls, respectively), between May and September. J pod was heard most often during winter and spring (76 percent of calls during December and February through May; Riera et al. 2019). K pod had the longest encounters in June, with 87 percent of encounters longer than 2 hours occurring between June and September. L pod had the longest encounters in May, with 79 percent of encounters longer than two hours occurring during the summer (May through September). The longest J pod encounters were during winter, with 72 percent of encounters longer than 2 hours occurring between December and May (Riera et al. 2019).

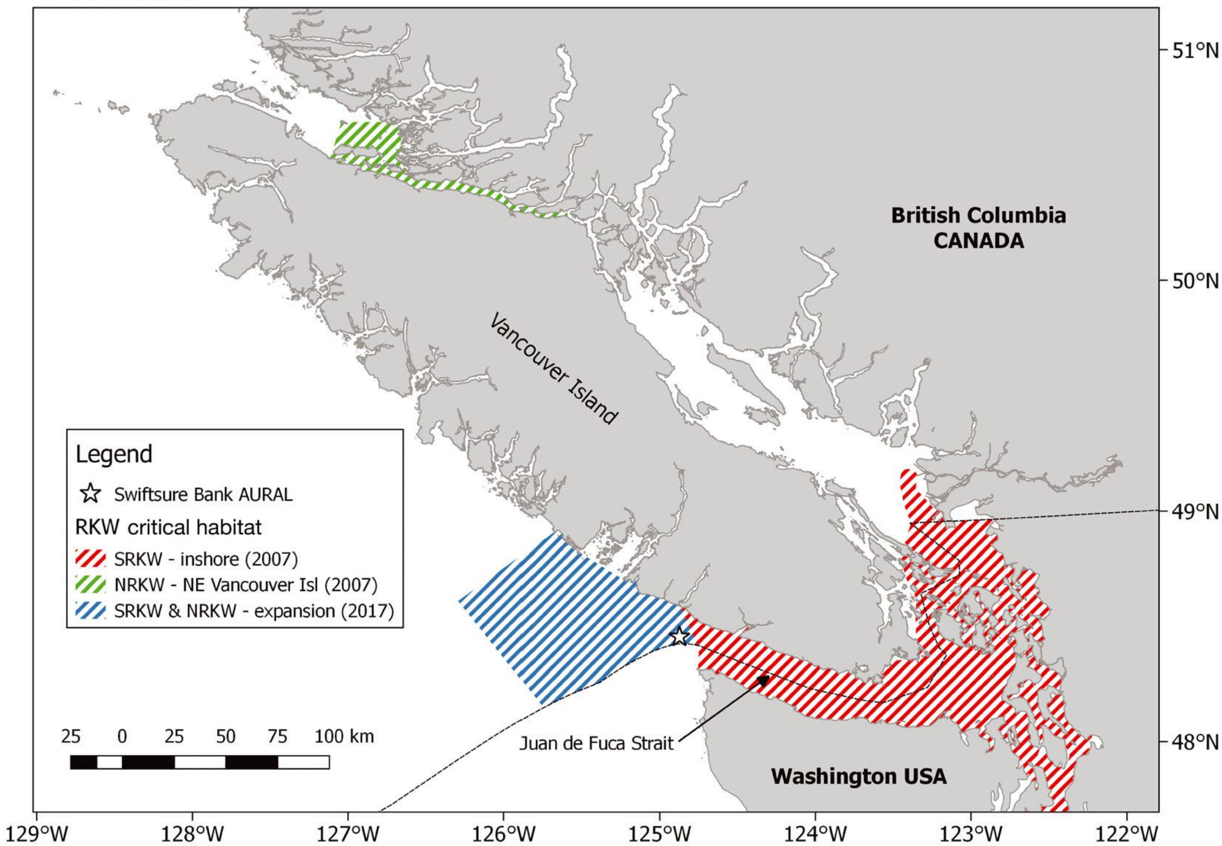


Figure 10. Swiftsure Bank study site off the coast of British Columbia, Canada in relation to the 2007 Northern Resident critical habitat (NE Vancouver Island) and 2007 Southern Resident killer whale critical habitat (inshore waters) and the 2017 Northern Resident and Southern Resident expansion of critical habitat (Riera et al. 2019).

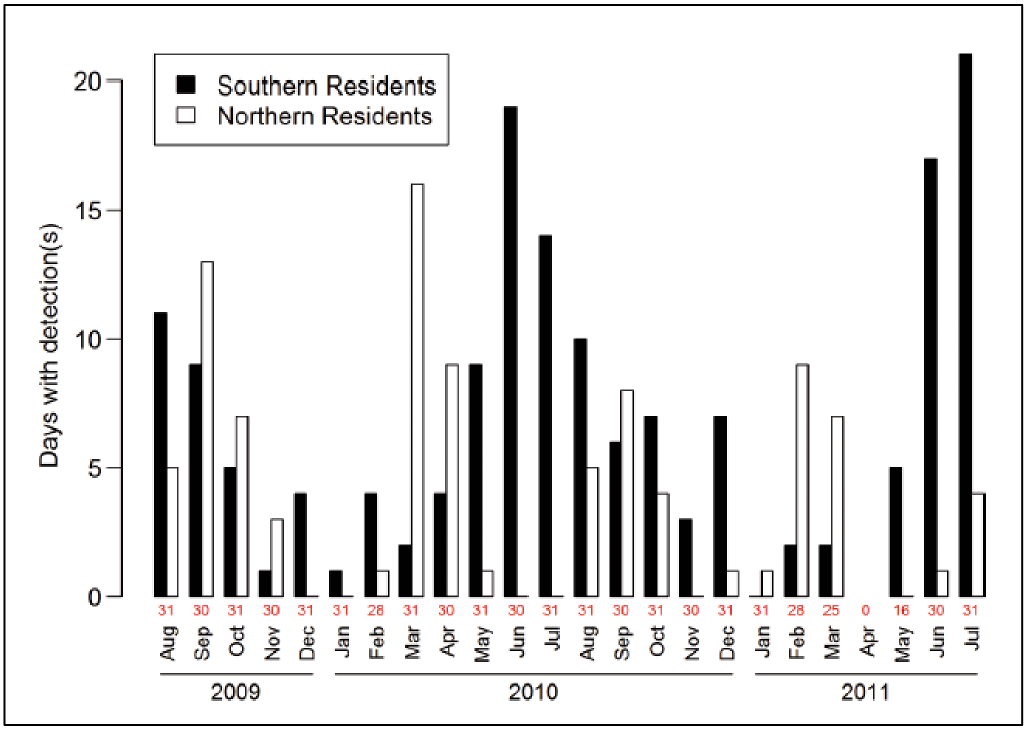


Figure 11. Number of days with acoustic detections of SRKWs at Swiftsure Bank from August 2009 – July 2011. Red numbers indicate days of effort. (Riera et al. 2019).

2.2.1.3 Limiting Factors and Threats

Several factors identified in the recovery plan for SRKW may be limiting recovery. The recovery plan identified three major threats including (1) the quantity and quality of prey, (2) toxic chemicals that accumulate in top predators, and (3) impacts from sound and vessels. Oil spills and disease as well as the small population size are also risk factors. It is likely that multiple threats are acting together to impact SRKWs. Modeling exercises have attempted to identify which threats are most significant to survival and recovery (e.g. Lacy et al. 2017) and available data suggest that all of the threats are potential limiting factors (NMFS 2008e).

<u>Quantity and Quality of Prey</u>

SRKWs have been documented to consume a variety of fish species (22 species) and one species of squid (Ford et al. 1998; Ford et al. 2000; Ford and Ellis 2006; Hanson et al. 2010; Ford et al. 2016), but salmon are identified as their primary prey. SRKWs are the subject of ongoing research, the majority of which has occurred in inland waters of Washington State and British Columbia, Canada during summer months and includes direct observation, scale and tissue sampling of prey remains, and fecal sampling. The diet data suggest that SRKWs are consuming mostly larger (i.e., generally age 3 and up) Chinook salmon (Ford and Ellis 2006). Chinook salmon is their primary prey despite the much lower abundance in comparison to other salmonids in some areas and during certain time periods (Ford and Ellis 2006). Factors of potential importance include the species' large size, high fat and energy content, and year-round occurrence in the SRKWs' geographic range. Chinook salmon have the highest value of total energy content compared to other salmonids because of their larger body size and higher energy density (kilocalorie/kilogram (kcal/kg)) (O'Neill et al. 2014). For example, in order for a SRKW to obtain the total energy value of one adult Chinook salmon, they would need to consume approximately 2.7 coho, 3.1 chum, 3.1 sockeye, or 6.4 pink salmon (O'Neill et al. 2014). Research suggests that SRKWs are capable of detecting, localizing, and recognizing Chinook salmon through their ability to distinguish Chinook echo structure as different from other salmon (Au et al. 2010). The degree to which killer whales are able to or willing to switch to non-preferred prey sources (i.e., prey other than Chinook salmon) is also largely unknown, and likely variable depending on the time and location.

Over the last forty years, predation on Chinook salmon off the West Coast of North America by marine mammals has been estimated to have more than doubled (Chasco et al. 2017). In particular, southern Chinook salmon stocks ranging south from the Columbia River have been subject to the largest increases in predation, and Chasco et al. (2017) suggested that SRKWs may be the most disadvantaged compared to other more northern resident killer whale populations given the northern migrations of Chinook salmon stocks in the ocean and this competition may be limiting the growth of the SRKW population.

May - September

Scale and tissue sampling from May to September in inland waters of Washington and British Columbia, Canada indicate that the SRKW's diet consists of a high percentage of Chinook salmon (monthly proportions as high as >90 percent) (Hanson et al. 2010; Ford et al. 2016). Genetic analysis of the Hanson et al. (2010) samples from 2006-2010 indicate that when SRKW are in inland waters from May to September, they primarily consume Chinook stocks that originate from the Fraser River (80–90 percent of the diet in the Strait of Juan de Fuca and San Juan Islands; including Upper Fraser, Mid Fraser, Lower Fraser, North Thompson, South Thompson and Lower Thompson), and to a lesser extent consume stocks from Puget Sound (North and South Puget Sound) and Central British Columbia Coast and West and East Vancouver Island. This is not unexpected as all of these stocks are returning to streams proximal to these inland waters during this timeframe. Few diet samples have been collected in summer months outside of the Salish Sea.

DNA quantification methods are also used to estimate the proportion of different prey species in the diet from fecal samples (Deagle et al. 2005). Recently, Ford et al. (2016) confirmed the importance of Chinook salmon to SRKWs in the early to mid-summer months (May-August) using DNA sequencing from SRKW feces collected in inland waters of Washington and British Columbia. Salmon and steelhead made up greater than 98 percent of the inferred diet, of which almost 80 percent were Chinook salmon. Coho salmon and steelhead are also found in the diet in inland waters of Washington and British Columbia in spring and fall months when Chinook salmon are less abundant. Specifically, coho salmon contribute to over 40 percent of the diet in September in inland waters, which is evidence of prey shifting at the end of summer towards coho salmon (Ford et al. 1998; Ford and Ellis 2006; Hanson et al. 2010; Ford et al. 2016). Less than 3 percent each of chum salmon, sockeye salmon, and steelhead were observed in fecal DNA samples collected in the summer months (May through September) in inland waters.

October - December

Prey remains and fecal samples collected in U.S. inland waters during October through December indicate Chinook and chum salmon are primary contributors of the whale's diet during this time (NWFSC unpublished data). Diet data for the Strait of Georgia and coastal waters is limited.

January – April

Observations of SRKWs overlapping with salmon runs (Wiles 2004; Zamon et al. 2007) and collection of prey and fecal samples have also occurred in coastal waters in the winter and spring months. Although fewer predation events have been observed and fewer fecal samples collected in coastal waters, recent data indicate that salmon, and Chinook salmon in particular, remains an important dietary component when the SRKWs occur in outer coastal waters during these timeframes. Prior to 2013, only three prey samples for SRKW on the U.S. outer coast had been collected (Hanson et al. in prep). From 2013 to 2016, satellite tags were used to locate and follow the whales to obtain predation and fecal samples. A total of 55 samples were collected from northern California to northern Washington (Figure 12). Results of the 55 available prey samples indicate that, as is the case in inland waters, Chinook are the primary species detected in diet samples on the outer coast, although steelhead, chum, lingcod, and halibut were also detected in samples. Despite J pod utilizing much of the Salish Sea – including the Strait of Georgia – in winter months (Hanson et al. 2018), few diet samples have been collected in this region in winter.

The occurrence of K and L pods off the Columbia River in March suggests the importance of Columbia River spring runs of Chinook salmon in their diet (Hanson et al. 2013). Chinook genetic stock identification from samples collected in winter and spring in coastal waters from California through Washington included 12 U.S. west coast stocks, and showed that over half the Chinook salmon consumed originated in the Columbia River (Hanson et al. in prep). Columbia River, Central Valley, Puget Sound, and Fraser River Chinook salmon collectively comprised over 90 percent of the 55 diet samples collected for SRKW's in coastal areas.

As noted, most of the Chinook prey samples opportunistically collected in coastal waters were determined to have originated from the Columbia River basin, including Lower Columbia Spring, Middle Columbia Tule, and Upper Columbia Summer/Fall. In general, we would expect to find these stocks given the diet sample locations (Figure 12) However, the Chinook stocks included fish from as far north as the Taku River (Alaska and British Columbia stocks) and as far south as the Central Valley California.

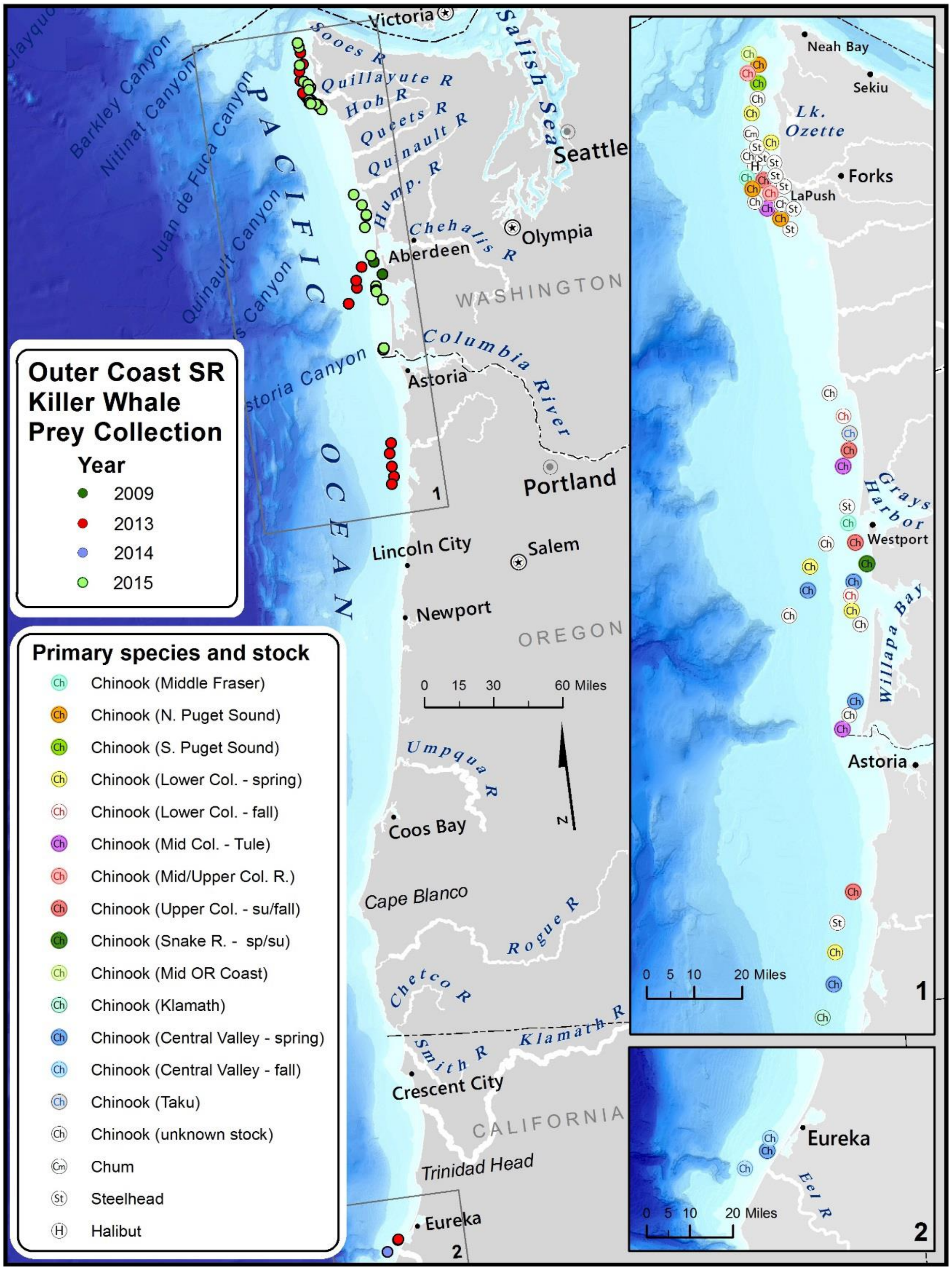


Figure 12. Location and species for scale/tissue samples collected from Southern Resident killer whale predation events in outer coastal waters (NMFS 2019d).

In an effort to prioritize recovery efforts such as habitat restoration and help inform efforts to use fish hatcheries to increase the whales' prey base, NMFS and WDFW developed a report identifying Chinook salmon stocks thought to be of high importance to SRKW along the West

Coast (NOAA and WDFW 2018)[2]. Scientists and managers from the U.S. and Canada reviewed the model at a workshop sponsored by the National Fish and Wildlife Foundation (NFWF), where the focus was on assisting NFWF in prioritizing funding for salmon related projects. The priority stock report was created using observations of Chinook salmon stocks found in scat and prey scale/tissue samples, and by estimating the spatial and temporal overlap with Chinook salmon stocks ranging from Southeast Alaska (SEAK) to California (CA).

Hatchery production is a significant component of the salmon prey base returning to watersheds within the range of SRKWs (Barnett-Johnson et al. 2007; NMFS 2008e). The release of hatchery fish has not been identified as a threat to the survival or persistence of SRKWs and there is no evidence to suggest the whales prefer wild salmon over hatchery salmon. Increased Chinook abundance, including hatchery fish, benefit this endangered population of whales by enhancing prey availability to SRKWs and hatchery fish often contribute significantly to the salmon stocks consumed (Hanson et al. 2010, Hanson et al. in prep). Currently, hatchery fish play a mitigation role of helping sustain Chinook salmon numbers while other, longer term, recovery actions for natural fish are underway. Although hatchery production has contributed some offset of the historical declines in the abundance of natural-origin salmon within the range of the whales, hatcheries also pose risks to natural-origin salmon populations (Nickelson et al. 1986; Ford 2002; Levin and Williams 2002; Naish et al. 2007). Healthy natural-origin salmon populations are important to the long-term maintenance of prey populations available to Southern Residents because it is uncertain whether a hatchery dominated mix of stocks is sustainable indefinitely and because hatchery fish can differ, relative to natural-origin Chinook salmon, for example, in size and hence caloric value and in availability/migration location and timing.

<u>Nutritional Limitation and Body Condition</u>

When prey is scarce or in low density, SRKWs likely spend more time foraging than when prey is plentiful or in high density. Increased energy expenditure and prey limitation can cause poor body condition and nutritional stress. Nutritional stress is the condition of being unable to acquire adequate energy and nutrients from prey resources and as a chronic condition, can lead to reduced body size of individuals and to lower reproductive or survival rates in a population (Trites and Donnelly 2003). During periods of nutritional stress and poor body condition, cetaceans lose adipose tissue behind the cranium, displaying a condition known as “peanut-head” in extreme cases (Pettis et al. 2004; Bradford et al. 2012; Joblon et al. 2014). Between 1994 and 2008, 13 SRKWs were observed from boats to have a pronounced “peanut-head”; and all but two subsequently died (Durban et al. 2009; Center for Whale Research unpublished data). None of the whales that died were subsequently recovered, and therefore definitive cause of death could not be identified. Both females and males across a range of ages were found in poor body condition.

Since 2008, NOAA’s Southwest Fishery Science Center (SWFSC) have used aerial photogrammetry to assess the body condition and health of SRKWs, initially in collaboration with the Center for Whale Research and the Vancouver Aquarium. Aerial photogrammetry studies have provided finer resolution for detecting poor condition, even before it manifests in “peanut-head” that is observable from boats. Annual aerial surveys of the population from 2013-2017 (with exception of 2014) have detected declines in condition before the death of seven

[2]https://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/killer_whales/recovery/srkw_priority_chinook_stocks_conceptual_model_report___list_22june2018.pdf

SRKWs (L52 and J8 as reported in Fearnbach et al. (2018); J14, J2, J28, J54, and J52 as reported in Durban et al. (2017)), including five of the six most recent mortalities (Trites and Rosen 2018). These data have provided evidence of a general decline in SRKW body condition since 2008, and documented members of J pod being in poorer body condition in May compared to September of the previous year (at least in 2016 and 2017) (Trites and Rosen 2018). Other pods could not be reliably photographed in both seasonal periods.

Data collected from three SRKW strandings in recent years have also contributed to our knowledge of the health of the population and the impact of the threats to which they are exposed. Transboundary partnerships have supported thorough necropsies of L112 in 2012, J32 in 2014, and L95 in 2016, which included testing for contaminant load, disease and pathogens, organ condition, and diet composition[3]. In fall 2016 another young adult male, J34, was found dead in the northern Georgia Strait (Carretta et al. 2019). The necropsy indicated that the whale died of blunt force trauma to the head and the source of trauma is still under investigation.

Previous scientific review investigating nutritional stress as a cause of poor body condition for SRKWs concluded "Unless a large fraction of the population experienced poor condition in a particular year, and there was ancillary information suggesting a shortage of prey in that same year, malnutrition remains only one of several possible causes of poor condition" (Hilborn et al. 2012). Body condition in whales can be influenced by a number of factors, including prey availability or limitation, increased energy demands, disease, physiological or life history status, and variability over seasons or across years. Body condition data collected to date has documented declines in condition for some animals in some pods and these occurrences have been scattered across demographic and social groups (Fearnbach et al. 2018).

It is possible that poor nutrition could contribute to mortality through a variety of mechanisms. To exhibit how this is possible, we reference studies that have demonstrated the effects of energetic stress (caused by incremental increases in energy expenditures or incremental reductions in available energy) on adult females and juveniles, which have been studied extensively (e.g., adult females: Gamel et al. (2005), Schaefer (1996), Daan et al. (1996), juveniles: Trites and Donnelly (2003)). Small, incremental increases in energy demands should have the same effect on an animal's energy budget as small, incremental reductions in available energy, such as one would expect from reductions in prey. Malnutrition and persistent or chronic stress can induce changes in immune function in mammals and may be associated with increased bacterial and viral infections, and lymphoid depletion (Mongillo et al. 2016; Neale et al. 2005; Maggini et al. 2018). Ford and Ellis (2006) report that SRKWs engage in prey sharing about 76 percent of the time. Prey sharing presumably would distribute more evenly the effects of prey limitation across individuals of the population than would otherwise be the case (i.e., if the most successful foragers did not share with other individuals).

Toxic Chemicals

Various adverse health effects in humans, laboratory animals, and wildlife have been associated with exposures to persistent pollutants. These pollutants have the ability to cause endocrine disruption, reproductive disruption or failure, immunotoxicity, neurotoxicity, neurobehavioral disruption, and cancer (Reijnders 1986; Subramanian et al. 1987; de Swart et al. 1996; Bonefeld-Jørgensen et al. 2001; Reddy et al. 2001; Schwacke et al. 2002; Darnerud 2003; Legler and

[3] Reports for those necropsies are available at: http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/killer_whale/rpi_strandings.html

Brouwer 2003; Viberg et al. 2003; Ylitalo et al. 2005; Fonnum et al. 2006; Darnerud 2008; Legler 2008). SRKWs are exposed to a mixture of pollutants, some of which may interact synergistically and enhance toxicity, influencing their health, and reproduction. Relatively high levels of these pollutants have been measured in blubber biopsy samples from SRKWs compared to other resident killer whales in the North Pacific (Ross et al. 2000; Krahn et al. 2007; Krahn et al. 2009; Lawson et al. 2020), and more recently, these pollutants were measured in fecal samples collected from SRKWs providing another potential opportunity to evaluate exposure to these pollutants (Lundin et al. 2016a; Lundin et al. 2016b).

Southern Resident killer whales are exposed to persistent pollutants primarily through their diet. For example, Chinook salmon contain higher levels of some persistent pollutants than other salmon species, but only limited information is available for pollutant levels in Chinook salmon (Krahn et al. 2007; O'Neill and West 2009; Veldhoen et al. 2010; Mongillo et al. 2016). These harmful pollutants, through consumption of prey species that contain these pollutants, are stored in the blubber and can later be released; when the pollutants are released, they are redistributed to other tissues when the SRKWs metabolize the blubber, for example, responses to food shortages or reduced acquisition of food energy as one possible stressor. The release of pollutants can also occur during gestation or lactation. Once the pollutants mobilize from the blubber in to circulation, they have the potential to cause a toxic response. Therefore, nutritional stress from reduced Chinook salmon populations may act synergistically with high pollutant levels in SRKWs and result in adverse health effects.

In April 2015, NMFS hosted a 2-day Southern Resident killer whale health workshop to assess the causes of decreased survival and reproduction in the killer whales. Following the workshop, a list of potential action items to better understand what is causing decreased reproduction and increased mortality in this population was generated and then reviewed and prioritized to produce the Priorities Report (NMFS 2015b). The report also provides prioritized opportunities to establish important baseline information on Southern Resident and reference populations to better assess negative impacts of future health risks, as well as positive impacts of mitigation strategies on Southern Resident killer whale health.

<u>Disturbance from Vessels and Sound</u>

Killer whales rely on their highly developed acoustic sensory system for navigating, locating prey, and communicating with other individuals. While in inland waters of Washington and British Columbia, SRKWs are the principal target species for the commercial whale watch industry (Hoyt 2001; O'Connor et al. 2009) and encounter a variety of other vessels in their urban environment (e.g., recreational, fishing, ferries, military, shipping). Several main threats from vessels include direct vessel strikes (which can result in injury or mortality (Gaydos and Raverty 2007)), the masking of echolocation and communication signals by anthropogenic sound, and behavioral changes (NMFS 2008e). There is a growing body of evidence documenting effects from vessels on small cetaceans and other marine mammals. Research has shown that SRKWs spend more time traveling and performing surface active behaviors and less time foraging in the presence of all vessel types, including kayaks, and that noise from motoring vessels up to 400 meters away has the potential to affect the echolocation abilities of foraging whales (Holt 2008; Lusseau et al. 2009; Noren et al. 2009; Williams et al. 2010). Individual energy balance may be impacted when vessels are present because of the combined increase in energetic costs resulting from changes in whale activity with the decrease in prey consumption resulting from reduced foraging opportunities (Williams et al. 2006; Lusseau et al. 2009; Noren et al. 2009; Noren et al. 2012).

At the time of the SRKWs' listing under the ESA, NMFS reviewed existing protections for the whales and developed recovery actions, including vessel regulations, to address the threat of vessels to SRKWs. NMFS concluded it was necessary and advisable to adopt regulations to protect SRKWs from disturbance and sound associated with vessels, to support recovery of SRKWs. Federal vessel regulations were established in 2011 to prohibit vessels from approaching SRKWs within 200 yards (182.9m) and from parking in the path of SRKWs within 400 yards (365.8m). These regulations apply to all vessels in inland waters of Washington State with exemptions to maintain safe navigation and for government vessels in the course of official duties, ships in the shipping lanes, research vessels under permit, and vessels lawfully engaged in commercial or treaty Indian fishing that are actively setting, retrieving, or closely tending fishing gear (76 FR 20870, April, 14, 2011).

In the final rule implementing these regulations, NMFS committed to reviewing the vessel regulations to evaluate effectiveness, and also to study the impact of the regulations on the viability of the local whale watch industry. In December 2017, NMFS completed a technical memorandum evaluating the effectiveness of regulations adopted in 2011 to help protect endangered SRKWs from the impacts of vessel traffic and noise (Ferrara et al. 2017). In the assessment, Ferrara et al. (2017) used five measures: education and outreach efforts, enforcement, vessel compliance, biological effectiveness, and economic impacts. For each measure, the trends and observations in the five years leading up to the regulations (2006-2010) were compared to the trends and observations in the five years following the regulations (2011-2015). The memo finds that some indicators suggested the regulations have benefited SRKWs by reducing impacts without causing economic harm to the commercial whale-watching industry or local communities, whereas some indicators suggested that vessel impacts continue and that some risks may have increased. The authors also find room for improvement in terms of increasing awareness and enforcement of the regulations, which would help improve compliance and further reduce biological impacts to the whales.

In addition to vessels, underwater sound can be generated by a variety of other human activities, such as dredging, drilling, construction, seismic testing, and sonar (Richardson et al. 1995; Gordon and Moscrop. 1996; National Research Council 2003). Impacts from these sources can range from serious injury and mortality to changes in behavior. In other cetaceans, hormonal changes indicative of stress have been recorded in response to intense sound exposure (Romano et al. 2003). Chronic stress is known to induce harmful physiological conditions including lowered immune function, in terrestrial mammals and likely does so in cetaceans (Gordon and Moscrop. 1996).

<u>Oil Spills</u>

In the Northwest, SRKWs are the most vulnerable marine mammal population to the risks imposed by an oil spill due to their small population size, strong site fidelity to areas with high oil spill risk, large group size, late reproductive maturity, low reproductive rate, and specialized diet, among other attributes (Jarvela-Rosenberger et al. 2017). Oil spills have occurred in the range of SRKWs in the past, and there is potential for spills in the future. Oil can be discharged into the marine environment in any number of ways, including shipping accidents, refineries and associated production facilities, and pipelines. Despite many improvements in spill prevention since the late 1980s, much of the region inhabited by SRKWs remains at risk from serious spills because of the heavy volume of shipping traffic and proximity to petroleum refining centers.

Repeated ingestion of petroleum hydrocarbons by killer whales likely causes adverse effects; however, long-term consequences are poorly understood. In marine mammals, acute exposure to petroleum products can cause changes in behavior and reduced activity, inflammation of the mucous membranes, lung congestion and disease, pneumonia, liver disorders, neurological damage, adrenal toxicity, reduced reproductive rates, and changes in immune function (Schwacke et al. 2013; Venn-Watson et al. 2015; de Guise et al. 2017; Kellar et al. 2017), potentially death and long-term effects on population viability (Matkin et al. 2008; Ziccardi et al. 2015). For example, 122 cetaceans stranded or were reported dead within 5 months following the Deepwater Horizon spill in the Gulf of Mexico (Ziccardi et al. 2015). An additional 785 cetaceans were found stranded from November 2010 to June 2013, which was declared an Unusual Mortality Event (Ziccardi et al. 2015). Previous PAH exposure estimates suggested SRKWs can be occasionally exposed to concerning levels (Lachmuth et al. 2011). More recently, Lundin et al. (2018) measured PAHs in whale fecal samples collected in inland waters of Washington between 2010 and 2013 and found low concentrations of the measured PAHs (<10 parts per billion (ppb), wet weight). However, PAHs were as high as 104 ppb in the first year of their study (2010) compared to the subsequent years. Although it is unclear the cause of this trend, higher levels were observed prior to the 2011 vessel regulations that increased the distance vessels could approach the whales. In addition, oil spills have the potential to adversely impact habitat and prey populations, and, therefore, may adversely affect SRKWs by reducing food availability.

2.2.1.4 Climate change and other ecosystem effects

Overwhelming data indicate the planet is warming (IPCC 2014), which poses a threat to many species. Climate change has the potential to impact species abundance, geographic distribution, migration patterns, timing of seasonal activities (IPCC 2014), and species viability into the future. Changes in climate and ocean conditions happen on several different time scales and have had a profound influence on distributions and abundances of marine and anadromous fishes.

Climate change is expected to impact anadromous fish during all stages of their complex life cycle. In addition to the direct effects of rising temperatures, indirect effects include alterations in stream flow patterns in freshwater and changes to food webs in freshwater, estuarine and marine habitats. There is high certainty that predicted physical and chemical changes will occur; however, the ability to predict biological changes to fish or food webs in response to these physical/chemical changes is extremely limited, leading to considerable uncertainty.

Pacific Northwest anadromous fish inhabit as many as three marine ecosystems during their ocean residence period: the Salish Sea, the California Current, and the Gulf of Alaska (Brodeur et al. 1992; Weitkamp and Neely 2002; Morris et al. 2007). The response of these ecosystems to climate change is expected to differ, although there is considerable uncertainty in all predictions. Columbia River and Puget Sound anadromous fish also use coastal areas of British Columbia and Alaska, and mid-ocean habitats in the Gulf of Alaska, although their fine-scale distribution and marine ecology during this period are poorly understood (Morris et al. 2007; Pearcy and McKinnell 2007). Increases in temperature in Alaskan marine waters have generally been associated with increases in productivity and salmon survival (Mantua et al. 1997; Martins et al. 2012).

Warmer streams, loss of coastal habitat due to sea level rise, ocean acidification, lower summer stream flows, higher winter stream flows, and changes in water quality and freshwater inputs are projected to negatively affect salmon (e.g. Mauger et al. 2015a). The persistence of cold water "refugia" within rivers and the diversity among salmon populations will be critical in helping salmon populations adapt to future climate conditions. More detailed discussions about the likely effects from climate change in freshwater systems on salmonids can be found in biological opinions such as the implementation of the Mitchell Act (NMFS 2017d)

In marine waters, increasing temperatures are associated with observed and predicted poleward range expansions of fish and invertebrates in both the Atlantic and Pacific oceans (Lucey and Nye 2010; Asch 2015; Cheung et al. 2015). Rapid poleward species shifts in distribution in response to anomalously warm ocean temperatures have been well documented in recent years, confirming this expectation at short time scales. Range extensions were documented in many species from southern California to Alaska during unusually warm water associated with "the blob" in 2014 and 2015 (Bond et al. 2015; Di Lorenzo and Manuta 2016), and past strong El Nino events (Pearcy 2002; Fisher et al. 2015).

The potential impacts of climate and oceanographic change on whales and other marine mammals will likely involve effects on habitat availability and food availability. For species that depend on salmon for prey, such as SRKWs, the fluctuations in salmon survival that occur with these changes in climate conditions can have negative effects. Site selection for migration, feeding, and breeding may be influenced by factors such as ocean currents and water temperature. For example, there is some evidence from Pacific equatorial waters that sperm whale feeding success and, in turn, calf production rates are negatively affected by increases in sea surface temperature (Smith and Whitehead 1993; Whitehead 1997). Different species of marine mammals will likely react to these changes differently. MacLeod (2009) estimated, based on expected shifts in water temperature, 88% of cetaceans would be affected by climate change, with 47% likely to be negatively affected. Range size, location, and whether or not specific range areas are used for different life history activities (e.g. feeding, breeding) are likely to affect how each species responds to climate change (Learmouth et al. 2007).

2.2.2 Status of Critical Habitat

Critical habitat for the Southern Resident killer whale DPS was designated on November 29, 2006 (71 FR 69054). Critical habitat includes approximately 2,560 square miles of inland waters of Washington in three specific areas: 1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; 2) Puget Sound; and 3) the Strait of Juan de Fuca. Based on the natural history of SRKWs and their habitat needs, NMFS identified the following physical or biological features essential to conservation: (1) Water quality to support growth and development; (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.

In 2006, few data were available on SRKWs distribution and habitat use in coastal waters of the Pacific Ocean. Since the 2006 designation, additional effort has been made to better understand the geographic range and movements of SRKWs. For example, opportunistic visual sightings, satellite tracking, and passive acoustic research conducted since 2006 have provided an updated estimate of the whales' coastal range that extends from the Monterey Bay area in California, north to Chatham Strait in southeast Alaska (NMFS 2019d).

On September 19, 2019 NMFS proposed to revise the critical habitat designation for the SRKW

DPS under the ESA by designating six new areas along the U.S. West Coast (84 FR 49214). Specific new areas proposed along the U.S. West Coast include 15,626.6 square miles (mi2) (40,472.7 square kilometers (km2)) of marine waters between the 6.1-meter (m) depth contour and the 200-m depth contour from the U.S. international border with Canada south to Point Sur, California (Figure 13). In the proposed rule (84 FR 49214), NMFS states that the "proposed areas are occupied and contain physical or biological features that are essential to the conservation of the species and that may require special management considerations or protection." The three physical or biological features essential to conservation in the 2006 designated critical habitat were also identified for the six new areas along the U.S. West Coast.

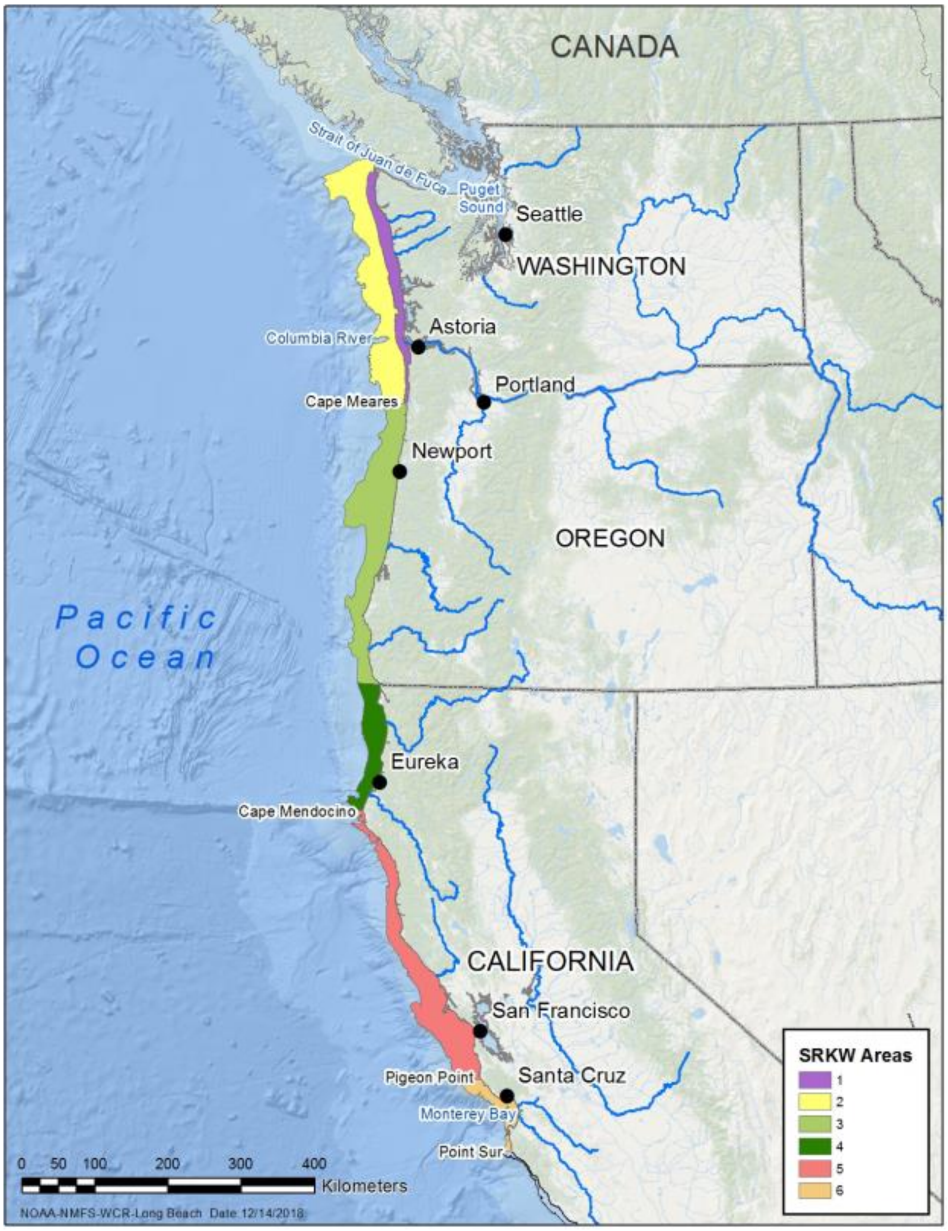


Figure 13. Specific areas containing essential habitat features (Figure 9 reproduced from NMFS 2019d).

Water Quality

Water quality supports SRKW's ability to forage, grow, and reproduce free from disease and impairment. Water quality is essential to the whales' conservation, given the whales' present contamination levels, small population numbers, increased extinction risk caused by any additional mortalities, and geographic range (and range of their primary prey) that includes highly populated and industrialized areas. Water quality is especially important in high-use areas where foraging behaviors occur and contaminants can enter the food chain. The absence of contaminants or other agents of a type and/or amount that would inhibit reproduction, impair immune function, result in mortalities, or otherwise impede the growth and recovery of the SRKW population is a habitat feature essential for the species' recovery. Water quality in Puget Sound, in general, is degraded as described in the Puget Sound Partnership 2018-2022 Action Agenda and Comprehensive (Puget Sound Partnership 2018). For example, toxicants in Puget Sound persist and build up in marine organisms including SRKWs and their prey resources, despite bans in the 1970s of some harmful substances and cleanup efforts. Water quality varies in coastal waters from Washington to California. For example, as described in NMFS (2019d), high levels of DDTs have been found in SRKWs, especially in K and L pods, which spend more time in California in the winter where DDTs still persist in the marine ecosystem (Sericano et al. 2014).

Exposure to oil spills also poses additional direct threats as well as longer term population level impacts; therefore, the absence of these chemicals is of the utmost importance to SRKW conservation and survival. Oil spills can also have long-lasting impacts on other habitat features. Oil spill risk exists throughout the SRKW's coastal and inland range. From 2002- 2016, the highest-volume crude oil spill occurred in 2008 off the California coast, releasing 463,848 gallons (Stephens 2017). In 2015 and 2016, crude oil spilled into the marine environment off the California coast totaled 141,680 gallons and 44,755, respectively; no crude oil spills were reported off the coasts of Oregon or Washington in these years (Stephens 2015, Stephens 2017). Non-crude oil spills into the marine environment also occurred off California, Oregon, and Washington in 2015 and 2016 (Stephens 2015, Stephens 2017).The Environmental Protection Agency and U.S. Coast Guard oversee the Oil Pollution Prevention regulations promulgated under the authority of the Federal Water Pollution Control Act. There is a Northwest Area Contingency Plan, developed by the Northwest Area Committee, which serves as the primary guidance document for oil spill response in Washington and Oregon. In 2017, the Washington State Department of Ecology published a new Spill Prevention, Preparedness, and Response Program Annual Report describing the Spills Program as well as the performance measures from 2007 – 2017 (WDOE 2017).

Prey Quantity, Quality, and Availability

Most wild salmon stocks throughout the whales' geographic range are at fractions of their historic levels. Beginning in the early 1990s, 28 ESUs and DPSs of salmon and steelhead in Washington, Oregon, Idaho, and California were listed as threatened or endangered under the ESA. Historically, overfishing, habitat losses, and hatchery practices were major causes of decline. Poor ocean conditions over the past two decades have reduced populations already weakened by the degradation and loss of freshwater and estuary habitat, fishing, hydropower system management, and hatchery practices. While wild salmon stocks have declined in many areas, hatchery production has been generally strong.

Contaminants and pollution also affect the quality of SRKW prey in Puget Sound and in coastal waters of Washington, Oregon, and California. Contaminants enter marine waters and sediment from numerous sources, but are typically concentrated near areas of high human population and industrialization. Once in the environment these substances proceed up the food chain, accumulating in long-lived top predators like SRKWs. Chemical contamination of prey is a potential threat to SRKW critical habitat, despite the enactment of modern pollution controls in recent decades, which were successful in reducing, but not eliminating, the presence of many contaminants in the environment. The size of Chinook salmon is also an important aspect of prey quality (i.e., SRKWs primarily consume large Chinook) so changes in Chinook size may affect the quality of this component critical habitat. In addition, vessels and sound may reduce the effective zone of echolocation and reduce availability of fish for the whales in their critical habitat (Holt 2008).

Passage

Southern Residents are highly mobile and use a variety of areas for foraging and other activities, as well as for traveling between these areas. Human activities can interfere with movements of the whales and impact their passage. In particular, vessels may present obstacles to whale passage, causing the whales to swim further and change direction more often, which can increase energy expenditure for whales and impacts foraging behavior (review in NMFS (2010b), Ferrara et al. (2017)).

2.3. Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

For the purposes of this consultation, the action area encompasses the waters of the U.S. Pacific Coast Region EEZ, which are directly affected by the action, and the coastal waters of the states of Washington, Oregon, and California, and inland waters of Washington (Salish Sea) which are indirectly affected by the action (i.e., potential reduction in available prey that would have moved into these waters if it had not been caught by the PFMC fisheries).

2.4. Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

NMFS recognizes the unique status of treaty Indian fisheries and their relation to the environmental baseline. Implementation of treaty Indian fishing rights involves, among other things, application of the sharing principles of various legal principles established through multiple cases affecting Council salmon fishery implementation (e.g., *United States v. Oregon (302 F. Supp. 899, D. Or. 1969); Unites States v. Washington (384 F. Supp. 312, W.D. Wash. 1974), and Parravano v. Masten, (70 F.3d 539, 9th Cir. 1995))*. Exploitation rate calculations, escapements, and harvest levels to which the sharing principles apply, in turn, are dependent upon various biological parameters, including the estimated run sizes for the particular year, the mix of stocks present, status of other species intercepted, the allowable fisheries and the anticipated fishing effort. The treaty fishing right itself exists and must be accounted for in the environmental baseline, although the precise quantification of treaty Indian fishing rights during a particular fishing season cannot be established by a rigid formula.

Native Americans have lived along the western coast of the present-day United States for thousands of years. On the coast, native people lived at the mouths of the many rivers that spill into the Pacific Ocean. Generally a seafaring people, along the Washington Coast they also always hunted seals and whales. In this area, and further south, anthropological and archaeological evidence suggests that for more than 10,000 years Native Americans have fished for salmon and steelhead, as well as for other species for ceremonial, subsistence, and economic purposes (Campbell and Butler 2010). These people expressed their relationship to the fish and waters that sustained them in dance, song, ceremony, and social relationships. In the late 1800s, they ceded most of their ancient lands to the federal government as waves of settlers encroached west and forced treaties took their lands, rivers, and fishing rights.

While we do not have reliable catch data for Indian fisheries prior to the 1800's to include as a baseline level of native harvest, Native American fish harvest and consumption helped elucidate the reservation of the treaty fishing right during treaty negotiations in the mid-1850s. Salmon and steelhead from the ocean had spiritual and cultural significance for tribes, and the fish had economic importance as both a trade and food item. Tribes developed elaborate rituals to celebrate the return of the first fish. These first-salmon ceremonies were intended to ensure that abundant runs and good harvests would follow. The health of Native Americans was heavily reliant on these resources whose diets traditionally included certain quantities and qualities of fish (Harper and Deward E. Walker 2015).

If, after completing this ESA consultation, circumstances change or unexpected consequences arise that necessitate additional Federal action to avoid jeopardy determinations for ESA listed species, such action will be taken in accordance with standards, principles, and guidelines established under Secretarial Order 3206, and other applicable laws and policies. Consistent with the September 23, 2004 Memorandum for the Heads of Executive Departments and Agencies pertaining to Government-to-Government Relationship with Tribal Governments and Executive Order 13175, Departmental and agency consultation policies guiding their implementation, and administrative guidelines developed to implement Secretarial Order 3206, these responses are to be developed through government-to-government discourse involving both technical and policy representatives of the West Coast Region and affected Indian tribes prior to finalizing a proposed course of action.

The final recovery plan for SRKWs reviews and assesses the potential factors affecting their survival and recovery, and lays out a recovery program to address each of the threats (NMFS 2008e). As described in the Status of the Species (Section 2.2) the limiting factors identified include reduced prey availability and quality, high levels of contaminants from pollution, and disturbances from vessels and sound (NMFS 2008e). This section summarizes these primary threats in the action area. It is likely that the three primary threats are acting together to impact the whales. Available data suggests that all the threats are potential limiting factors. Subsequent sections describe activities in the Environmental Baseline resulting from the other primary threats.

2.4.1 Climate Change

As described in the Status of the Species section, extensive climate change caused by the continuing buildup of human-produced atmospheric carbon dioxide and other greenhouse gases is predicted to have major environmental impacts in the action area during the 21st century and beyond. Warming trends in water and air temperatures are ongoing and are projected to disrupt the region's annual cycles of rain and snow, alter prevailing patterns of winds and ocean currents, and result in higher sea levels (Glick 2005, Snover et al. 2005). These changes, together with increased acidification of ocean waters, will likely have profound effects on marine productivity and food webs, including populations of salmon. Changing ocean conditions driven by climate change may influence ocean survival and distribution of Chinook and other Pacific salmon further affecting the prey available to SRKWs.

The primary effects of climate change on Pacific Northwest salmon and steelhead are (1) direct effects of increased water temperatures of fish physiology, (2) temperature-induced changes to stream flow patterns, (3) alterations to freshwater, estuarine, and marine food webs, and (4) changes in estuarine and ocean productivity. While all habitats by Pacific salmon will be affected, the impacts and certainty of the change vary by habitat type.

Evidence suggests that marine survival among salmonids fluctuates in response to 20 to 30-year cycles of climatic conditions and ocean productivity. The Pacific Decadal Oscillation and the El Nino/Southern Oscillation conditions can cause changes in ocean productivity that can affect natural mortality and distribution of salmon, affecting the prey available to SRKWs. Recent studies have provided evidence that growth and survival rates of salmon in the California Current off the Pacific Northwest can be linked to fluctuations in ocean conditions related to Pacific Decadal Oscillation and the El Nino-Southern Oscillation conditions and events, such as the recent northeast Pacific marine warming phenomenon (aka "the blob") (Wells et al. 2008; Bond et al. 2015; Di Lorenzo and Manuta 2016). Evidence suggests early marine survival for juvenile salmon is a critical phase in their survival and development into adults. The correlation between various environmental indices that track ocean conditions and salmon productivity in the Pacific Ocean, both on a broad and a local scale, provides an indication of the role they play in salmon survival in the ocean. California Central Valley Chinook stocks, and spring-run Chinook stocks in the interior Columbia and Willamette River basins were ranked most vulnerable to climate change (Crozier et al. 2019). Moreover, when discussing the potential extinctions of salmon populations, Francis and Mantua (2003) point out that climate patterns would not likely be the sole cause, but could certainly increase the risk of extinction when combined with other factors, especially in ecosystems under stress from humans.

Although no formal predictions of impacts on the Southern Residents have yet been made, it seems likely that any changes in weather and oceanographic conditions resulting in effects on salmon populations will have consequences for the whales. The potential impacts of climate and oceanographic change on whales and other marine mammals will likely involve effects on habitat availability and food availability.

2.4.2 Prey Availability

Chinook salmon are the primary prey of SRKWs throughout their geographic range, which includes the action area. The abundance, productivity, spatial structure, and diversity of Chinook salmon are affected by a number of natural and human actions and these actions also affect prey availability for SRKWs. As discussed in the Status section, the abundance of Chinook salmon in recent years is significantly less than historic abundance due to a number of human activities. The most notable human activities that cause adverse effects on ESA-listed and non ESA-listed salmon include land use activities that result in habitat loss and degradation, hatchery practices, harvest and hydropower systems.

Here we provide a review of previous ESA Section 7(a)(2) consultations covering affects to SRKW from activities whose effects in the action area were sufficiently large in terms of reducing available prey that they were found likely to adversely affect or jeopardize the continued existence of the whales. We also consider ESA Section 7(a)(2) consultations on hatchery actions that are contributing prey to the whales. Finally, we consider activities that have impacts in the action area and are outside of NMFS' jurisdiction for Section 7(a)(2) consultation, but nonetheless were sufficiently large in terms of impacting the number of available prey. We then qualitatively assess the remaining prey available to SRKW in light of this environmental baseline.

2.4.2.1 ESA Section 7(a)(2) Consultations

<u>Harvest Actions</u>

PFMC Groundfish Fisheries

The groundfish fisheries in the EEZ off the West Coast are managed by NMFS and the PFMC pursuant to the Pacific Coast Groundfish FMP. PFMC groundfish fisheries catch Chinook salmon as bycatch while conducting these fisheries (Table 3). Chinook salmon bycatch in the groundfish fishery ranged from 3,068 to 15,319 from 2008 to 2015 and averaged 6,806 (NMFS 2017e). Bycatch consists of primarily subadult Chinook salmon taken annually in the groundfish fisheries.

Stock composition of the Chinook salmon bycatch was determined using samples taken from 2009 to 2014 from the at-sea and shore side sectors of the whiting fishery ((NMFS 2017e). Although listed and unlisted ESUs contributed to bycatch, the major contributors to Chinook salmon bycatch in the at-sea sector were from unlisted ESUs. They contributed, on average, Klamath/Trinity Chinook (28%) followed by south Oregon/north California (25%), Oregon Coast (10%), and northern British Columbia (11%) Chinook salmon (NMFS 2017e). Samples from Chinook salmon bycatch in the shore side whiting sector showed a contribution from Central Valley Chinook (13%), similar to the Oregon Coast and very low contribution from British Columbia Chinook salmon (NMFS 2017e). The remainder of stocks that included contributions from listed ESUs contributed 5% or less of the Chinook salmon bycatch in either fleet on average. NMFS concluded in previous opinions on PFMC groundfish fishery implementation that the effects on ESA-listed Chinook salmon ESUs most likely to be subject to measurable impacts (Snake River fall-run Chinook, LCR Chinook, and UWR Chinook salmon) were very low (NMFS 2017e). In general, the shore side fishery is focused closer to shore. It does not extend as far south as the at-sea fishery (NMFS 2017e).

The results demonstrate a strong regional pattern in contribution of Chinook salmon ESUs, with a greater proportion of southern Chinook salmon ESUs as bycatch when the fleets move south along the coast and similar patterns in the distribution of those salmon between the at-sea and shore side fleets. Samples from years when fisheries had more southerly distribution include more southern ESUs and the reverse is true for more northerly fleet distributions. Moreover, some ESUs fit this pattern more closely than others (e.g., Puget Sound, Central Valley) due to different migration patterns (tending to migrate differentially north or south). Catches further north included Columbia River and increasing percentages of Puget Sound and Fraser River Chinook salmon.

Table 3. Bycatch of Chinook salmon in the Pacific Coast Groundfish Fisheries, 2008 to 2015 (NMFS 2017e).

Fishery	Species	2008	2009	2010	2011	2012	2013	2014	2015
At-Sea whiting	Chinook	718	318	714	3,989	4,209	3,739	6,695	1,806
Shorebased whiting	Chinook	1,962	279	2,997	3,722	2,359	1,263	6,898	2,002
Tribal-whiting[4]	Chinook	696	2,145	678	828	17	1,014	45	3
Bottom trawl	Chinook	449	304	282	175	304	323	984	996
Midwater non-whiting	Chinook	n/a	n/a	n/a	n/a	12	71	661	482
Non-trawl gear[5]	Chinook	0	22	16	8	63	124	36	40
Total	**Chinook**	**3,825**	**3,068**	**4,687**	**8,722**	**6,964**	**6,534**	**15,319**	**5,329**

Directed Salmon Fisheries

Directed salmon fisheries that intercept fish that would otherwise reach the action area as adults occur all along the Pacific Coast, from Alaska to California. In past harvest consultations including Puget Sound salmon fisheries—(NMFS 2010a; 2014a; 2015; 2016a; 2017a; 2018c; 2019a), Pacific Coast Salmon Plan fisheries (NMFS 2008a), the *U.S. v. Oregon* Management Agreements (NMFS 2008d; 2018b), the PST 2009 Agreement (NMFS 2008c) and southeast Alaska salmon fisheries (NMFS 2019c) —we characterized the short-term and long-term effects harvest has on the SRKWs from prey reduction. We considered the short-term direct effects to whales resulting from reductions in Chinook salmon abundance that occur during a specified year, and the long-term indirect effects to whales that could result if harvest affected viability of the salmon stock over time by decreasing the number of fish that escape to spawn.

The new PST Agreement includes reductions in harvest impacts in all Chinook fisheries within its scope and refines the management of coho salmon caught in these areas. As described in Section 1.3, the new PST Agreement includes reductions in the allowable annual catch of Chinook salmon in the SEAK and Canadian West Coast of Vancouver Island and Northern British Columbia fisheries by up to 7.5 and 12.5 percent, respectively, compared to the previous agreement. The level of reduction depends on the Chinook abundance in a particular year. This comes on top of the reductions of 15 and 30 percent for those same fisheries that occurred as a

[4] Includes only the Pacific whiting fishery. Tribal non-whiting fishery values were not available.
[5] Includes bycatch by vessels fishing under Exempted Fishing Permits (EFPs) not already included in a sector count. The added Chinook bycatch by year under EFPs was 2002-22, 2003-51, 2004-3, 2014-1.

result of the prior 10 year agreement (2009 through 2018). Harvest rates on Chinook salmon stocks caught in southern British Columbia and southern U.S. salmon fisheries, including those under the jurisdiction of the PFMC are reduced by up to 15 percent from the previous agreement (2009 through 2018). These reductions will result in larger proportions of annual salmon abundance returning to the more southerly U.S. Pacific Coast Region portion of the EEZ than under prior PST Agreements. Therefore, under the new PST agreement, reductions in prey from fisheries managed under the new agreement are expected to be lower than under the previous agreement.

In its 2019 opinion on domestic actions related to the new PST Agreement, (NMFS 2019c), NMFS assumed that the State of Alaska would manage its SEAK salmon fisheries consistent with the provisions of the new 2019 PST Agreement. Using methodology similar to previous biological opinions completed up to that time (e.g. NMFS 2019a), NMFS estimated that the percent reductions of Chinook salmon in inland waters of WA from the SEAK fisheries in the three FRAM time steps (October – April, May – June, July – September) were expected to range from 0.1% to 2.5% with the greatest reductions occurring in July – September under the 2019 PST Agreement. Percent reductions in coastal waters of WA and OR from the SEAK fisheries were expected to range from 0.2% to 12.9%[6] and similarly the greatest reductions would occur in July – September. Under the 2009 PST Agreement, percent reductions of Chinook salmon in inland waters ranged from 0.2% to 2.9% and 0.2% to 15.1% in coastal waters as a result of the SEAK fisheries (NMFS 2019c). Therefore, the majority of the impacts that the SEAK salmon fisheries have on prey availability in the action area would occur in the coastal waters of WA and OR.

In the most recent biological opinion on salmon fisheries in Puget Sound (NMFS 2019a), NMFS reviewed past years of data on Chinook salmon abundance and percent reductions from Puget Sound fisheries and compared pre-season estimates of Chinook salmon abundance anticipated in 2019 and percent reductions in Chinook salmon prey availability from the proposed action to abundance and percent reductions from the retrospective time period (1992-2016). The pre-season estimates for abundance of age 3-5 Chinook in inland waters were slightly higher in 2019 than in 2018. The 2019 estimate was also higher than the recent 10-year average (2007-2016). Furthermore, there was an expected additional 28% increase in adult hatchery-origin Puget Sound Chinook escaping pre-terminal fisheries over the most recent 10-year average (Warren 2019). NMFS estimated that the percent reductions of Chinook salmon from the Puget Sound fisheries in 1992 – 2016 in inland waters of WA in the three FRAM time steps (October – April, May – June, July – September) were expected to range from 0.4% to 17.7%[7] with the greatest reductions occurring in July – September. Percent reductions in coastal waters from Puget Sound fisheries were expected to range from 0.0% to 2.7% and similarly the greatest reductions would occur in July – September (NMFS 2019a). Additional conservation measures were also implemented in 2019 to reduce impacts on SRKWs given the whales' declining status including area closures in an area known to be important to SRKWs, continuing implementation of a package of outreach and education programs, and continuing the promotion of adhering to

[6] The methodology to estimate this percent reduction differs from current methods that were derived during the PFMC SRKW Ad Hoc workgroup. Because of this, we are limited in our ability to compare impacts from different fisheries. NMFS and the co-managers are currently developing a similar methodology as that described in PFMC 2020. We provide general percent reductions from salmon fisheries in the meantime but this warrants caution in comparing impacts.

voluntary “No-Go” Whale Protection Zone along the western side of San Juan Island (Warren 2019). In the short term, prey reductions were small relative to remaining prey available to the whales. In the long term, harvest actions have met the conservation objectives of harvested stocks, were not likely to appreciably reduce the survival or recovery of listed Chinook salmon and SRKW, and were therefore not likely to jeopardize the continued existence of listed Chinook salmon or SRKW. For 2020, prey abundance is expected to be slightly above the 10 year average from 2007 to 2016 (Cunningham 2020)[8]. Percent reductions in overall abundance from the Puget Sound salmon fisheries of Chinook in the Salish Sea in 2020 will be an average of 3% relative to the starting abundance (October – April) (Cunningham 2020). The co-managers are developing a long term RMP and NMFS will work with the co-managers to consider a long term assessment for SRKWs.

The harvest biological opinions referenced above concluded that the harvest actions cause prey reductions in a given year, and were likely to adversely affect but were not likely to jeopardize the continued existence of ESA-listed Chinook salmon. With the exception of *U.S. v. Oregon*, the harvest biological opinions referenced above also conclude that the harvest actions were likely to adversely affect but were not likely to jeopardize the continued existence of SRKW. The *U.S. v. Oregon* action was determined to be not likely to adversely affect SRKWs because hatchery production included as part of that action offset the in-river harvest reductions, Columbia River salmon stocks are currently managed in line with recovery planning, the status of several stocks and ESUs have improved under the fishing regime, and hatchery programs are managed in ways to minimize effects to listed species.

<u>Hatchery Production</u>

Hatchery production of salmonids has occurred for over 100 years. Currently, there are over 300 hatchery programs in Oregon, Washington, Idaho, and California that produce juvenile salmon that migrate through the action area. Currently, hatchery operators release over 350 million juvenile salmon and steelhead annually. Many of these fish contribute to both ocean fisheries and the SRKW prey base.

NMFS has completed section 7 consultation on over 200 hatchery programs in over 45 biological opinions (Appendix B, Table B.1). A detailed description of the effects of these hatchery programs can be found within the site-specific biological opinions referenced in Appendix B, Table B.1. These effects are further described in Appendix C of NMFS (2018b), which is incorporated here by reference. For efficiency, discussion of these effects is not repeated here.

Currently, hatchery production is a significant component of the salmon prey base within the range of SRKW (Barnett-Johnson et al. 2007; NMFS 2008e). Scarcity of prey has been identified as a threat to SRKW’s survival, and we expect these hatchery programs to continue benefiting SRKW by contributing to their prey base.

<u>Hatchery programs to support critical Chinook populations and increase SRKW prey base</u>

Conservation hatchery programs are currently operating in the Nooksack, Dungeness, and Stillaguamish rivers. A new program is being developed for Mid-Hood Canal. Information for

[8] These percent reductions and abundance values are not comparable to the estimates in NMFS 2019c or NMFS 2019a because they were estimated using the more recent methodology described in PFMC 2020a (that assesses prey abundance and reductions using FRAM and the Shelton et al. model) and throughout this opinion, whereas NMFS 2019a and NMFS 2019c assessed prey abundance and reductions using FRAM.

these programs is considered in the environmental baseline of this opinion. A programmatic consultation on the PST funding initiative was included in the consultation on SEAK fisheries (2019c) and the 2020 funding already appropriated provides a level of certainty these programs will continue. As site-specific actions under the PST funding initiative are identified the effects will be analyzed through subsequent section 7 consultations, unless the activities and effects have already been analyzed through an existing consultation. NMFS previously reviewed both the Dungeness and Stillaguamish programs through a section 7 consultation and approved them under the 4(d) rule for threatened Chinook salmon (NMFS 2016b; NMFS and BIA 2019). Review of the Nooksack program and development of the Mid-Hood Canal program is currently ongoing. The latter two programs will be subject to further consultation once the site specific details are fully described. Modifications to the Dungeness and Stillaguamish programs could trigger reinitiation of those site specific consultations. The likely effects of these programs are described in general terms here.

Conservation programs are designed to preserve the genetic resources of salmon populations and protect against demographic risks while the factors limiting anadromous fish viability are addressed. In this way, hatchery conservation programs reduce the risk of extinction (NMFS 2005b; Ford et al. 2011a). However, hatchery programs that conserve vital genetic resources are not without risk to the natural salmonid populations. These programs can affect the genetic structure and evolutionary trajectory of the natural population that the hatchery program aims to conserve by reducing genetic diversity and fitness (HSRG 2014; NMFS 2014f). More details on how hatchery programs can affect ESA-listed salmon and steelhead can be found in Appendix C of NMFS (2018b), incorporated here by reference, and summarized below.

In addition, there are new initiatives to increase hatchery production to further enhance the SRKW's prey base. In 2019, NMFS completed a biological opinion on several domestic actions associated with implementation of the new PST Agreement (NMFS 2019c). As described in the 2019 biological opinion, additional hatchery production of Chinook funded through the PST funding initiative is expected to result in increased available prey throughout the SRKW's geographic range. The increases in the abundance of Chinook salmon available as prey to SRKW as a result from the funded hatchery production are expected to occur in the next 3 – 5 years as adult Chinook return to the action area. In Fiscal Year 2020 Congress appropriated $35.1 million dollars in the NMFS budget U.S. actions associated with for implementation of the new PST agreement, which included $5.6 million that is being used for increased hatchery production to support prey abundance for SRKW. While there is 2020 funding, and actions are being implemented during the year covered by this opinion, the potential for additional years of funding will be considered as part of future consultations on the PFMC salmon FMP and other fishery management plans as they are developed or amended as necessary.

In a programmatic assessment of the PST funding initiative (NMFS 2019c), we described our expectations for increased prey abundance for SRKWs through increases in the abundance of age 3-5 Chinook salmon in the times and areas most important to SRKWs. The expectations included increased abundance in inside areas (Puget Sound) in the summer and outside areas (Coast) during the winter (Dygert et al. 2018) resulting in a minimum increase of adult fish abundance by 4-5 percent in both inside areas in the summer and coastal areas in the winter. We estimated accomplishing this would require the release of 20 million smolts from hatcheries located in Puget Sound, the Columbia River, and coastal Washington areas.

In 2020, NMFS developed the following criteria to determine which hatchery production proposals might be funded by NMFS to increase the SRKW prey base:

- Increased hatchery production should be for Chinook stocks that are a high priority for SRKW (NMFS and WDFW 2018)
- Increased production should represent an array of Chinook stocks from different geographic areas and run timings (i.e., a portfolio)
- Increased production cannot jeopardize the survival and recovery of any ESA-listed species, including salmon and steelhead
- Because of funding and timing constraints, increased production proposals should not require major capital upgrades to hatchery facilities
- All proposals should have co-manager agreement, as applicable
- All increased production must be reviewed under the ESA and NEPA, as applicable, before NMFS funding can be used.

NMFS will work with hatchery operators and funders to ensure that all increased hatchery production to support SRKW has been reviewed under ESA (and NEPA as applicable) to ensure that it does not jeopardize the survival and recovery of any ESA-listed species. This will include a review of the effects to the species and its designated critical habitat. NMFS has been working collaboratively with the state and tribal co-managers, and other interested parties, to meet the goals related to increasing prey abundance, minimize the risk to listed salmon species, and provide coincident benefits for additional harvest. While the appropriations described above have been secured, thereby providing certainty that the program will operate, NMFS is working with the hatchery operators to determine the details of the increased production (e.g., what hatcheries will be used, what Chinook stocks will be reared, etc.). NMFS will ensure all applicable ESA consultations and NEPA analyses are completed for the increased hatchery production.

Additional increased production is being funded by WDFW and is contributing toward the goal of producing an additional 20 million juvenile Chinook salmon annually. Some of this increased production has completed ESA consultations and is included in Table B.1. The rest of the increased production is being reviewed by NMFS and is discussed in Section 2.6, Cumulative Effects.

<u>Habitat Actions</u>
Habitat-altering activities such as agriculture, forestry, marine construction, levy maintenance, shoreline armoring, dredging, hydropower operations and new development can reduce prey available to SRKWs in the action area. Many of these activities have a federal nexus and have undergone section 7 consultation. Those actions have nearly all met the standard of not jeopardizing the continued existence of the listed salmonids or adversely modifying their critical habitat, and when they did not meet that standard, NMFS identified reasonable and prudent alternatives. In addition, the environmental baseline is influenced by many actions that pre-date the salmonid listings and that have substantially degraded salmon habitat and lowered natural production of ESA-listed Chinook salmon. In fact, Chinook salmon currently available to the whales are still below their pre-ESA listing levels, largely due to these past activities that pre-date the salmon listings. Since the SRKWs were listed, federal agencies have also consulted on

impacts to the whales from actions affecting salmon.

In 2014, NMFS finalized its biological opinion on the operation and maintenance of the Mud Mountain Dam project (NMFS 2014b). This opinion concluded that the proposed actions would jeopardize the continued existence of Puget Sound Chinook salmon, Puget Sound steelhead, and SRKWs and would adversely modify or destroy their designated critical habitats. We have also previously consulted on the effects of flood insurance on SRKWs. NMFS' biological opinion on the National Flood Insurance Program in Washington State-Puget Sound region concluded that the action was likely to jeopardize the continued existence of the Puget Sound Chinook salmon ESU, and that the potential extinction of this ESU in the long-term jeopardized the continued existence of SRKWs (NMFS 2008b). For these consultations, RPAs were identified in order to avoid jeopardy and not adversely modify or destroy designated critical habitat (NMFS 2008b; 2014b). We recently consulted on the Howard Hanson Dam, Operations, and Maintenance (NMFS 2019b). The opinion concluded that the proposed action would jeopardize the continued existence of Puget Sound Chinook salmon, Puget Sound steelhead, and SRKWs. For these consultations, RPAs were identified in order to avoid jeopardy and not adversely modify or destroy designated critical habitat (NMFS 2008b; 2014b; NMFS 2019b).

In 2012, we consulted on the Environmental Protection Agency's Proposed Approval of Certain Oregon Administrative Rules Related to Revised Water Quality Criteria for Toxic Pollutants (NMFS 2012a). The opinion concluded that the proposed action would jeopardize the continued existence of several Chinook salmon ESUs including Lower Columbia River (LCR) Chinook salmon, Upper Willamette River Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Snake River (SR) spring/summer Chinook salmon, SR fall-run Chinook salmon, and SRKWs. An RPAs were identified in order to avoid jeopardy and not adversely modify or destroy designated critical habitat (NMFS 2012a).

More recently, NMFS finalized its biological opinion on the Klamath Project Operations from April 1, 2019 through March 31, 2024 and found that action was not likely to jeopardize the continued existence of SRKWs (NMFS 2019e). While the analysis indicated that the Operations will generally continue to reduce Chinook salmon productivity in the Klamath River, additional measures were included in the action that are expected to lower disease risk conditions and ultimately improve overall juvenile fall-run Chinook salmon survival.

In addition to increased hatchery production, the programmatic consultation on the funding initiative for U.S. domestic actions associated with the new PST Agreement (NMFS 2019c) assessed improved habitat conditions for specified populations of Puget Sound Chinook salmon. By improving conditions for these populations, we anticipate Puget Sound Chinook abundance would increase, also benefiting SRKW. The FY20 appropriated funds for implementation of U.S. domestic actions associated with the new PST Agreement includes $10.4 million in support of Puget Sound Critical Stock Habitat Restoration and Protection. The following outlines the criteria for prioritizing $10.4 million in FY20 implementation funds in support of Puget Sound Critical Stock Habitat Restoration and Protection as informed by the programmatic criteria from NMFS 2017. These criteria will emphasize habitat projects in the watersheds for four ESA-listed Puget Sound Chinook salmon populations that are in critical status. Similar to the hatchery element of the PST funding initiative NMFS has developed phased selection criteria to select projects in FY 2020 – FY 2022. They are (in rank order):

1) Project supports one or more limiting life stage of at least one of the four Puget Sound critical stocks,
2) Project supports one or more limiting life stage of a high priority population for Puget Sound Chinook recovery,
3) Project supports Puget Sound Chinook salmon population that are priority prey for SRKWs (NMFS and WDFW 2018),
4) Project supports the recovery of multiple ESA-listed species (i.e., Chinook and steelhead) in a given watershed, and
5) Project removes a passage barrier for one or more of the four Puget Sound critical stocks or high priority populations for Puget Sound Chinook recovery

In 2017, NMFS conducted a programmatic consultation resulting in a biological opinion (NMFS 2017b) on the effects of the Seattle District Corps of Engineers permitting of fish passage and restoration actions in the state of Washington. We anticipate that most if not all of the projects funded through the Puget Sound Critical Stock Habitat Restoration and Protection initiative would require some form of Corps approval and will fall within the scope of the 2017 programmatic consultation, but in cases where they would not they would be subject to individual site-specific consultations. The projects under consideration for the initiative would include riverine, lacustrine, wetland, estuarine and marine restoration activities designed to maintain, enhance, and restore aquatic functions as well as projects specifically designed to recover listed fishes. In order to be covered under the programmatic consultation, projects must meet design criteria that would be expected to limit the adverse impacts of the constructing the projects to ESA listed fish, thus we expect projects funded under this initiative to use those design criteria. Design constraints for the types of projects expected to be funded are found in Washington state technical guidelines (described in NMFS 2017b), and are informed by other programmatic consultations that are used to provide consistency across programs. Actions covered by the NMFS (2017b) programmatic consultation are fish passage and habitat restoration projects that include several restoration action categories (e.g. levee removal, salmonid spawning gravel restoration, and fish passage restoration or improvement).

Projects considered under the programmatic consultation on the PST funding initiative for U.S. domestic actions associated with the new PST Agreement would be reviewed for consistency with the design constraints specified in NMFS' opinion (NMFS 2017d). NMFS will ensure projects have ESA and NEPA coverage before they can utilize federal funds.

2.4.2.2 Assessing Baseline Prey Availability

We assessed Chinook salmon abundance in the Action Area in the absence of the proposed action (i.e., pre-fishing) by referring to the approach described in the PFMC SRKW Ad Hoc Workgroup Report (PFMC 2020a). Here, we briefly describe the method the Workgroup developed to estimate the starting abundance of Chinook salmon (age 3 and older) available for fishery management years 1992 – 2016 within the Action Area during October – April.

Coastwide adult abundance estimates for most Chinook salmon stocks were generated using Chinook Fishery Regulation Assessment Model (FRAM) (MEW 2008) post-season runs (Round 6.2 of base period calibration; 10.29.2018). Abundance estimates for FRAM stocks (see Appendix C; Table C.1 for a list of the FRAM stocks) are calculated using stock-specific terminal run size estimates by age and mark status provided by regional technical staff. Stock-specific terminal run sizes are then expanded by maturation rates, fishing mortality, and natural mortality estimates to derive a starting abundance. For additional details related to calculations of FRAM starting abundances, please refer to PFMC (2020a).

There are several stocks that are known to occur in the action area but the Council either does not currently use models to account for these stocks, or a model is available but the stock's contribution as potential prey was considered insubstantial (refer to Appendix A in PFMC (2020a) for the rationale for excluding particular stocks). There are also several stocks that are currently modeled external to FRAM that were also considered and included in the abundance estimates due to the likely spatial-temporal overlap of these stocks with SRKW and relatively large abundances of these stocks. These include Sacramento Fall, Klamath Fall, and Rogue Fall stocks along with Upper Columbia Spring/Snake River spring-summer. The Sacramento River Fall stock tends to dominate ocean abundances in much of California (Satterthwaite et al. 2015), and Sacramento Fall, Klamath Fall, and Rogue Fall can make up a large proportion of the ocean abundance off northern California and southern/central Oregon (Bellinger et al. 2015). Fisheries are managed to meet conservation objectives for these stocks under the FMP using a several domestic fishery management models.

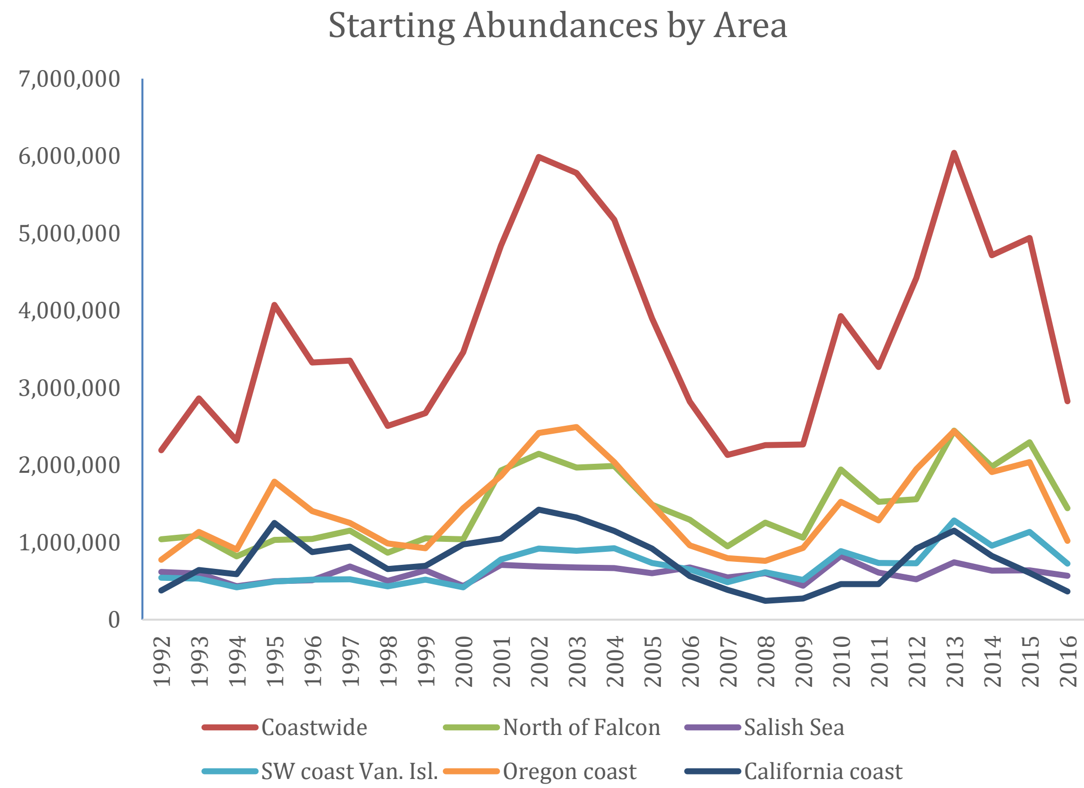
Rangewide ocean abundances were distributed among spatial boxes (e.g., waters off California and Oregon as well as North of Falcon (NOF), southwest Vancouver Island and the Salish Sea; see PFMC 2020a for the full descriptions of the areas) based on estimates of the proportion of each stock found in each area each season. For fall run stocks, proportional abundance in each management area was based on the results of Shelton et al. (2019). The "Shelton et al. model" is a state-space model that infers time- and area-specific ocean abundances of tagged fish from representative coded-wire tagged release groups using information on release size, time- and area-specific fishery catch and effort, and age structure of returning spawners. For spring run stocks, which lacked distribution estimates from the Shelton et al. model, the Workgroup followed the logic described in https://www.fisheries.noaa.gov/webdam/download/93036440. Because the stocks in the two models (FRAM and the Shelton et al. model) were not identically defined, the Workgroup matched up individual FRAM stocks to units of analysis in the Shelton et al. model as described in PFMC (2020a) and shown in Table 4.

Estimated Chinook salmon abundances aggregated in the various spatial areas prior to Council fishing (i.e., no proposed action) during the first time step in October – April during 1992 – 2016 are provided in Figure 14. These starting abundances are prior to natural mortality estimates or fishery mortality estimates. The starting abundances are based on Time Step 1 because the Workgroup agreed this was the most appropriate initial abundance estimate for the purpose of estimating reductions in area-specific abundance attributable to Council-area directed fishery removals. To determine the effects of the fisheries, fishery mortalities from the season are removed (see Effects section). These estimated abundances include the FRAM stocks identified in Table 4 and the non-FRAM stocks that are estimated external to FRAM that are considered because of the spatial-temporal overlap with SRKWs and their relatively large abundances (e.g. Sacramento Fall, Klamath Fall, and Rogue Fall stocks along with Upper Columbia Spring/Snake River spring-summer).

Table 4. Mapping Chinook salmon stocks used within the Shelton et al. model to the FRAM model stocks (replicated from PFMC 2020a).

Stock (Shelton)	Stocks (FRAM)
Central Oregon	Mid Oregon Coast
Lower Columbia	Columbia River Oregon and Washington Hatchery Tules, Lower Columbia River Wilds, Lower Columbia River Naturals, Columbia River Bonneville Pool Hatchery
Upper Columbia	Columbia River Upriver Summer, Columbia River Upriver Bright, and Snake River Fall
Northern Oregon	Oregon North Coast
Puget Sound	Nooksack/Samish, Skagit, Snohomish, Stillaguamish, Tulalip, Mid Puget Sound, University of Washington Accelerated, South Puget Sound, Hood Canal, Juan de Fuca Tributaries, Hoko
Southern Georgia Strait	Fraser Lates, Fraser Earlies, Lower Georgia Strait
Washington Coastal	Willapa Bay, Washington North Coast
West Coast Vancouver Island	West Coast Vancouver Island

Figure 14. Starting abundances in October – April (FRAM time step 1) for “zero PFMC” fishing runs (PFMC 2020a, Appendix E) for each spatial area from 1992 – 2016.



To put these starting abundance estimates in Figure 14 in context, we are able to estimate the prey energy requirements for all members of the SRKW population each day, and estimate the prey energy requirements for the entire year, for specific seasons, and/or for geographic areas (inland waters and coastal waters) as described in previous biological opinions (e.g. NMFS 2019a). The daily prey energy requirements (DPERs) for individual females and males range from 41,376 to 269,458 kcal/day and 41,376 to 217,775 kcal/day, respectively (Noren 2011). The DPERs can be converted to the number of fish required each year if the caloric densities of the fish (kcal/fish) consumed are known. However, caloric density of fish can vary because of multiple factors including differences in species, age and/or size, percent lipid content, geographic region and season. Noren (2011) estimated the daily consumption rate of a population with 82 individuals over the age of 1 that consumes solely Chinook salmon would consume 289,131–347,000 fish/year by assuming the caloric density of Chinook was 16,386 kcal/fish (i.e., the average value for adults from Fraser River). Williams et al. (2011) and Chasco et al. (2017) modeled annual SRKW prey requirements and found that the whole population requires approximately 211,000 to 364,100 and 190,000 to 260,000 Chinook salmon per year, respectively. These estimates provide a general indication of how many Chinook salmon need to be available and consumed to meet the biological needs of the whales. These estimates can vary based on several underlying assumptions including the size of the whale population and the caloric density of the salmon.

In previous biological opinions (e.g. NMFS 2019a), we compared the food energy of prey available to the whales to the estimated metabolic needs of the whales. Forage ratios indicate prey available is greater than the whales' needs by the magnitude of the value. For example, a ratio of 5.0 indicates that prey availability is 5 times the energy needs of the whales. Although we have low confidence in the ratios, we consider them as an indicator to help focus our analysis on the time and location where prey availability may be lowest and where the action may have the most significant effect on the whales. Relatively low foraging ratios were estimated in the summer months (July – September) in inland waters of WA. For example, to estimate Chinook food energy available, the baseline (derived from the FRAM validation scenario that approximates what actually occurred from 1992 to 2016 and is based on post season information) food energy from Chinook available compared to the whales' Chinook needs (assuming a population size of 75 individuals and using maximum daily prey energy estimates) in inland waters ranged from 17.57 to 29.77 in October – April, 16.39 to 30.87 in May – June, and from 8.28 to 16.89 in July – September (see NMFS 2019a for further details). In coastal waters off Washington, Oregon, and California, forage ratios ranged from 10.84 to 33.41 in October – April, from 29.24 to 88.15 in May – June, and from 42.67 to 154.79 in July – September. Chasco et al. (2017) compared forage ratios across regions (i.e., the ratio between Chinook salmon available as prey and the energy needs of killer whales in that region), from California to Southeast Alaska. They found forage ratios were useful in detecting estimated declines in prey over the last four decades and comparing forage ratios across geographic areas. They found forage ratios were across the entire west coast have declined during the last 40 years and were consistently higher in coastal waters of British Columbia and southeast Alaska than estimated ratios in Washington waters.

The abundance estimates in Figure 14 are the number of adult Chinook salmon available to the whales at the beginning of the year, prior to natural mortality and fishery mortality. Therefore these are considered maximum estimates of prey available. Similar to other fishery models, the Workgroup assumed constant adult mortality throughout the year; however, natural mortality of salmonids likely varies across years, due in part to the relative abundance of Chinook salmon and their multiple predators. Hilborn et al. (2012) noted that natural mortality rates of Chinook salmon are likely substantially higher than the previous analyses suggest. Salmonids are prey for pelagic fishes, birds, and marine mammals (including SRKWs).

2.4.3 Prey Quality

Contaminants enter marine waters and sediments from numerous sources, but are typically concentrated near populated areas of high human activity and industrialization. Freshwater contamination is also a concern because it may contaminate salmon that are later consumed by the whales in marine habitats. Chinook salmon contain higher levels of some contaminants than other salmon species, however levels can vary considerably among populations. Mongillo et al. (2016) reported data for salmon populations along the west coast of North America, from Alaska to California and found the salmon’s marine distribution was a large factor affecting persistent pollutant accumulation. They found higher concentrations of persistent pollutants in Chinook salmon populations that feed in close proximity to land-based sources of contaminants. There is some information available for contaminant levels of Chinook in inland waters (i.e., Krahn et al. 2007; O'Neill and West 2009; Veldhoen et al. 2010; Mongillo et al. 2016). Some of the highest levels of certain pollutants were observed in Chinook salmon from Puget Sound and the Harrison River (Mongillo et al. 2016). These populations are primarily distributed within the urbanized waters of the Salish Sea and along the west coast of Vancouver Island (DFO 1999; Weitkamp 2010). However, populations of Chinook salmon that originated from the developed Fraser River that had a more northern distribution in the coastal waters of British Columbia and Alaska (DFO 1999) had much lower concentrations of certain contaminants (Mongillo et al. 2016). Additionally, (O'Neill and West 2009) discovered elevated concentrations of polychlorinated biphenyls (PCBs) in Puget Sound Chinook salmon compared to those outside Puget Sound. Similarly, J pod--the SRKW pod most frequently seen in Puget Sound--has also been found to have higher levels of PCBs, consistent with these higher PCB concentrations in Puget Sound Chinook salmon (O'Neill et al. 2006; Krahn et al. 2007). Intermediate levels of PCBs were measured in California and Oregon populations, but Chinook originating from California have been measured to have higher concentrations of DDTs (O'Neill et al. 2006; Mongillo et al. 2016).

Size and age structure in Chinook salmon has substantially changed across the Northeast Pacific Ocean. Since the late 1970s, adult Chinook salmon (ocean ages 4 and 5) along most of the eastern North Pacific Ocean are becoming smaller, whereas the size of age 2 fish are generally increasing (Ohlberger et al. 2018). Additionally, most of the Chinook salmon populations from Oregon to Alaska have experienced lower proportions of age 4 and 5 year olds and an increase in the proportion of 2 year olds; the mean age of Chinook salmon in the majority of the populations has declined over time. For Puget Sound Chinook salmon (primarily hatchery origin), there were little or weak trends in size-at-age of 4 year olds and the declining trend in the proportion of older ages in Washington stocks was also observed but slightly weaker than that in Alaska populations (Ohlberger et al. 2018). Reasons for this shift may be largely due to direct effects from size-selective removal by marine mammals and fisheries, followed by evolutionary changes toward these smaller sizes and early maturation (Ohlberger et al. 2019).

2.4.4 Vessels and Sound

Commercial shipping and military, recreational and fishing vessels occur in the coastal range of SRKWs and additional whale watching, ferry operations, recreational and fishing vessel traffic occurs in their inland range. The density of traffic is lower in coastal waters compared to inland waters of Washington State and British Columbia. Several studies in inland waters of Washington State and British Columbia have linked interactions of vessels and Northern Residents and SRKW with short-term behavioral changes (see review in Ferrara et al. (2017)), whereas there have been no studies that have linked interactions of vessels and SRKWs with behavioral changes in coastal waters. These vessel activities in inland waters may affect foraging efficiency, communication, and/or energy expenditure through the physical presence of the vessels, underwater sound created by the vessels, or both. Collisions of killer whales with vessels are rare, but remain a potential source of serious injury and mortality, although the true effect of vessel collisions on mortality is unknown.

Vessel sounds in coastal waters are most likely from large ships, tankers and tugs, whereas vessel sounds in inland waters also come from whale watch platforms, ferry operations and smaller recreational vessels. Commercial sonar systems designed for fish finding, depth sounding, and sub-bottom profiling are widely used on recreational and commercial vessels and are often characterized by high operating frequencies, low power, narrow beam patterns, and short pulse length (National Research Council 2003). Frequencies fall between 1 and 500 kilohertz (kHz), which is within the hearing range of some marine mammals including killer whales and may have masking effects (i.e., sound that precludes the ability to detect and transmit biological signals used for communication and foraging).

Recently, there have been several studies that have characterized sound from ships and vessels as well as ambient noise levels in the inland waters (Bassett et al. 2012; McKenna et al. 2013; Houghton et al. 2015; Veirs et al. 2016). Bassett et al. (2012) assessed ambient noise levels in northern Admiralty Inlet (a waterway dominated by larger vessels). They found that vessel activity contributed most to the variability measured in the ambient noise and cargo ships contributed to the majority of the vessel noise budget. Veirs et al. (2016) estimated sound pressure levels for larger ships that transited through the Haro Strait, and found that the received levels were above background levels, and that underwater noise from ships extends up to high frequencies similar to noise from smaller boats. Commercial shipping was also identified as a significant source of low frequency ambient noise in the ocean, which has long-range propagation and therefore can be heard over long distances. Additionally, the contribution of shipping to ambient noise has increased by as much as 12dB over the past few decades (Hildebrand 2009). Ship noise was identified as a concern because of its potential to interfere with SRKW communication, foraging, and navigation (Veirs et al. 2016). Although there are several vessel characteristics that influence noise levels, vessel speed appears to be the most important predictor in source levels (McKenna et al. 2013; Houghton et al. 2015; Veirs et al. 2016; Holt et al. 2017), and reducing vessel speed would likely reduce acoustic exposure to SRKWs.

Behavioral responses of killer whales to received levels from ships was estimated using a dose-response function (Williams et al. 2014). The authors predicted that the whales would have a 50% chance of responding behaviorally to ship noise when received noise levels were approximately 130 dB rms. Following this study, Holt et al. (2017) utilized Digital Acoustic Recording Tags (DTAGs) to measure received noise levels by the whales (in decibels (dB) re 1 Micropascal (μPa)) in inland waters. The received noise levels (in the 1 to 40 kHz band) measured in inland waters were between 96 and 127 dB re 1μPa, with an average of 108 dB ± 5.5. It is currently unclear if SRKWs experience noise loud enough to have more than a short-term behavioral response; however, new research from the NWFSC is investigating fine scale details of subsurface acoustic and movement behavior under different scenarios, especially those predictive of foraging, to then determine potential effects of vessels and noise on SRKW behaviors in inland waters.

Recent evidence indicates there is a higher energetic cost of surface active behaviors and vocal effort resulting from vessel disturbance (Williams et al. 2006; Noren et al. 2012; Noren et al. 2013; Holt et al. 2015). For example, Williams et al. (2006) estimated that changes in activity budgets in Northern Resident killer whales in inland waters in the presence of vessels result in an approximate 3% increase in energy expenditure compared to when vessels are not present. However, this increased energy expenditure may be less important than the reduced time spent feeding and the resulting potential reduction in prey consumption (Ferrara et al. 2017). Southern Resident killer whales spent 17 to 21% less time foraging in inland waters in the presence of vessels for 12 hours, depending on vessel distance (see Ferrara et al. 2017). Although the impacts of short-term behavioral changes on population dynamics is unknown, it is likely that because SRKWs are exposed to vessels the majority of daylight hours they are in inland waters, there may be biologically relevant effects at the population-level (Ferrara et al. 2017).

The Be Whale Wise viewing guidelines and the 2011 federal vessel regulations (www.bewhalewise.org) were designed to reduce behavioral impacts, acoustic masking, and risk of vessel strike to SRKWs in inland waters of Washington State. Since the regulations were codified, there is some evidence that the average distance between vessels and the whales has increased (Houghton 2014; Ferrara et al. 2017). The majority of vessels in close proximity to the whales in inland waters are commercial and recreational whale watching vessels and the average number of boats accompanying whales can be high during the summer months (i.e., from 2013 to 2017 an average of 12 to 17 boats;(Seely 2020)). The average number of vessels with the whales decreased in 2018 and 2019 due to decreased viewing effort on SRKWs by commercial whale watching vessels, with an average of 10 and 9 vessels with the whales at any given time, respectively (Shedd 2020). However, fishing vessels are also found in close proximity to the whales in inland waters and were responsible for 13% of the incidents inconsistent with the Be Whale Wise Guidelines and non-compliant with federal regulations in 2019 (Shedd 2019). These activities included entering a voluntary no-go zone and fishing within 200 yards of the whales. A number of recommendations to improve compliance with guidelines and regulations are being implemented in inland waters by a variety of partners to further reduce vessel disturbance (Ferrara et al. 2017).

Anthropogenic (human-generated) sound in inland waters is generated by other sources beside vessels, including construction activities, and military operations. Natural sounds in the marine environment include wind, waves, surf noise, precipitation, thunder, and biological noise from other marine species. The intensity and persistence of certain sounds (both natural and anthropogenic) in the vicinity of marine mammals vary by time and location and have the potential to interfere with important biological functions (e.g., hearing, echolocation, communication).

In-water construction activities are permitted by the Army Corps of Engineers (ACOE) under section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act of 1899 and by the State of Washington under its Hydraulic Project Approval (HPA) program. NMFS conducts consultations on these permits and helps project applicants incorporate conservation measures to minimize or eliminate potential effects of in-water activities, such as pile driving, to marine mammals. Sound, such as sonar generated by military vessels also has the potential to disturb killer whales and mitigation including shut down procedures are used to reduce impacts.

2.4.5 Entrapment and Entanglement in Fishing Gear

Drowning from accidental entanglements in nets and longlines is a minor source of fishing related mortality in killer whales. One killer whale was reported interacting with a salmon gillnet in British Columbia in 1994, but did not get entangled (Guenther et al. 1995). Two killer whales have been recorded entangled in Dungeness crab commercial trap fishery gear off California (one in 2015 and one in 2016) (NMFS 2016c). In 2018, DFO disentangled a transient killer whale entangled in commercial prawn gear near Salt Spring Island, British Columbia (NMFS strandings data, unpubl.). In 2013, a Northern Resident killer whale stranded in British Columbia and a fish hook was observed in its colon, but had no evidence of perforation or mucosal ulceration (NMFS strandings data, unpubl.). Typically, killer whales are able to avoid nets by swimming around or underneath them (Jacobsen 1986; Matkin 1994), and not all entanglements automatically result in death. For example, J39, a young male killer whale in J pod, was observed with a salmon flasher hooked in his mouth during the summer of 2015 around the San Juan Islands, which subsequently fell out with no signs of injury or infection (Center for Whale Research unnpubl. data).

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 considered injured, and must be reported[9]. No entanglements, injuries or mortalities have been reported in recent years.

2.4.6 Oil Spills

As described in the Status of the Species section, SRKWs are vulnerable to the risks imposed by an oil spill. The risk from serious spills because of the heavy volume of shipping traffic and proximity to petroleum refining centers. The total volume of oil spills in inland waters of Washington has increased since 2013 and inspections of high-risk vessels have declined since 2009 (WDOE 2017). In 2014, NOAA responded to 16 actual and potential oil spills in Washington and Oregon. In 2017, over 46,000 gallons of non-crude oil was spilled into marine waters from Hawaii to Alaska (Stephens 2018). Polycyclic aromatic hydrocarbons (PAHs), a component of oil (crude and refined) and motor exhaust, are a group of compounds known to be carcinogenic and mutagenic (Pashin and Bakhitova 1979). Exposure can occur through five known pathways: contact, adhesion, inhalation, dermal contact, direct ingestion, and ingestion through contaminated prey (Jarvela-Rosenberger et al. 2017).

Following the *Deepwater Horizon* oil spill, substantial research effort has occurred to document adverse health effects and mortality in cetaceans in the Gulf of Mexico. Common dolphins (*Tursiops truncatus*) in Barataria Bay, an area that had prolonged and severe contamination from the Deepwater Horizon oil spill, were found to have health effects consistent with adrenal toxicity and increased lung disease (Schwacke et al. 2013; Venn-Watson et al. 2015), low reproductive success rates (Kellar et al. 2017), and changes in immune function (de Guise et al. 2017). As described above, SRKWs can be occasionally exposed to concerning PAH levels (Lachmuth et al. 2011). Lundin et al. (2018) measured relatively higher levels of PAHs in whale fecal samples prior to the 2011 vessel regulations that increased the distance vessels could approach the whales compared to subsequent years after the vessel regulations were in place.

2.4.7 Scientific Research

Most of the scientific research conducted on SRKW occurs in inland waters of Washington State and British Columbia. In general, the primary objective of this research is population monitoring or data gathering for behavioral and ecological studies. Research activities are typically conducted between May and October in inland waters and can include aerial surveys, vessel surveys, close approaches, and documentation, and biological sampling. Most of the authorized takes would occur in inland waters, with a small portion in the coastal range of SRKWs. In light of the number of permits, associated takes, and research vessels and personnel present in the environment, repeated disturbance of individual killer whales is likely to occur in some instances. In recognition of the potential for disturbance and takes, NMFS took steps to limit repeated harassment and avoid unnecessary duplication of effort through conditions included in the permits requiring coordination among permit holders, such as restricting the number of research vessels within 200 yards of a SRKW at any given time. The cumulative effects of research activities were considered in a batched biological opinion for four research permits in 2012 (NMFS 2012b). The cumulative effects were also considered in the biological opinion on the renewal of the research permits (NMFS 2018g).

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[9] Review of reporting requirements and procedures, 50 CFR 229.6 and http://www.nmfs.noaa.gov/pr/pdfs/interactions/mmap_reporting_form.pdf

2.5. 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 (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

2.5.1 Effects on Southern Resident Killer Whales

Fisheries conducted under the FMP may directly affect SRKWs through interactions with vessels and gear, and indirectly affect them by reducing prey availability. This section evaluates the direct and indirect effects of the proposed action on the Southern Resident killer whale DPS. First, we summarize the description of the PFMC salmon fisheries described in more detail in Section 1.3 and describe the temporal and spatial overlap of the fisheries with SRKWs and their proposed critical habitat to provide a context to assess the effects on SRKWs. Second, we evaluate the direct and indirect effects of the proposed action. NMFS has incorporated analyses from the draft Pacific Fishery Management Council Salmon Fishery Management Plan Impacts to Southern Resident Killer Whales Final Draft Risk Assessment February 2020 (Agenda Item E.3.a, SRKW Workgroup Report 1, March 2020 cited as PFMC 2020a) into this biological opinion to analyze the effects on SRKWs from PFMC fisheries in 2020-2021.

PFMC Salmon Fisheries Description

As described in Section 1.2 Consultation History, in 2009 NMFS consulted on the effects of the Pacific Coast Salmon FMP (NMFS 2009) and concluded that the Council salmon fisheries did not jeopardize the survival and recovery of SRKW. On April 12, 2019, NMFS reinitiated consultation to consider the effects of the fisheries on SRKWs given the change in the whales' status and substantial amount of new information available on the whales' diet and distribution (NMFS 2019). The PFMC formed a workgroup to reassess the effects of Council-area ocean salmon fisheries on the Chinook salmon prey base of SRKW, and depending on the results, develop a long-term approach that may include proposed conservation measure(s) or management tool(s) that limit Council salmon fishery impacts to prey availability for SRKW relative to implementing the FMP. Below, we describe the 2020/2021 fisheries in each management area NOF and SOF and the temporal and spatial overlap of the fisheries with SRKWs.

<u>North of Falcon Salmon Fisheries</u>
The NOF management area encompasses the Washington coast and the northern Oregon coast. Harvest allocation and seasons may vary among the four ocean subareas, which include Marine Area 1 (Columbia River subarea - Leadbetter Point to Cape Falcon, OR), Marine Area 2 (Westport subarea - Queets River to Leadbetter Point, WA), Marine Area 3 (La Push subarea - Cape Alava to Queets River, WA) and Marine Area 4 (Neah Bay subarea - U.S./Canada Border to Cape Alava, WA) (refer to Figure 1).

Stocks that constrain NOF fisheries vary annually depending on relative stock abundance and sharing of the conservation responsibility between ocean and inside fisheries. In recent years, fisheries have been structured to limit impacts on (a) ESA-listed Chinook salmon stocks from the

Columbia River and Puget Sound, non-listed Chinook stocks in California, (b) ESA-listed coho salmon from the Columbia River, (c) non-listed coho salmon stocks from the Washington Coast and Puget Sound; and (d) coho stocks from the Fraser River consistent with provisions of the PST Agreement.

North of Falcon Coastal Non-Tribal Commercial and Recreational Ocean Fisheries
Fisheries are planned based on allocations between recreational and commercial sectors and between subareas as established in the FMP. The commercial non-tribal troll fishery NOF is typically open for a Chinook-only season between May 1 and June 30 and an all-species season July 1-September 30. For 2020, the fishery is proposed to be open seven days a week from May 6 to June 28 (or 13,820 Chinook) and from July 1 to September 30 (or 13,820 Chinook or 2,000 coho). In 2021, the season will open May 1 unless modified following Council review at its March and/or April 2021 meetings. For the recreational fishery NOF in previous years, season opening dates, closing dates and daily retention limits vary by year and by subarea. For 2020, the season is proposed to open June 20 for each subarea (Neah Bay, La Push, Westport, and Columbia River Subareas) and to remain open until the earlier of September 30 or when the subarea coho and Chinook quotas are reached.

Because the July-September season operates with a quota for Chinook salmon and another quota for coho salmon, reaching one quota before the fishery catches the other would result in closure for the season. In-season management focuses on extending quotas throughout the season to avoid early closures. To achieve this goal, occasionally quota is transferred between subareas, sectors and/or species on an impact-neutral basis. These changes are analyzed to ensure impacts on limiting stocks (identified annually at the preseason process) are not different than those analyzed in the preseason process.

Washington Coast Treaty Ocean Troll Fishery
The Makah, Quileute, Hoh, and Quinault tribes may exercise their treaty rights to harvest salmon in their respective usual and accustomed fishing areas off Washington. In addition, Makah, Lower Elwha Klallam, Jamestown S'Klallam, and Port Gamble S'Klallam tribes may exercise their treaty rights to harvest salmon in their respective usual and accustomed fishing areas in Marine Area 4B, the entrance to the Strait of Juan de Fuca. During the May through September time period tribal salmon harvest in Area 4B is attributed to the treaty troll quotas. Treaty Indian tribes have a legal entitlement to take up to 50 percent of the harvestable surplus of stocks which pass through their usual and accustomed fishing areas.

The 2020 proposed treaty troll fishery would consist of a Chinook-only season between May 1 and June 30 (or a 17,500 Chinook quota) and an all-species season between July 1-September 30 (or a 17,500 Chinook quota or 16,500 coho quota). Chinook remaining from the May through June treaty troll quota may be transferred to the July through September quota on an impact-neutral basis for limiting stocks. Treaty tribes may apply in-season effort controls, such as days open per week, vessel landing limits, fishery closures, etc., when necessary to ensure tribal harvest does not exceed the Chinook or coho treaty troll quotas.

Overlap of Council ocean salmon fisheries NOF and SRKWs

For the most recent ten-year period where data are available (2009-2018), the average NOF commercial troll fishing effort measured in days fished per month were highest in May (999 days fished[10]) which then decreased through the remaining season (Figure 15a). For the recreational fishery NOF, season opening dates, closing dates and daily retention limits vary by year and by subarea (PFMC 2020a). The average number of angler trips from 2009 to 2018 were highest in August (40,636 trips) and lowest in May (1,460 trips) and October (234 trips) (Figure 15b; PFMC 2020b). 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; also see Section 2.2.1.2 Geographic Range and Distribution).

We expect the general seasonal patterns of the fisheries to be similar to the previous 10-year period discussed above. Although seasonal movements of SRKWs are generally predictable, there can be large inter-annual variability in the time spent in inland waters of WA and BC from spring through fall, there have been fewer days present in recent years (Hanson and Emmons 2010; Whale Museum unpublished data). For example, in 2019, some members of L pod were not encountered in the inland waters between January and August 11 and then not again until September (spending only a few days in inland waters in the summer months). Some K pod members were encountered for a couple of days in July and then again in September (Center for Whale Research unpublished data). This is substantially different than what was observed in previous years. Between 2003 – 2017, the average number of days K pod spent in inland waters in the summer months (July – September) was 20 - 21 days each month; the average number of days L pod spent in inland waters in the summer months was 22 - 23 days each month (raw data from The Whale Museum, from 2003 – 2017). If we assume that when K and L pods are not encountered in inland waters, they are likely in the coastal waters of their range, then in some years there may be more potential for an overlap between PFMC fishing vessels and SRKWs. Given the large inter-annual variability in the SRKWs seasonal distribution, we cannot predict the whales' movements in 2020. Therefore, we take a conservative approach and assume K and L pods will spend more time in coastal waters than the average in 2003 - 2017 (similar to what was observed in 2019).

Because the whales have been detected or observed in every month of the year NOF (although not in every year because there can be large inter-annual variability), they may overlap with the fisheries at any time during May through September. Although there is limited information on the location of the fishing vessels and SRKWs, and the vessels are likely spread out throughout the entire NOF coastal area, we can assume that in years that the whales spend less time in inland waters of WA, there may be an increased likelihood of a direct overlap between vessels and whales in coastal waters. Because the commercial fishing effort is typically highest in May and reduces over the season, we assume a higher potential of overlap with the whales early in the season with commercial vessels. The recreational fishing effort is typically highest in August and therefore there may be a higher potential of direct overlap with the recreational vessels and whales in August.

[10] Fishing days is the summation of the number of days each commercial fishing vessel fished.

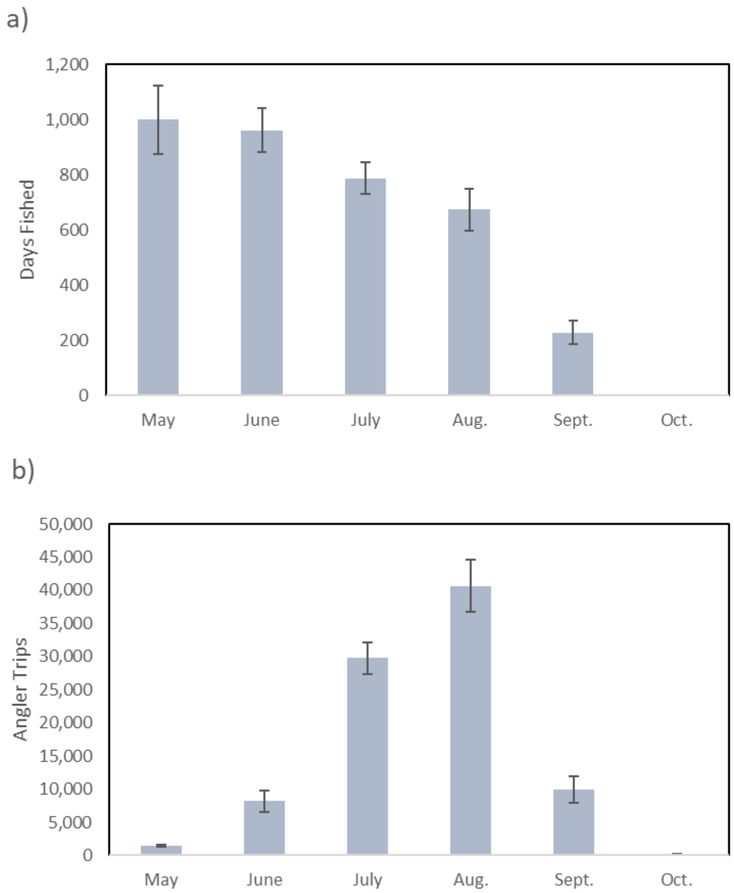


Figure 15. U.S./Canada border to Cape Falcon a) commercial troll salmon fishing effort in average days fished (total Treaty Indian and non-Indian) and b) recreational fishing effort in average angler trips during open seasons from 2009 to 2018 (data from Table A-24 and Table A-27, PFMC 2020b). Error bars represent standard error. The solid gray bars represent an increased likelihood there may be an overlap of whales and fishing vessels. Because whales are present in all months NOF, all bars are solid gray.

South of Falcon to California Border Salmon Fisheries

Oregon Coast

This area includes the major management areas of Oregon (Cape Falcon to Humbug Mt.) and the Oregon portion of the Klamath Management Zone (KMZ; Humbug Mt. to the OR/CA border; Figure 1).

In the Cape Falcon to Humbug Mt. area, the commercial season is typically open from mid-March/early-April through October, with various mid-season closures to reduce impacts on limiting stocks. The 2020 proposed commercial season for Cape Falcon to Humbug Mt. is April 20-30; May 1-5, 26-31; June 4-30; July 1-31; August 1-25; and September 1 – October 31. The Oregon KMZ commercial season typically opens in mid-March/early-April, with monthly quotas beginning in June. The 2020 proposed commercial season for KMZ is April 20-30; May 1-5, 26-31; June 4-June 30 (or a 700 Chinook quota); and July 1-31 (or 300 Chinook quota). In 2021, the proposed commercial season will open March 15 in both subareas off Oregon unless modified through inseason action at the Council's March or April 2021 meetings. Constraining Chinook salmon stocks for commercial fisheries in the Oregon areas are most often those originating in

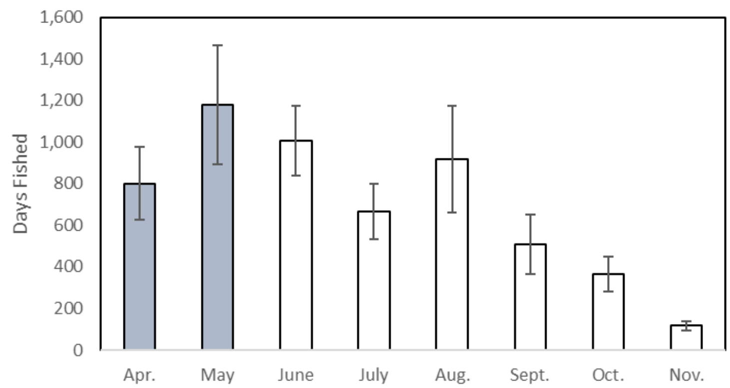
California rivers (e.g. Klamath River fall Chinook salmon and Sacramento basin fall Chinook salmon). Coho retention has been prohibited in commercial troll fisheries SOF since 1993 with the exception of limited fisheries in 2007, 2009, and 2014, and is prohibited in 2020/2021.

In the Cape Falcon to OR/CA border area, the large majority of the catch and effort in the recreational salmon fishery is directed at coho salmon. Various coho salmon quota fisheries occur from June through the summer (depending on quota) and into September, overlapping with the ongoing Chinook salmon season. The recreational fishery in Cape Falcon to Humbug Mt. is from March 15-October 31 and in 2021 is also proposed open March 15 unless modified through inseason action. The KMZ recreational fishery is usually open for Chinook salmon (with some years of limited summer coho salmon fishing in the Oregon KMZ), early-May through early-September, although mid-season closures are common. In 2020, the recreational fishery for Chinook is open June 20-August 7.

Overlap of Council ocean salmon fisheries off Oregon coast and SRKWs

For the most recent ten-year period where data are available (2009-2018), the highest average Oregon commercial troll salmon fishing effort (in days fished) occurred in May (1,180 days) followed by an average of 1,007 days in June (Figure 16a). In contrast, the highest average Oregon ocean recreational salmon fishing effort (in angler trips) occurred in August (22,726 trips) and July (19,942 trips) (Figure 16b). Based on opportunistic sightings, satellite tagging efforts, and acoustic detections, the whales are observed off the Oregon coast (see Section 2.2.1.2 Geographic Range and Distribution) and may have some direct overlap with the fisheries. Although the whales' predictive use in any particular area is uncertain and the limited data seems to suggest considerable year-to-year variation, the current data suggest that an overlap may be more likely to occur from March through May when fisheries are open and whales have been observed or detected in the area. During this time, the commercial fishing effort is highest but the recreational fishing effort is lowest (Figure 16a, b; PFMC 2020b). Because the whales have not been detected or observed in the coastal waters of Oregon during the majority of duration of the commercial and recreational fishing seasons, we do not anticipate an overlap of whales with the fisheries from June through October. Although there may be overlap of the whales with recreational fisheries from March – May and November, the recreational fishing effort is relatively low during these months and therefore there may be a lower likelihood of a direct overlap.

a)



b)

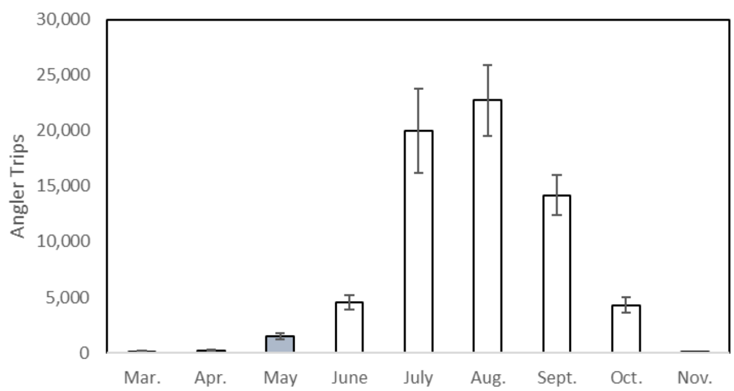


Figure 16. Oregon a) commercial troll salmon fishing effort in average days fished per month and b) ocean recreational salmon fishing effort in average number of angler trips per month in open seasons from 2009 – 2018 (data from Table A-6 and Table A-9, PFMC 2020b). Error bars represent standard error; solid gray bars represent higher likelihood there may be an overlap of whales and vessels; white bars represent a lower likelihood that there may be an overlap of whales and vessels. Given the whales have not been detected or observed in Oregon waters in June through October, there is a lower likelihood of an overlap of whales and vessels even though the effort is relatively higher.

California Coast

Commercial and recreational fisheries targeting Chinook salmon along the California coast are managed within four major catch/port areas (north to south, Figure 1): (1) the California portion of the Klamath Management Zone (CA-KMZ), which extends from the OR-CA border to Horse Mountain, (2) Fort Bragg (Horse Mountain to Point Arena), (3) San Francisco (Point Arena to Pigeon Point), and (4) Monterey (Pigeon Point to the US-Mexico border).

Both commercial and recreational opportunity tend to be greatest in Fort Bragg and San Francisco areas. To the south and north, protracted early (Monterey) or late (CA-KMZ) seasons or quotas [CA-KMZ troll] are often adopted to reduce impacts on ESA-listed Sacramento River Winter Run Chinook salmon and California Coastal Chinook. Management objectives for Sacramento Fall and Klamath River Fall Chinook stocks also often play a role in limiting opportunity coast wide; fishing in the Fort Bragg and CA-KMZ is most constrained by objectives for Klamath River Fall Chinook, or by California Coastal Chinook in years with high Klamath River Fall Chinook abundance. In a year with high Klamath River Fall Chinook or Sacramento River Fall Chinook abundance, commercial opportunity exists from May 1 through the middle of

October, with earlier or later seasons precluded by winter run ESA consultation standards south of Point Arena. For 2020, the proposed commercial season in the California KMZ and Humboldt South Jetty to Horse Mt. subareas are closed. In the Fort Bragg subarea, the proposed commercial season is August 1-10 and September 1-30. In the San Francisco subarea, the proposed commercial season is on and off from May 6-September 30. In 2021, the season is proposed to open May 1 in the California KMZ, April 15 in the Fort Bragg and May 1 in the San Francisco subareas. In the Fall Area Target Zone subarea (Point Reyes to Point San Pedro) the 2020 commercial season opens October 1. The Monterey subarea is proposed open on and off in 2020 from May 1-August 28 and will open May 1 in 2021. Recreational fisheries are available from May 1 in Fort Bragg and San Francisco, and continue to November 8. In Monterey, the recreational fishery opens May 1-October 4. In the California KMZ the 2020 recreational season opens June 6-August 9. In 2021, the season opens May 1 in California KMZ and April 3 for the remaining subareas in California.

Overlap of Council ocean salmon fisheries off California coast and SRKWs
For the most recent ten-year period where data are available (2009-2018), the highest average California commercial troll salmon fishing effort (in days fished) occurred in May and July (approximately 2,500 days) followed by an average of 2,355 days in August (Figure 17a). The highest average California ocean recreational salmon fishing effort (in angler trips) occurred in July (27,410 trips) (Figure 17b). The whales are observed off the California coast (see Section 2.2.1.2 Geographic Range and Distribution), and may have some direct overlap with the fisheries. Although the whales' predictive use in any particular area is uncertain and the limited data seems to suggest considerable year-to-year variation, the spatial distribution data for the whales suggest overlap may be more likely to occur April, May, and October because the whales and the fisheries both occur off California during these months in some years. During these months of potential overlap (i.e., the fishing season is open and the whales have been observed or detected in the area), the average effort for commercial fishing is relatively high in May and relatively low in October and the average effort for recreational fishing is at average levels in April and May and relatively low in October (Figure 17a, b; PFMC 2020b). We assume the higher the fishing effort during months the whales may overlap with the fisheries, the higher the likelihood of the overlap.

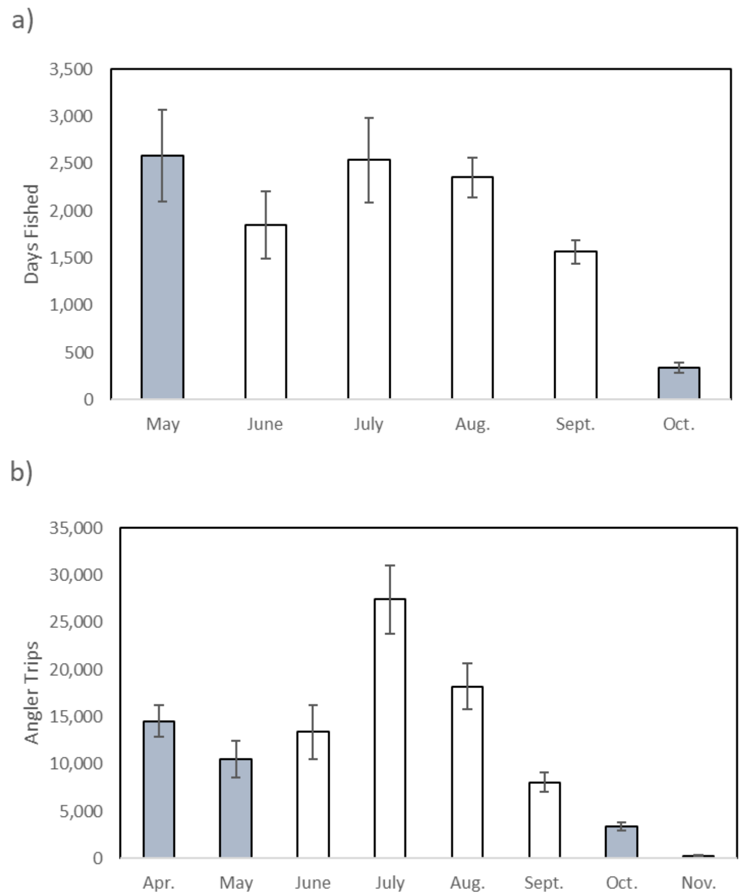


Figure 17. California a) commercial troll salmon fishing effort in average days fished per month and b) ocean recreational salmon fishing effort in average number of angler trips per month from 2009 – 2018 (data from Table A-2 and Table A-4, PFMC 2020b). Error bars represent standard error; solid gray bars represent higher likelihood of overlap of whales and vessels; white bars represent a lower likelihood of overlap with the whales and vessels.

Direct Effects: Vessel and Gear Interactions

There is potential for direct interaction between SRKWs and fishing vessels and gear in the whales' coastal range because of the spatial and temporal overlap between the whales' distribution and the distribution of the Council salmon fisheries as described above. There is no potential for direct effects on the SRKWs from vessels or gear when the whales occur in inland waters because the ocean salmon fisheries of the FMP do not occur in inland waters of Washington and British Columbia. As described in the Status of the Species, SRKWs have typically spent a substantial amount of time in the inland waterways of the Salish Sea during late spring, summer, and early fall. However, their seasonal movements are only somewhat predictable because there can be large inter-annual variability in arrival time and days present in inland waters. Late arrivals and fewer days present in inland waters have been observed in recent years.

In the 2020/2021 fishing season, vessel traffic and fishing effort associated with the Council fisheries are not anticipated to be higher than past levels in the Action Area[11] and in some cases less due to reduced coho quotas. This analysis considers how effects from vessel activities and gear interactions associated with the proposed fisheries may impact the fitness of SRKWs (e.g., reproduction, numbers, or their distribution). Here we describe the potential interactions (e.g., vessel strike, gear interaction, vessel or acoustic disturbance) and potential responses (e.g., mortality, serious injury, behavioral changes).

Potential Interactions and Responses

Interactions of SRKWs with commercial and recreational vessels could occur while vessels are fishing or while they are transiting to and from the fishing grounds. Vessel strikes or any potential for gear interaction with marine mammals are rare and have never been observed in association with PFMC ocean salmon fisheries. NMFS, through its List of Fisheries (LOF), monitors and categorizes bycatch of marine mammals in all commercial fisheries according to relative risks of mortality and serious injury (M/SI)[12]. The LOF lists U.S. commercial 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) that result in M/SI of marine mammals. Commercial fishers in all categories (with the exception of tribal treaty fisheries, but tribes voluntarily report such interactions) participating in U.S. fisheries are required to report incidental marine mammal injuries and mortalities. The List of Fisheries for 2019 classified the "CA/OR/WA salmon troll" fisheries as a Category III fishery (i.e., remote likelihood of/no known incidental mortality or serious injury of marine mammals) (84 FR 22051, May 16, 2019). Although vessel strikes and gear interactions are unlikely, NMFS will evaluate the need for additional actions if fishery interactions with SRKWs are reported (in accordance with provisions of the MMPA, 50 CFR 229.7).

As discussed in the Status of the Species and Environmental Baseline sections, vessel effects can also include disruptions in behavior and acoustic interference. Several studies have addressed the potential consequences, both physiological consequences and the increase in energetic costs, from the behavioral responses of killer whales to vessel presence, including changes in behavior state, swimming patterns and increased surface active behaviors. Williams et al. (2006) estimated that changes in Northern Resident killer whale activity budgets in the presence of vessels resulted in a higher increase in energy expenditure compared to when vessels were not present. Other studies measuring metabolic rates in captive dolphins have shown these rates can increase during the more energetically costly surface behaviors (Noren et al. 2012) that are observed in killer whales in the wild, as well as during vocalizations and the increased vocal effort associated with vessels and noise (Noren et al. 2013; Holt et al. 2015). These studies that show an increase in energy expenditure during surface active behaviors and changes in vocal effort may negatively impact the energy budget of an individual, particularly when cumulative impacts of exposure to multiple vessels throughout the day are considered.

Even more of a concern for SRKWs than an increase in energy expenditure from increased surface active behaviors and increased vocal effort is the cost of the loss of foraging opportunities and the probable reduction in prey consumption (Ferrara et al. 2017). Several cetacean species worldwide forage less in the presence of vessels (Senigaglia et al. 2016). As

[11] This may be a conservative estimate because the fishing season, at least the early months of the season, is reduced due to the public and social restrictions from the COVID-19 pandemic.

[12] Stocks as defined under the MMPA. These may not necessarily coincide with ESA-listed populations of marine mammals.

mentioned above, Southern Residents spent 17 to 21% less time foraging in the presence of vessels depending on the distance of vessels (see Ferrara et al. 2017). An increase in energetic costs because of behavioral disturbance or reduced foraging can decrease the fitness or health of individuals (Dierauf and Gulland 2001; Trites and Donnelly 2003; Lusseau and Bejder 2007). Currently, the degree of impact of repeated disruptions from vessels on Southern Residents foraging and energy intake is unknown. However, decreasing the number of repeated disruptions from vessels will likely reduce the impact on foraging and, in turn, reduce the potential for nutritional stress.

There is substantial vessel traffic along the U.S. West Coast, particularly into and out of major ports (NMFS 2019d). It is reasonable to expect that the Council salmon fisheries may result in more vessels in the general proximity to the whales than there would be if no fishing is authorized, and therefore based on the limited information presented previously, we expect that the proposed action may result in some additional exposure of SRKWs to the physical presence or sound generated by vessels fishing in the PFMC salmon fisheries if SRKWs were present nearby. If the whales were to occur in coastal waters, the highest likelihood for interaction in 2020 is during the entire season NOF but also in the beginning months of the season off Oregon and California (i.e., April and May).

For fishing vessels, if interactions were to occur, vessel and acoustic disturbances may cause behavioral changes, avoidance, or a decrease in foraging (as described above). Some of the disturbances may result in less efficient foraging by the whales than would occur in the absence of the vessel effects. However, it is difficult to estimate the number of disturbances likely to result in behavioral changes or avoidance, and not possible to quantify effects on foraging efficiency. The greatest effects would be expected to occur in areas NOF where the potential for overlap of the whales and fisheries may be the greatest. Although vessel and acoustic disturbance are potential threats to SRKWs, fishing vessels operate at slow speeds or in idle when actively fishing. When in transit, vessels would likely travel at faster speeds with potential to affect the whales' behavior; however, fishing vessels do not target whales, no interactions of ocean fishing vessels and SRKWs have been reported and any disturbance that may occur would likely be transitory. Fishing vessels also will be subject to new state regulations when transiting state waters that protect SRKWs (see RCW 77.15.740) and otherwise subject to guidelines to avoid impacts to whales. NMFS and other partners have outreach programs in place to educate vessel operators, including the fishing community. For example, NMFS' annual Federal Regulations Reference Guide provides the current regulations and the www.bewhalewise.org website for reference to the guidelines on vessel approach distances to SRKWs and other marine life.

In summary, vessel strikes or any potential for gear interactions with SRKWs are rare in general and have not been observed in association with PFMC ocean salmon fisheries. However, there remains some potential for the vessels to be close enough to the whales, either while fishing or transiting, to cause behavioral changes. If such interactions were to occur, they would more likely occur in NOF areas and would likely result in very minor short-term changes to the whales' behavior or avoidance (as described above). We expect that any transitory small amount of disturbance caused by the fishing vessels is not likely to disrupt normal behavioral patterns.

Indirect Effects: Reduction of Prey

We evaluated the potential indirect effects of the Council salmon fishing on SRKWs based on the best scientific information about the whales' diet and distribution and the reduction in

Chinook caused by the Council salmon fishing. We relied on the PFMC SRKW Ad Hoc Workgroup report (PFMC 2020a) where appropriate. Similar to past biological opinions where we assessed the effects of fisheries (NMFS 2009, NMFS 2019a, c) our analysis of Council salmon fisheries focuses on effects to Chinook salmon availability because the best available information indicates that SRKWs prefer Chinook salmon (as described in Section 2.2.1 Status of Southern Resident Killer Whales) and this provides a conservative approach to assessing impacts from prey reductions. Focusing on Chinook salmon 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. This analysis considers whether effects of that prey reduction may impact the fitness of individual whales or effect survival and recovery.

First, we discuss the relationship between SRKWs and their primary prey, Chinook salmon. We then discuss our evaluation on the potential short-term (or annual) effects as well as the long-term effects of changes in prey availability from the Council salmon fisheries in 2020 described further below. The analysis also highlights our level of confidence in the available data, and identifies where there is uncertainty in light of data gaps and where we made conservative assumptions.

Relationship between SRKWs and Chinook salmon

Several studies in the past have found correlations between Chinook salmon abundance indices and SRKW demographic rates (e.g. fecundity and mortality) (Ford et al. 2005; Ford et al. 2009; Ward et al. 2009; Ward et al. 2013). Although these studies examined different demographic responses related to different Chinook salmon abundance indices, they all found significant positive relationships (high Chinook salmon abundance coupled with high Southern Resident fecundity or survival). Another study found a significant relationship between the observed demographic patterns in the SRKW population with the biennial pattern in abundance of pink salmon (Ruggerone et al. 2019). The authors, however, provide no clear mechanistic explanation for this relationship but offer up a couple of hypotheses including that in high abundant pink salmon years (odd years), SRKW foraging efficiency declines thereby reducing the whales' nutritional status and affecting the survival in the subsequent year.

In recent years, the relationship between Chinook salmon abundance and SRKW demographic rates have weakened (e.g. SRKW status continues to decline with varying levels of Chinook abundance) and uncertainty remains. There are several challenges to quantitatively characterize the relationship between SRKWs and Chinook salmon. As described in PFMC (2020a), the results of statistical models relating indices of Chinook salmon abundance to measures of SRKW demographic rates are sensitive to several factors. Attempts to compare the relative importance of any specific Chinook salmon stocks or stock groups using the strengths of statistical relationships have not produced clear distinctions as to which are most influential, and most Chinook salmon abundance indices are highly correlated with each other. Different Chinook salmon populations are likely more important in different years. Large aggregations of modeled Chinook salmon stocks that reflect abundance on a more coastwide scale appear to be equally or better correlated with SRKW vital rates than smaller aggregations of Chinook salmon stocks, or specific stocks such as Chinook salmon originating from the Fraser River that have been positively identified in diet samples as key sources of prey for SRKWs during certain times of the year in specific areas (see Hilborn *et al.* 2012; Ward *et al.* 2013). There are also multiple interacting factors at play, and the strength of any one effect likely varies through time, leading to a situation known as "non-stationarity". These multiple threats affect SRKW's demographic performance through time, in addition to random chance, and these effects can confound the analysis of the effects of prey abundance.

Lacy et al. (2017) developed a population viability assessment (PVA) model that attempts to quantify and compare the three primary threats affecting the whales (e.g. prey availability, vessel noise and disturbance, and high levels of contaminants). The Lacy et al. (2017) model relies on published correlations using older data, assumes the correlations represent a causative relationship, and models SRKW demographic trajectories assuming that the relationship is constant over time. These assumptions (correlation represent causation, etc.) were previously criticized by a panel of experts and they cautioned against overreliance on correlative studies, particularly the prey relationships used in the Lacy et al. model, in evaluating reduced harvest impacts on the whales (Hilborn et al. 2012). Furthermore, the small population size limits the ability to detect a relationship to input into a PVA and the relationships are not constant over time.

The Workgroup related past SRKW demographic performance with estimates of Chinook salmon abundances in specific time (October – April, May – June, and July – September) and areas (off the coasts of Washington, Oregon, California and in the Salish Sea and off SWVCI) (PFMC 2020a). However, similar to past efforts, they also found predicting the relationship between SRKWs and Chinook salmon to be challenging. Although one of the fitted regressions met the criterion of statistical significance ($p \leq 0.05$) (winter Chinook abundance NOF and SRKW survival with one year time lag) and several regressions had $p \leq 0.10$ in times and areas where whale presence is known to be most likely, caution should be used when interpreting these results. One limitation to the regression analysis is the difference in distribution between J pod and K and L pods. For example, in the winter, J pod appears to remain much more within the Salish Sea relative to K and L pods that spend more time in coastal waters, thus it is likely that they would have differential responses to changes in the abundance of particular aggregates of Chinook stocks compared to K and L. However, considerable statistical power is lost when analyzing one pod at a time due to lower sample sizes. As a result the Workgroup examined all three pods together. Based on the new available information on the whales' distribution and diet and supported by the Workgroup's regression analysis, they found Chinook salmon abundance in NOF coastal areas to likely be most consistently important to the whales.

To quantify the effects of directed PFMC ocean salmon fisheries on SRKW performance metrics, the workgroup compared model predictions of SRKW performance metrics corresponding to the estimated Chinook abundance left in the ocean after fishing each year ("postseason abundance") to model predictions of vital rates corresponding to the estimated Chinook abundance that would have been left in the ocean that same year, if removals in PFMC fisheries did not occur ("zero PFMC"). The difference in predicted performance metrics with and without PFMC fisheries was calculated for three performance metrics: survival, fecundity, and the occurrence of peanut head, each modeled independently as a function of the current year's estimated abundance with or without PFMC fisheries. For survival, abundance at a lag of one year was also considered; for fecundity, lags of both one and two years were considered. Separate models were run for each season (time step), and for Chinook abundances in each ocean area.

In all cases, the modeled performance metrics reflected performance over a full year, not just over the season for which abundance was modeled. Within each performance metric, the model runs for each area, season, and lag can be viewed as reflecting separate hypotheses about which area- and time-specific Chinook abundance was most limiting to SRKW performance. The models were not fit assuming additive effects across times or areas, thus it is not appropriate to add the model predictions across areas, time steps, or lags.

For example, if one were to consider NOF time step 2 abundance versus fecundity (lag 0) to be the most informative regression, the prediction is that annual fecundity would increase by a mean of 0.2% in age 20 females (Table 6). Conversely, if one were to consider NOF time step 1 abundance versus fecundity (lag 0) as most informative, the prediction is that annual fecundity would increase by a mean of 0.1% in age 20 females (Table 6). It would not be appropriate to add these two numbers together, nor to add the modeled time step 3 effect as well, nor to add effects modeled for other areas or at other time lags.

In general, in any given year, the model-estimated changes in fecundity and survival with versus without the reductions in Chinook abundance attributable to PFMC fisheries are generally very small (generally ≤ 0.2% change in both survival and fecundity for most years). The Workgroup also found that overall, the PFMC salmon fishery impacts on NOF abundance are relatively small relative to both annual variation in NOF Chinook abundance and the total abundance in a given year. Because these estimates of mean changes in demographic rates were produced by the regression analyses, they should be interpreted cautiously, similar to the regression results.

The PFMC's Scientific and Statistical Committee (SSC) reviewed the Workgroup's risk assessment methods and found "the data sets used and the analyses performed to be reasonable and appropriate for the questions at hand given the complexity of the problem and the challenges presented by small populations. The SSC agrees that further analyses are unlikely to yield more informative results, as the regressions, generalized linear models, and cluster analyses had similar results to each other and to previous analyses. Given the large amount of data usually required to detect small differences in survival of long-lived species, further work is unlikely to resolve these relationships." (Agenda E.4.a, Supplemental SSC Report 1, November 2019). Given that we are limited in our interpretation of the regression analyses, and the relationship between Chinook abundance and SRKWs is not linear and has a degree of non-stationarity (i.e., the underlying assumptions of the regression analyses assume a linear relationship that does not change through time), we apply a relatively low weight to the results in Table 6. We discuss the limitations and uncertainties of the Workgroup's risk assessment further below.

Table 5. Mean estimates of change in fecundity, and survival (lag of 1 year) from 1992 – 2016 as predicted using the Workgroup regressions (Time steps 1: October – April, 2: May – June, and 3: July – September) (see PFMC 2020a, Appendix F for all mean estimates of change of SRKW demography.

Area	Time Step	Fecundity	Survival L1
NOF	1	0.1%	0.0%
NOF	2	0.2%	0.1%
NOF	3	0.2%	0.1%
OR	1	0.2%	0.0%
OR	2	0.6%	0.1%

Area	Time Step	Fecundity	Survival L1
OR	3	1.6%	0.2%
CA	1	0.0%	0.0%
CA	2	0.0%	0.2%
CA	3	-0.5%	0.4%

When prey is scarce, whales likely spend more time foraging than when it is plentiful. Increased energy expenditure and prey limitation can cause nutritional stress. Nutritional stress is the condition of being unable to acquire adequate energy and nutrients from prey resources and as a chronic condition can lead to reduced body size and condition of individuals and lower birth and survival rates of a population (e.g., Trites and Donnelly 2003). Reduced body condition and body size has been observed in Southern and Northern Resident killer whale populations. In general, killer whales physically mature at age 20 and the body stops growing (Noren 2011). For example, Groskreutz et al. (2019) used aerial photogrammetry to measure growth and length in adult Northern Resident killer whales, which prey on similar runs of Chinook salmon, from 2014 to 2017 and found adult whales that were 20 – 40 years old have significantly shorter body lengths than those older than 40 years of age, suggesting the younger mature adults had experienced inhibited growth. Similarly, adult Southern Residents that were under 30 years of age that were measured in 2008 by the same photogrammetric technique were also shorter on average than older individuals also suggesting reduced growth (Fearnbach et al. 2011).

What appears to be constrained growth in both resident killer whale populations occurred in the 1990s - during a time when range-wide abundance of Chinook salmon in multiple subsequent years fell below the 1979 – 2003 average (Figure 18; Ford et al. 2010). The low Chinook salmon abundance and smaller growth in body size in whales was concurrent with an almost 20 percent decline from 1995 to 2001 (from 98 whales to 81 whales) in the SRKW population (NMFS 2008). During this period of decline, multiple deaths occurred in all three pods of the SRKW population and relatively poor survival occurred in nearly all age classes and in both males and females. The Northern Resident killer whales also experienced population declines during the late 1990s and early 2000s. Hilborn et al. (2012) stated that periods of decline across killer whale populations “suggest a likely common causal factor influencing their population demographics” (Hilborn et al. 2012).

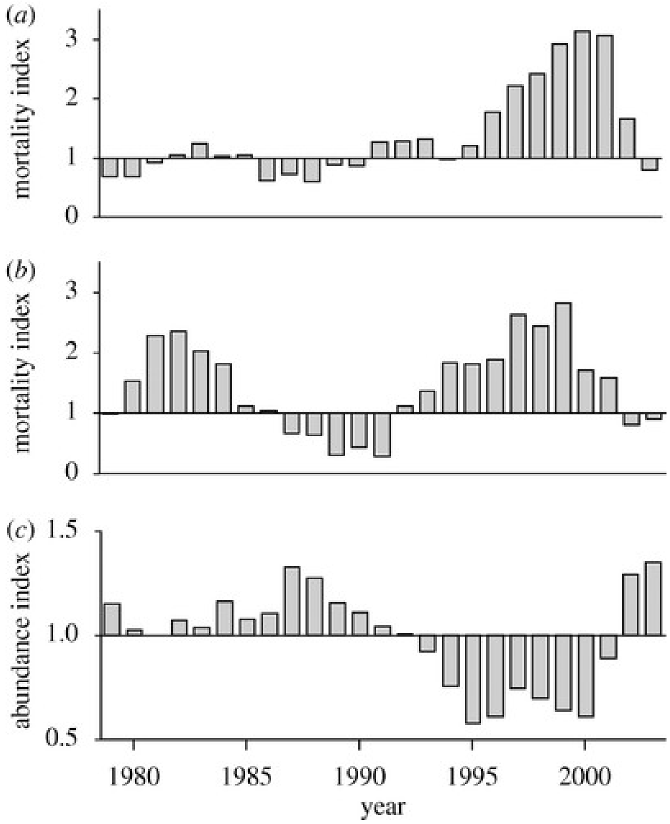


Figure 18. Annual mortality indices for a) Northern Resident and b) Southern Resident killer whales and c) abundance index of Chinook salmon from 1979 to 2003 (reprinted from Ford et al. 2010).

During this same general period of time of low Chinook abundance, declining body size in whales, and declining resident killer whale populations, all three SRKW pods experienced substantially low social cohesion (Parsons et al. 2009). This temporal shift in SRKW social cohesion may reflect a response to changes in prey. Although both intrinsic and extrinsic factors can affect social cohesion, it has been generally recognized the most important extrinsic factors for medium and larger terrestrial carnivores are the distribution and abundance of prey (refer to Parsons et al. 2009). In social animals, once optimal group size occurs (that is based on intrinsic an extrinsic factors), the response to reduced prey abundance for example could include "group fissioning". However, this may not always be the case, especially if the benefit of "cooperative care" or food sharing outweighs the cost of the large group size. The authors note that smaller divisions within the pod's matrilines may temporarily occur in SRKWs as opposed to true fission but this warrants further investigation. Good fitness and body condition coupled with stable group cohesion and reproductive opportunities are important for reproductive success.

Intuitively, at some low Chinook abundance level, the prey available to the whales will not be sufficient to allow for successful foraging leading to adverse effects (such as reduced body condition and growth and/or poor reproductive success). This could affect SRKW survival and fecundity. Although there is currently no quantitative model that identifies a low abundance threshold that will cause adverse effects, there is evidence SRKW and other killer whale populations that are known to consume Chinook salmon may have experienced adverse effects from low prey availability in the late 1990s likely due to common factors affecting changes in the populations (NMFS 2008; Towers et al. 2015).

Populations with healthy individuals may be less affected by changes to prey abundance than SRKW (i.e., there may be a spectrum of risk based on the status of the whale population). Because SRKW are already stressed due to the cumulative effects of multiple stressors that could be additive or synergistic, reductions in Chinook salmon abundance likely have a greater physiological effect, which may have negative implications for SRKW vital rates and population viability (e.g., NAS 2017). For example, food scarcity could cause whales to draw on fat stores, mobilizing the relatively high levels of contaminants stored in their fat and potentially affecting reproduction and immune function (Mongillo et al. 2016). Increasing time spent foraging during reduced prey availability also decreases the time spent socializing and reduces reproductive opportunities.

Potential Effects of Changes in Prey Availability in 2020 from the Council salmon fisheries

In NMFS' February 27, 2020 guidance letter to the Council, we stated that (1) upon receiving the 2020 pre-season NOF abundance estimate, we will compare it to the average of the seven lowest abundance years NOF (1994 ‐ 1996, 1998 ‐ 2000, and 2007; 971,921 adult Chinook salmon) when the SRKW's status was poor for the majority of the years; (2) we expect the Council salmon fisheries in the coastal waters of the EEZ will continue to be responsive to the abundance of salmon stocks similar to that over this last decade when the whale status has declined; (3) the Council will continue to meet the conservation objectives for salmon stocks managed under the FMP; (4) NMFS supports managers for fisheries SOF to the U.S.-Mexico border moving forward with the recommendations the Council adopted at its September 2019 meeting in conjunction with its recommendations for the rebuilding plans for the Sacramento and Klamath Rivers Chinook salmon stocks; and (5) we also expect the Workgroup will continue to develop and refine a set of recommendations for the Council to consider that can help inform a long term biological opinion.

As described in the proposed action, the Council has recommended and NMFS is proposing to approve and implement 2020 management measures consistent with the MSA, ESA, the updated PST, exercise of Indian fishing rights, and other applicable laws (PFMC 2020c). Here we discuss our evaluation on the potential short-term (or annual) effects as well as the long-term effects of changes in prey availability in 2020/2021 from the Council salmon fisheries.

Short Term Effects

Given that NOF Chinook abundance is consistently more important to SRKWs than other ocean areas, and there is concern about years with critically low Chinook salmon abundance, for the 2020/2021 season NMFS identified a low abundance threshold for Chinook salmon abundance in waters north of Cape Falcon and recommended that if the NOF abundance was equal to or less than the threshold, the Council should implement precautionary conservation measures for Council salmon fisheries that affect the abundance in NOF waters (this includes salmon fisheries in Washington, Oregon, and California waters) to benefit SRKW (NMFS 2020). We acknowledge there is uncertainty in developing a low abundance threshold. The relationships between modeled Chinook salmon abundance and SRKW demographics examined by the SRKW Workgroup appear to be weaker than those from prior analyses as mentioned above (e.g. Ford et al. 2005; Ward et al. 2009; Ward et al. 2013). There is uncertainty on what the whales' status would be below the low abundance threshold. It may be that multiple consecutive years of low abundance as that observed in the late 1990s are important to consider rather than a single low year. Despite the uncertainty, NMFS believes using this threshold (i.e., the average abundance of the years 1994 ‐ 1996, 1998 ‐ 2000, and 2007 NOF) to evaluate a single year of fishing is the best available approach given that declining body size in whales, declining resident killer whale populations, and substantially low social cohesion in all three SRKW pods occurred during a period of time that had low Chinook abundance at or below the abundance threshold.

We first assess the short term (annual) effects of the 2020/2021 PFMC fisheries by comparing the preseason Chinook abundance estimate to the low abundance threshold. Because the pre-season Chinook salmon abundance NOF of 1,250,900 fish exceeds the Chinook abundance threshold of approximately 972,000 adult Chinook (PFMC 2020c), no additional precautionary conservation measures were recommended to benefit SRKWs (PFMC 2020c).

We also assess the short term affects by considering the responsiveness of the proposed fisheries to the abundance of salmon stocks similar to that over this last decade. This is because the Council salmon fisheries have been taking a lower proportion of the available Chinook abundance over time (PFMC 2020a). In order to assess if the Council salmon fisheries in the coastal waters of the EEZ will continue to be responsive to the abundance of salmon stocks similar to that over this last decade when the whale status has declined, we compared the percent reductions in prey available expected for 2020/2021 to the average percent reductions in Chinook abundance from 1992 – 2016 and in the most recent 10-year time period. Here we rely on the Workgroup's report (PFMC 2020a Appendix E) that provides these prey reductions from 1992 to 2016.

In general, the fisheries' effects on potential prey abundance have varied highly over 1992-2016, but the percent reductions in abundance attributable to PFMC salmon fisheries is lower in the recent 10-yr period (2007 – 2016) compared to over the entire time period. These reduced impacts (i.e., lower percent reductions in Chinook abundance from the Council fisheries) were observed coastwide and in each area with the exception of the Salish Sea that had a relatively stable average percent reduction in abundance (Table 6). When plotted by year for coastwide abundance, the percent of potential abundance that remained after Council directed salmon ocean fisheries occurred has been increasing over time – meaning these fisheries have been taking a lower proportion of the available abundance over time (Figure 19). The trend line depicted in Figure 19 is not intended to reflect any particular level of significance, but is simply to demonstrate the trend. These changes in the fisheries over time (i.e., fisheries have been taking less of the available abundance over time) are a combined result of effects of increased limits on impacts to salmon stocks through updates to harvest control rules, updated conservation objectives, and increasingly restrictive Pacific Salmon Treaty obligations.

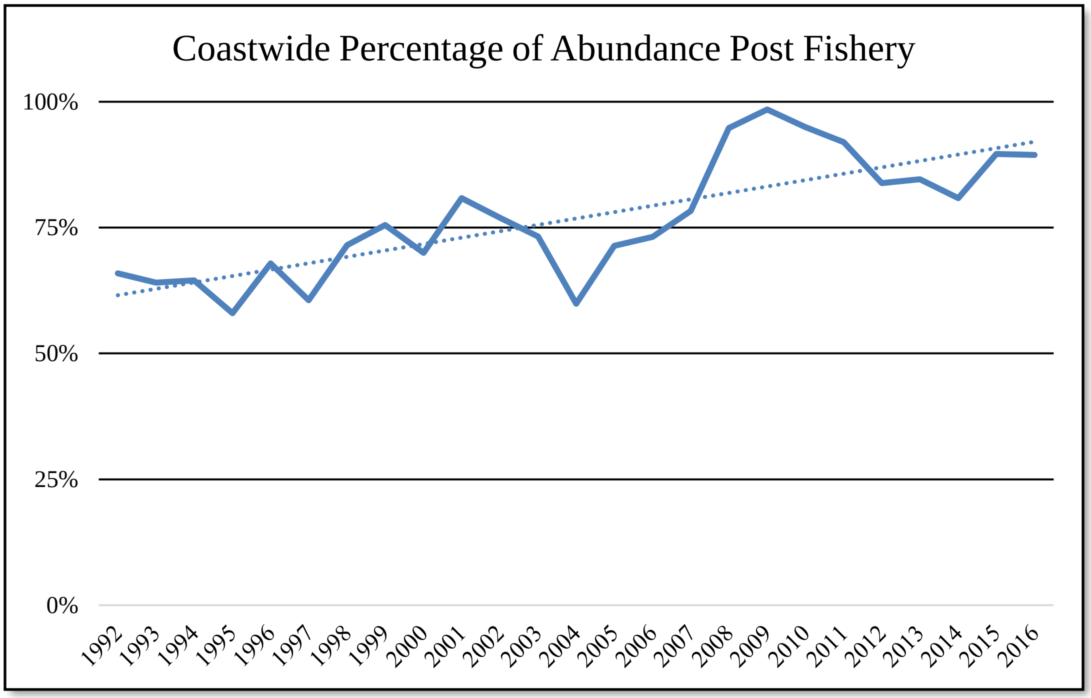
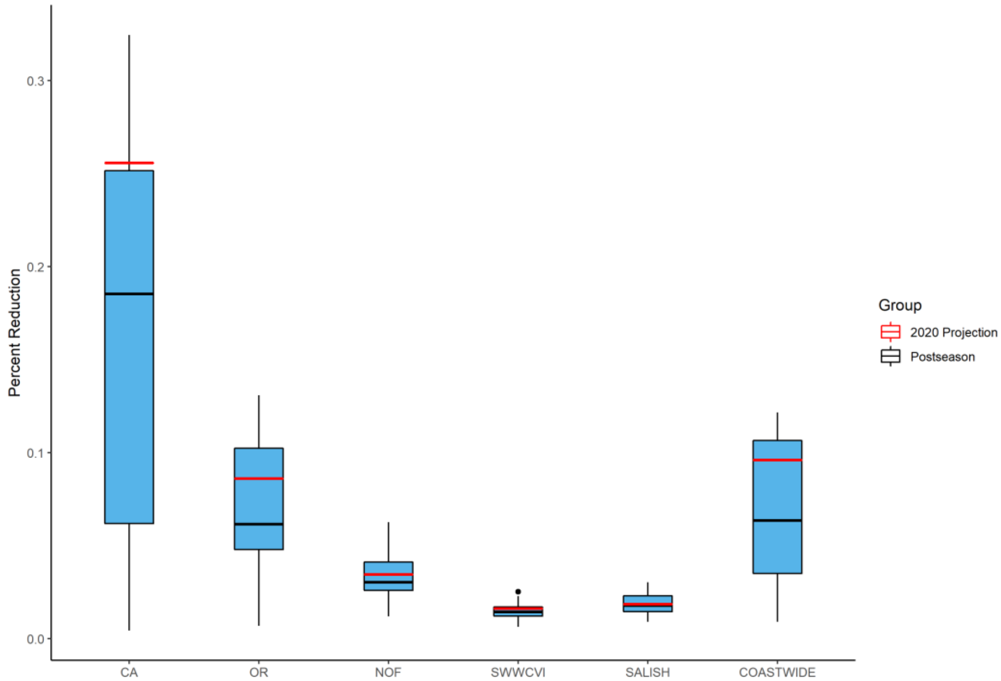


Figure 19. Coastwide (EEZ) 1992-2016 trend in percent of Chinook adult abundance remaining after PMFC ocean salmon fisheries from October through the following September (reproduced from PFMC 2020a).

As described in the Environmental Baseline, the Workgroup estimated starting adult Chinook salmon abundance in seasonal time steps (October – April, May – June, July– September) and aggregated in various spatial areas (NOF, SWCVI, Salish Sea, Oregon coast (Cape Falcon, OR to Horse Mountain, CA), and the California coast, south of Horse Mountain) for the fishery management years 1992 – 2016 (PFMC 2020a). Area-specific PFMC fishery removals were estimated in a two-step process. First, stock-specific reductions in abundance attributable to Council-area directed salmon fisheries were calculated across all fisheries for each modeled stock and each time step. This was to determine total stock abundance changes resulting from fishery removals. Then these reductions in abundance were apportioned across space based on the assumed distribution of each stock (based on the spatial model and assumptions), rather than attempting to account for where fishery removals actually occurred and subsequent movement of fish within and across time steps (refer to PFMC 2020a for further details on estimates of removals of FRAM stocks and non-FRAM stocks).

During 1992 – 2016, the starting (i.e., no PFMC fisheries) Chinook salmon abundance coastwide (in the EEZ) in October – April was estimated to range from 2,131,210 to 6,040,198 fish with an average of 3.6 million. Over the last decade (2007 – 2016), the estimated average pre-fisheries Chinook salmon abundance in the EEZ was similar (3.6 million) but the PFMC salmon harvest was reduced. For example, the average annual fishery reduction in the most recent 10-year period (280,006 fish or a 7.0% reduction in prey) was approximately half the average annual reduction in EEZ abundance that was estimated to occur between 1992 and 2016 (552,888 fish or 14.9%) due to PFMC salmon fisheries coastwide (Table 6). In 2020, the percent reduction in the EEZ is expected to be 9.6% (within the range of the last decade (Figure 20). Therefore, the 2020 Council salmon fisheries in the coastal waters of the EEZ are consistent with our expectation that the Council salmon fisheries will continue to be responsive to the abundance of salmon stocks similar to that over this last decade.

Figure 20. Percent reduction in adult Chinook salmon abundance in each area: California (CA), Oregon (OR), North of Falcon (NOF), SWCVI (southwest coast Vancouver Island), Salish (Salish Sea), and Coastwide (EEZ) expected in 2020 (indicated in red) and the average percent reductions (Postseason) in each area over the most recent 10-year time period (2007 – 2016).



In NOF coastal areas, pre-fisheries abundance estimates ranged from 819,183 to 2,446,093 Chinook salmon in 1992 - 2016. During this time period, reductions in abundance NOF attributable to PFMC salmon fisheries was estimated to range from 1.2% to 7.7% and from 12,883 to 144,602 fish (Table 6). The estimated average annual abundance in NOF over the recent 10-year average was approximately 1.6 million Chinook salmon. The recent 10-year average annual reduction attributable to PFMC salmon fisheries (57,926 fish or a 3.3% reduction in prey) was slightly less than the average from 1992 – 2016 (69,095 fish or a 4.5% reduction in prey). In 2020, the percent reduction in NOF is expected to be 3.5% (within the range of the most recent decade, Figure 20).

Because the whales are observed in the NOF area in all seasons, they will likely be affected by reduced prey availability resulting from PFMC salmon fisheries in the area. PFMC ocean fisheries in the NOF coastal area can directly reduce the abundance of Chinook salmon in the NOF coastal area, and can also indirectly reduce abundances in areas south and in other areas including the Salish Sea and (probably to a lesser extent) and SWCVI areas by removing fish that otherwise would have moved into those areas.

Reductions in abundance in the Salish Sea attributable to PFMC salmon fisheries ranged from 0.9% to 3.0% and from 2,244 to 21,020 fish from 1992 – 2016 (Table 6). The recent 10-year average annual reduction attributable to PFMC salmon fisheries (11,920 fish or a 1.9% reduction in prey) was similar to the average reduction in 1992 – 2016 (11,747 fish or a 1.9%). In 2020, the percent reduction in the Salish Sea is expected to be 1.8% (within the range of the most recent decade, Figure 20). Reductions in abundance in SWCVI attributable to PFMC salmon fisheries ranged from 0.8% to 3.4 percent and from 3,277 to 30,919 fish from 1992 – 2016 (Table 6). The recent 10-year average annual reduction attributable to PFMC salmon fisheries (12,632 fish or a 1.5% reduction in prey) was less than from 1992 – 2016 (14,581 fish or a 2.1% reduction in prey). In 2020, the percent reduction in SWCVI is expected to be 1.6% (within the range of the most recent decade, Figure 20).

In Oregon's coastal waters (as defined by the Workgroup to be Cape Falcon, OR to Horse Mountain, CA), pre-fisheries abundance estimates ranged from 760,853 to 2,492,455 Chinook salmon in 1992 – 2016. During this time, percent reductions in Chinook salmon abundance in Oregon's coastal waters due to the PFMC salmon fisheries ranged from 0.7% to 26.3% and from 6,483 to 536,591 fish (Table 6). The average abundance in the last 10 years was similar to the average abundance in the overall time period (approximately 1.5 million), however, the annual reduction in abundance attributable to PFMC salmon fisheries in the last 10 years of the time period (109,902 fish or a 7.0% reduction in prey) was almost half the average over the full time period (199,783 fish or a 13.5% reduction in prey). In 2020, the percent reduction in Oregon is expected to be 8.6% (within the range of the most recent decade, Figure 20).

In California coastal waters south of Horse Mountain, pre-fisheries Chinook salmon abundance from 1992 – 2016 was estimated to range from 243,719 to 1,423,376 fish. Percent reductions in abundance attributable to PFMC salmon fisheries during the total time series ranged from 0.4% to 60.0% and from 1.231 to 751,725 fish (Table 6). The estimated average annual abundance in the recent 10-year average (569,194 fish) was slightly less than the average over the entire time series (765,369 fish). The average percent reduction have dropped in the recent 10 years (16.6% reduction in prey) compared to the average percent reduction in prey in the total time series (34.0%). Reductions in abundance attributable to PFMC salmon fisheries in the last 10 years (2007 – 2016) ranged from 1,231 fish to 302,216 fish with an average of 112,048 fish. In 2020, the percent reduction in California is expected to be 25.6% (within the upper end of the range in the most recent decade, Figure 20). The percent reduction is at the upper end of the range because of the extensive fishery closures off CA 2008-2009 that skewed the average.

Reductions in Chinook salmon abundance attributable to PFMC ocean salmon fisheries are highest in California coastal areas. The most abundant SOF stock, Sacramento River Fall Chinook salmon, has a dominant age-3 maturation rate and so most large adults leave the ocean each fall, leaving predominantly smaller individuals newly recruited to the adult stage over the wintertime. While acknowledging that the greatest percent reductions occur in SOF waters, particularly in California coastal waters, there is less justification overall to conclude that Chinook salmon abundance in SOF areas are consistently important to SRKW. SRKW presence SOF is less frequent and may primarily occur only in a season (winter/spring) during which there is little direct effect of the fishery on Chinook salmon abundance. In addition, the maturation schedule for the primary stock in this area also limits the carryover effect of fisheries in California during times of the year when the whales are present.

In summary, the short term effects from the 2020/2021 PFMC salmon fisheries will include small prey reductions in the areas with the most overlap with SRKWs (e.g. the percent reduction in NOF is expected to be 3.5%) during a year with Chinook salmon abundance above the critical abundance threshold (at or below this abundance threshold we anticipate prey available to be insufficient to allow for successful foraging leading to adverse effects). This year's percent reductions are also within the range of what has been observed in the most recent 10 year period, therefore consistent with the pattern of the PFMC salmon fisheries taking a lower proportion of the available abundance over that decade.

Table 6. Annual fishery reduction in abundance (percent reduction), which represents the percent difference between end of year abundances absent fishing and end of year abundances with PFMC fisheries that occurred for each spatial area from 1992 – 2016 (PFMC 2020a, Appendix E).

Year	Coastwide EEZ	North of Falcon	Salish Sea	SW coast Van. Isl.	Oregon coast	California coast
1992	406,988 (18.6%)	58,593 (5.6%)	13,794 (2.2%)	13,348 (2.5%)	132,840 (17.2%)	215,555 (56.9%)
1993	605,134 (21.1%)	56,291 (5.2%)	12,430 (2.1%)	12,821 (2.4%)	216,252 (19.1%)	332,591 (51.9%)
1994	531,229 (22.9%)	31,238 (3.8%)	2,244 (0.5%)	5,879 (1.4%)	170,198 (18.7%)	329,793 (55.9%)
1995	1,224,997 (30.1%)	79,088 (7.7%)	5,017 (1.0%)	14,257 (2.9%)	394,183 (22.1%)	751,725 (60.0%)
1996	763,829 (23.0%)	56,444 (5.4%)	5,178 (1.0%)	10,872 (2.1%)	285,070 (20.3%)	422,315 (48.2%)
1997	880,562 (26.3%)	61,715 (5.4%)	8,618 (1.3%)	12,433 (2.4%)	277,549 (22.2%)	541,299 (57.2%)
1998	479,717 (19.1%)	42,367 (4.9%)	7,772 (1.5%)	9,547 (2.2%)	150,944 (15.3%)	286,407 (43.7%)
1999	435,959 (16.3%)	39,196 (3.7%)	11,244 (1.8%)	9,494 (1.8%)	137,735 (14.9%)	259,027 (37.2%)
2000	679,535 (19.6%)	48,705 (4.7%)	5,828 (1.3%)	9,503 (2.3%)	236,358 (16.4%)	394,472 (40.4%)
2001	586,087 (12.1%)	88,837 (4.6%)	13,622 (1.9%)	17,713 (2.3%)	209,794 (11.3%)	287,456 (27.4%)
2002	902,991 (15.1%)	136,080 (6.3%)	18,532 (2.7%)	26,659 (2.9%)	310,577 (12.8%)	456,335 (32.1%)
2003	1,021,112 (17.7%)	144,602 (7.3%)	21,020 (3.1%)	30,697 (3.4%)	424,715 (17.0%)	451,795 (34.2%)
2004	1,329,810 (25.7%)	150,729 (7.6%)	17,318 (3.0%)	30,919 (3.3%)	536,591 (26.3%)	642,489 (55.9%)
2005	725,804 (18.6%)	109,068 (7.3%)	17,746 (3.0%)	23,063 (3.1%)	251,155 (16.9%)	365,582 (39.7%)
2006	448,376 (15.9%)	45,159 (3.5%)	11,119 (1.6%)	11,010 (1.7%)	161,603 (16.8%)	241,614 (42.7%)
2007	258,956 (12.2%)	29,733 (3.1%)	8,903 (1.6%)	8,008 (1.7%)	104,051 (13.1%)	125,172 (32.5%)

Year	Coastwide EEZ	North of Falcon	Salish Sea	SW coast Van. Isl.	Oregon coast	California coast
2008	66,384 (2.9%)	18,864 (1.5%)	6,613 (1.1%)	4,777 (0.8%)	36,659 (4.8%)	10,861 (4.5%)
2009	20,597 (0.9%)	12,883 (1.2%)	4,070 (0.9%)	3,277 (0.6%)	6,483 (0.7%)	1,231 (0.4%)
2010	121,041 (3.1%)	56,881 (2.9%)	14,782 (1.8%)	12,183 (1.4%)	43,731 (2.9%)	20,430 (4.4%)
2011	155,502 (4.8%)	41,613 (2.7%)	10,711 (1.8%)	9,647 (1.3%)	61,378 (4.8%)	52,511 (11.4%)
2012	452,627 (10.2%)	68,699 (4.4%)	15,742 (3.0%)	16,692 (2.3%)	181,196 (9.3%)	202,732 (22.0%)
2013	651,732 (10.8%)	92,111 (3.8%)	15,992 (2.2%)	19,145 (1.5%)	257,405 (10.5%)	302,216 (26.2%)
2014	573,296 (12.2%)	124,077 (6.3%)	19,234 (3.0%)	24,146 (2.5%)	218,168 (11.4%)	230,577 (28.0%)
2015	329,203 (6.7%)	97,678 (4.3%)	15,190 (2.4%)	19,799 (1.7%)	128,168 (6.3%)	103,357 (17.1%)
2016	170,725 (6.0%)	36,723 (2.5%)	7,966 (1.4%)	8,644 (1.2%)	61,310 (6.0%)	72,693 (19.9%)
Time series average	552,888 (14.9%)	69,095 (4.6%)	11,747 (1.9%)	14,581 (2.1%)	199,783 (13.5%)	284,009 (34%)
Recent 10-Yr Average	280,006 (7.0%)	57,926 (3.3%)	11,920 (1.9%)	12,632 (1.5%)	109,902 (7.0%)	112,178 (16.6%)

Long Term Effects from the 2020 PFMC Fisheries

To assess the long term effects from the 2020/2021 PFMC salmon fisheries on prey availability, we consider whether the Council meets the conservation objectives for salmon stocks managed under the FMP, and consider the adaptability and response of the Council fisheries to changes in Chinook abundance and status. We rely in part on harvest being set at sustainable levels for all affected salmon stocks, measured with respect to the applicable FMP objectives and standards.

As described in the Proposed Action, the PFMC develops recommended annual management measures consistent with its FMP and the annual guidance for ESA stocks provided by NMFS,[13] which provides a framework for development of these measures. The FMP together with the ESA guidance specifies conservation objectives for each salmon stock impacted in the fishery (ESA-listed and non-listed), and reference points used to determine when a stock is overfished or experiencing overfishing. The conservation objectives help ensure the fishery responds to changes in abundance over time and are designed to ensure the fisheries are sustainable by establishing conservation objectives that are consistent with the available information on the productivity, abundance and status of individual salmon stocks. The objectives are generally in terms of spawning escapement goals or ceiling exploitation rates. Fisheries are managed to ensure the objectives for all stocks are met. Some stocks are weaker than others. Managing to meet objectives for all stocks, ensures that the weakest stocks are protected which often results in foregoing harvest on the stronger stocks. Under the Council's recommended salmon fisheries, salmon stocks (ESA-listed and non-listed) originating from Washington, Oregon, and California are expected to meet all of the applicable conservation objectives in the FMP and the provisions of the applicable biological opinions (see Table 5 in PFMC 2020c).

For ESA-listed stocks in the fishery, the FMP requires consistency with RPMs and RPAs in biological opinions covering those stocks, or with harvest control rules that have been analyzed in biological opinions referred to in the FMP as "consultation standards," and described with respect to the current year's abundance forecasts. For ESA-listed stocks affected by the fishery, NMFS has concluded that action does not appreciably reduce the likelihood of survival and recovery of Chinook salmon (i.e., we consider if the PFMC salmon fisheries inhibit the recovery or survival of the whales' primary prey to help inform us if the PFMC salmon fisheries inhibit the recovery or survival of SRKWs). Biological opinions addressing the effects of the fisheries managed under the FMP are summarized in Table 1; in these opinions NMFS either concluded the proposed actions are not likely to jeopardize the listed salmon ESUs or provided an RPA which the Council uses to design its management measures. NMFS' opinions on effects of FMP fisheries on salmon also consider the effects of environmental variability on sustainability of salmon stocks (i.e., ocean conditions) and aim to maintain stocks at or above conservation objectives. These conclusions on Chinook, other salmon ESUs, and critical habitat were informed by recovery plans, objectives for priority stocks, and/or other considerations specific to individual ESUs, as discussed in the biological opinions and 4(d) determination documents cited in Table 1.

In our 2020 guidance letter (NMFS 2020), we also stated that NMFS supports managers for fisheries SOF to the U.S.-Mexico border moving forward with the recommendations the Council adopted at its September 2019 meeting in conjunction with its recommendations for the

[13] The annual guidance letter summarizes the requirements of the Council's harvest control rules for ESA-listed stocks, and reasonable and prudent measures (RPM), and reasonable and prudent alternatives (RPA) included in biological opinions addressing those stocks, in consideration of the annual abundance forecasts for those stocks.

rebuilding plans for the Sacramento and Klamath Rivers Chinook salmon stocks that will help improve these stocks in the long term. We specifically address the Sacramento River Fall Chinook and Klamath River Fall Chinook stocks because they tend to dominate ocean abundances in much of California (Satterthwaite et al. 2015), and can make up a large proportion of the ocean abundance off northern California and southern/central Oregon (Bellinger et al. 2015). Although Chinook salmon abundance SOF may not be consistently important to SRKW as suggested in NOF, SRKW require healthy Chinook salmon stocks throughout their geographic range and these rebuilding plans support improved status of these stocks.

NMFS determined in June 2018 that the Klamath River Fall and Sacramento River Fall Chinook stock were overfished under the provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (83 FR 38292, August 6, 2018). The MSA requires adoption of a rebuilding plan within two years of a determination that a stock is overfished. In 2019, the Council adopted rebuilding plans for the overfished Klamath River Fall and Sacramento River Fall Chinook stocks, demonstrating its ability to respond to the status of Chinook stocks and respond to Chinook abundance in short order. The MSA requires the rebuilding of stocks as quickly as possible, taking into account the status and biology of any overfished stock and the needs of fishing communities (50 CFR 600.310(j)(3)(i)). The Council developed rebuilding plans for these stocks in September 2019 and recommended them to NMFS. NMFS is currently considering approval of these plans. In 2020, consistent with the proposed rebuilding plan, the exploitation rate under the Klamath River Fall Chinook harvest control rule was 25% allowing only limited seasons south of Cape Falcon that employ restrictive time/area closures. These include closures for the commercial fishery in the California portion of the KMZ, and restricted seasons for the Fort Bragg commercial fishery and both the Oregon and California KMZ recreational fisheries. The Sacramento Index forecast is 473,183, which is higher than last year's preseason forecast of 379,632 (second largest over the past 5 years) (PFMC 2020c). The adopted management measures have a projected escapement of 233,174 Sacramento River Fall Chinook, which exceeds the control-rule defined minimum of 141,955 hatchery and natural area adult spawners (PFMC 2020c), again consistent with the proposed rebuilding plan.

Lastly, we also expect the Workgroup will continue to develop and refine a set of recommendations for the Council to consider that can help inform a long term approach to managing salmon fisheries with respect to SRKW, and a long term biological opinion. We are adopting an improved understanding of the fishery impacts and methodology accomplished through the Workgroup in this opinion to assess fishery impacts to SRWKs in 2020/2021 in expectation of having a final long term assessment for the long term opinion. Our guidance to the Council (NMFS 2020) also included that we expect the Workgroup will continue to develop and refine a set of recommendations for the Council to consider that can help inform a long term biological opinion. Currently the Workgroup has additional meetings scheduled and is expected to provide the Council with an update on their progress at the June 2020 Council meeting. Moving forward we will incorporate those recommendations into future analyses to continue to inform our long-term assessment. However, we view this one year biological opinion as part of the first step in assessing the fisheries using a long-term adaptive approach.

In summary, the Council's recommended salmon fisheries are expected to meet all of the applicable conservation objectives in the FMP, are consistent with the biological opinions for all ESA-listed species in the fishery, and therefore are not likely to result in unsustainable impacts to unlisted stocks, to jeopardize listed species, or to inhibit rebuilding of overfished stocks, all of which contribute to the SRKW prey base. The Workgroup will continue to develop and refine a set of recommendations based on its Risk Assessment that will help inform a long term approach to managing the impacts of the fisheries to prey availability for SRKW.

Additional limitations and uncertainties

Here we briefly describe some limitations and uncertainties of the Workgroup analysis that we relied upon for estimated Chinook abundances and impacts on the SRKWs prey base from the fisheries (these uncertainties are described in more detail in PFMC 2020a).

Historically, Chinook salmon stocks were far more abundant than they currently are. However, the analysis is limited to Chinook salmon abundances for the years 1992-2016. There are uncertainties in these retrospective Chinook abundance estimates (as well as in abundance forecasts). These abundances rely on harvest and escapement estimates, which contain their own uncertainties, and also depend on assumptions such as constant adult natural mortality rates across years (although natural mortality likely varies across years). Chinook abundance estimates also rely on mortality associated with fish caught but released, drop-off mortality, and bycatch mortality in other fisheries that are not accounted for in the management models. Lastly, not all Chinook salmon stocks are included in the estimates of abundance (see Appendix A in PFMC 2020a for further details on non-modeled stocks).

There is also uncertainty in the estimated fishing mortalities. The fishing mortality estimates by stock, age, fishery and FRAM time step is based on coded wire tag recoveries from fishing years 2007–2013. If stock distributions differ considerably from what occurred during this period of time, or if tagged and untagged fish have different distributions, these fishery mortality estimates would be less realistic and prey availability for Southern Residents could be over- or under-estimated. The Workgroup was also limited in assessing the effects of fishery impacts on age-2 fish, and did not consider multi-year effects (i.e., fishery removals in prior years can reduce the abundance of older fish in the current year, and fishery removals in the current year can reduce the abundance of older fish in future years).

There is also uncertainty in Chinook stock distributions, particularly on Chinook salmon distributions during the winter, and there is limited information for most spring-run stocks (PFMC 2020a). As described above, the Workgroup used the Shelton et al. (2019) distribution model to estimate Chinook abundance in particular time and areas, but the model is subject to uncertainty due to sampling error in harvest data, assumptions about how catch per unit effort scales with local abundance, and similar assumptions as that discussed above (e.g. natural mortality, similar distributions between tagged and untagged fish, etc.). Additionally, the time steps in Shelton et al. (2019) are offset by a month relative to the FRAM model. Finally, the spatial model ignores changes in Chinook salmon spatial distribution within each timestep, and assumes that the effects on Chinook salmon abundance from fishery removals are distributed across space in proportion to Chinook salmon abundance, rather than based on where fishery removals actually occur and how quickly fish redistribute themselves across space.

The models described in PFMC (2020a) assume that the effect of Chinook salmon abundance in a particular season and area is the same every year (i.e. assume stationarity), and the same for all pods, regardless of where SRKW actually spent the most time that year, and do not account for any variation at finer spatial or temporal scales than those defined by the model. The logistic regressions used for survival and fecundity assume that all whales of the same age (fecundity) or sex/stage (survival) have identical probabilities of giving birth or dying in a given year, ignoring individual variability (aside from excluding whales who gave birth the prior year from the fecundity analysis). Among the conclusions by Hilborn et al. (2012) were that "considerable caution is warranted in interpreting the correlative results as confirming a linear causal relationship between Chinook salmon abundance and SRKW vital rates". These relationships are likely non-linear, the relationships may be influenced by small sample sizes of killer whale births and deaths, and the relationships may arise from uncertainties in the indices of Chinook abundance used for fisheries management.

Much of the knowledge of SRKW distribution is based on sightings reported in the inland waters of the Salish Sea, especially in summer months (Olson et al. 2018; Hauser et al. 2006). The distribution of SRKW year to year can be characterized as variable, and possibly subject to short term trends. Over the last several years, for example, many social groups of the SRKW population have not spent much time in inland waters during the summer relative to their historical occurrence (Olson et al. 2018). For non-summer months, sighting data is generally limited. Several satellite tags have been deployed on SRKWs and acoustic recorders have been deployed primarily in Washington waters, but also off Oregon and California, to characterize coastal distribution. Data from these deployments suggest differences in distributions between J pod and K/L pods (J pod appears to remain much more within the Salish Sea relative to K and L pods that spend more time in coastal waters) (Hanson et al. 2018). Thus it is likely that they would have differential responses to changes in the abundance of particular Chinook stocks. However, considerable statistical power is lost when analyzing one pod at a time due to lower sample sizes. As a result all three pods were examined together.

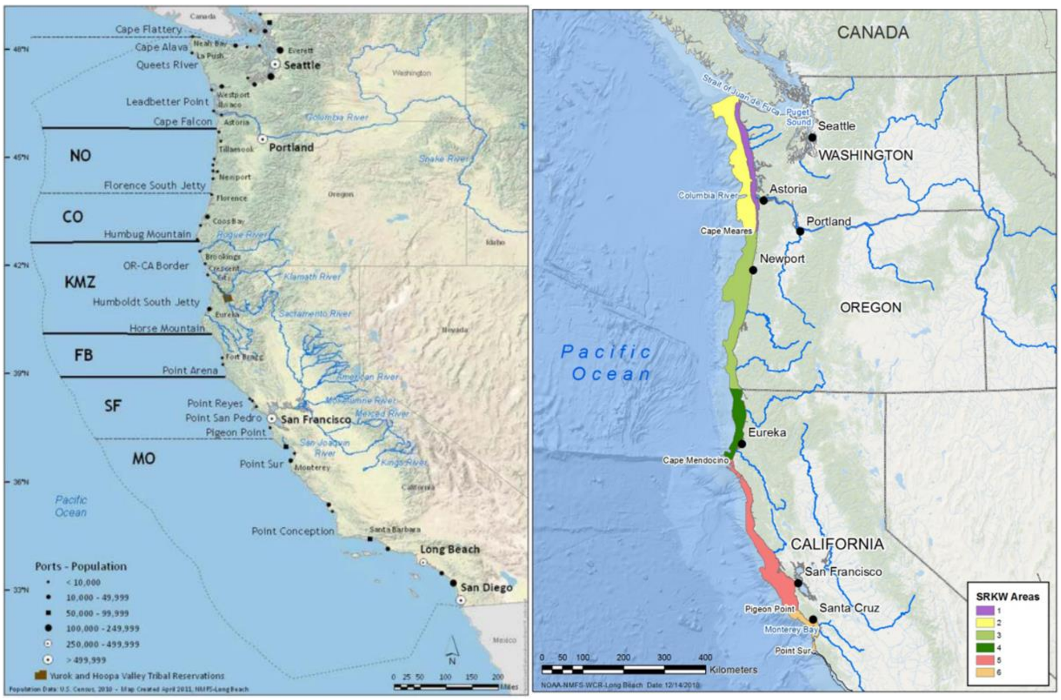
The degree to which killer whales are able to or willing to switch to non-preferred prey sources (*i.e.*, prey other than Chinook salmon) is also largely unknown, and likely variable depending on the time and location. We took a conservative approach to assessing impacts from prey reductions by assuming whales consume solely Chinook salmon and do not account for varying abundance and availability of alternative prey sources in these analyses. Previous genetics work has suggested that SRKWs switch from Chinook to other salmon in fall months (particularly coho and chum salmon, Ford *et al.* 2016). Given Chinook salmon are consumed throughout the whales' range and prey samples indicate they are consumed the majority of the time, we assume the whales prey switch if their primary prey, i.e. Chinook salmon, are not available.

2.5.2 Effects on Current and Proposed Southern Resident Killer Whale Critical Habitat

In addition to the direct and indirect effects to SRKWs discussed above, the proposed action affects critical habitat designated for SRKWs in inland waters of Washington and proposed critical habitat in 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, we identified three physical or biological features essential to conservation in designating critical habitat in inland waters of Washington: (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. In addition, these same three physical or biological features are consistent with the essential features in the proposed critical habitat in coastal waters. This analysis considers effects to these features and identifies where there are differences in those effects between the existing inland and proposed coastal critical habitat.

As discussed above, NMFS identified six specific areas off the U.S. West Coast, delineated based on their habitat features and use by SRKWs (Figure 21), as proposed critical habitat. The six area boundaries reflect the spatial scale of the whales' movements and behavioral changes (e.g., where tagged whales were primarily traveling versus observed foraging), as well as to align with some existing fishery management boundaries (e.g., geographic points used by the PFMC in salmon management, see Figure 21). Areas 1 and 2 in the proposed critical habitat align generally with the NOF spatial area defined by the Workgroup, Areas 3 and 4 align with the Oregon area as defined by the Workgroup, and Areas 5 and 6 align with the California area as defined by the Workgroup. The six areas have some similarities and contain all three essential features.

Figure 21. Comparison between the spatial areas as described in the Workgroup report (PFMC 2020a) and the proposed critical habitat areas (Areas 1 – 6).



The proposed action has the potential to affect passage conditions and the quantity and availability of prey in the proposed critical habitat. Although the proposed critical habitat remains at risk from serious spills because of the heavy volume of shipping traffic and proximity to petroleum refining centers, we do not expect the proposed fisheries to impact water quality because fishing vessels do not carry large amounts of oil, making the risk from spills minor. Therefore, we do not anticipate adverse effects to water quality.

Effects of the proposed fishing include the potential for exposure to the physical presence and sound generated by vessels associated with the proposed action. This increase in vessel presence and sound in the proposed critical habitat, contribute to total effects on passage conditions. As described above, there is some potential for the vessels associated with the fishing activities to overlap with the whales in NOF (Areas 1 and 2) every month the fishing season is open, and in waters off Oregon and California (in Areas 3 – 6) in the early and later months of the season but likely not every year or consistently. There are no effects on passage conditions resulting from PFMC salmon fisheries expected in the inland waters of Washington. Although we cannot quantify the increase in vessels around the whales that may result from the proposed action, it is reasonable to expect that authorization of the proposed fishery will result in more vessels in the whales' proposed critical habitat than there would be if no fishing is authorized.

Area 3 is considered an important corridor between Areas 1 and 2 and Area 4 feeding areas. Similarly, Area 5 is considered an important corridor between the Area 4 and Area 6 feeding areas. Passage is the primary habitat feature identified in these areas. While foraging may be occurring, it has rarely been observed in Area 3 despite dedicated monitoring for predation (NMFS 2019d). The majority of activity observed in Area 3 is travel. If there is an effect of passage in these areas in the 2020/2021 fishing season, it would more likely occur in March, April, May, and October.

For reasons described above, if interactions were to occur, the amount of disturbance caused by the fishing vessels may affect whale behavior including spending more time traveling and performing surface active behaviors and less time foraging and resting in their proposed critical habitat. Although there is some potential for the PFMC fisheries to overlap with SRKWs, fishing vessels operate at slow speeds or in idle when actively fishing. When in transit, vessels would likely travel at faster speeds with potential to affect the whales' behavior; however, fishing vessels do not target whales and disturbance would likely be transitory, including small avoidance movements away from vessels. NMFS and other partners have outreach programs in place to educate vessel operators, including the fishing community, about regulations and guidelines to minimize impacts to the whales. The number and spread of fishing vessels is not expected to result in blocking movements of the whales in their travel corridors. Therefore, it is unlikely that any small transitory disturbance that might occur would have more than a very minor effect on passage in the proposed critical habitat.

Effects of the proposed fishing reduce prey quantity and availability in proposed critical habitat resulting from the harvest of adult salmon. As described previously, several studies have correlated Chinook salmon abundance indices (i.e. quantity) with Southern Resident killer whale population growth rates (Ford et al. 2005; Ford 2009; Ward et al. 2009; Ward et al. 2013), but that relationship has weakened with the inclusion of more recent years of SRKW and Chinook abundance data. The Workgroup also related past SRKW demographic performance with estimates of Chinook salmon abundances in specific time (October – April, May – June, and July – September) and areas (off the coasts of Washington, Oregon, California and in the Salish Sea and off SWVCI) (PFMC 2020a). However, uncertainty remains because there are several challenges to understanding this relationship.

The 2020 pre-season estimates for abundance of age 3-5 Chinook in proposed critical habitat will be approximately 1,249,800 fish in Areas 1 and 2 (NOF), 1,070,200 fish in Areas 3 and 4 (Oregon waters), 542,400 fish in Areas 5 and 6 (California waters), and 627,652 in the Salish Sea. As described above, the NOF Chinook abundance estimates are above the low abundance threshold of 971,921 adult Chinook salmon. Therefore, we do not consider the prey quantity in proposed critical habitat to be extremely low.

Areas 1 and 2 are considered high-use areas for SRKWs, particularly for foraging, based on presence documented through sightings, acoustic recordings, and satellite tag data, and documented consumption of essential prey sources (NMFS 2019d). Prey is the primary essential feature of Areas 1 and 2, but passage and water quality are also important features of high-use areas where foraging behaviors occur. Analysis of the 42 SRKW prey samples collected in Area

1 identified 32 Chinook salmon, eight steelhead, one chum, and one halibut. The area of origin was identified for 25 of the Chinook salmon, most of which originated from the Columbia River, Puget Sound, the Central Valley, and the Fraser River (NMFS 2019d). Prey is also the primary essential feature of Areas 4 and 6 off California. Area 4 is characterized as “an important feeding habitat” for SRKWs. The Klamath River and California Central Valley – comprise approximately 50% of the total fall Chinook salmon available in this region, with southern Oregon rivers comprising a large portion of the remaining fish (Shelton et al. 2018). Columbia River basin fish provide a small proportion of fall Chinook but virtually no fish from Washington or areas further north are present in this area (Shelton et al. 2018). The three prey samples collected near foraging whales in Area 4 were identified as Chinook salmon from the Central Valley spring and fall runs (NWFSC unpubl. data). Area 6 is characterized as the southernmost feeding area for SRKWs and contains essential prey resources (NMFS 2019d). Both K and L pods have been observed foraging in Monterey Bay, California (Krahn et al. 2004). There has been no prey sampling conducted in this area; however, the Salinas and Carmel Rivers are freshwater systems adjacent to the area where Chinook stocks may be present.

It is difficult to assess how reductions in prey abundance may vary throughout proposed critical habitat and we have less confidence in our understanding of how reductions could result in localized depletions in the areas of proposed critical habitat. Furthermore, seasonal prey reduction throughout proposed critical habitat may not accurately predict reductions in prey available in their foraging hotspots. For inland waters, reductions in prey quantity are expected to be very small as described in the effects section (1.6% reduction in Salish Sea prey).

As described in the Effects to Species section, the percent of potential abundance that remained after Council directed salmon ocean fisheries occurred has been increasing over time – meaning for the proposed critical habitat these fisheries have been taking a lower proportion of the available abundance over time and having a decreasing effect on the conservation value of the habitat areas. The 2020/2021 percent prey reduced is expected to be 9.6% across the EEZ (3.5% in Areas 1 and 2; 8.6% in Areas 3 and 4; 25.6% in Areas 5 and 6). Prey quantity and availability in proposed critical habitat are anticipated to be within the range of the last decade.

The fishing vessels may affect availability of the prey if they reduce effectiveness in locating and consuming sufficient prey through acoustic and physical interference. This would only be the case in the proposed coastal areas and not for inland critical habitat. These impacts may also reduce overall foraging at times and may cause whales to move to areas with less disturbance outside of proposed critical habitat. However, based on fishing vessel movements that don’t focus on or follow the whales together with the large size of the management areas and the dispersed nature of the fishing fleet, the vessel impacts would likely be minimal and transitory, similar to passage.

2.6. Cumulative Effects

“Cumulative effects” are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 and 402.17(a)). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. State, local and private activities that adversely affect the whales are expected to continue at levels similar to those described in the baseline, except as limited by recent government actions described below.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline instead of cumulative effects—especially given the one-year duration of the action. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4).

Future tribal, state and local government actions will likely be in the form of legislation, administrative rules, or policy initiatives and fishing permits. Activities in the action area are primarily those conducted under state, tribal or federal government management. These actions may include changes in ocean policy and increases and decreases in the types of activities currently seen in the action area, including changes in the types of fishing activities, resource extraction, or designation of marine protected areas, any of which could impact listed species or their habitat. Government actions are subject to political, legislative and fiscal uncertainties. These realities, added to geographic scope of the action area which encompasses several government entities exercising various authorities, and the changing economies of the region, make any analysis of cumulative effects speculative. Private activities are primarily associated with other commercial and sport fisheries, construction, dredging and dredge material disposal, vessel traffic and sound, alternative energy development, offshore aquaculture/mariculture, and marine pollution. These potential factors are ongoing, expected to continue in the future, and the level of their impact is uncertain. Therefore, it is difficult to assess the cumulative impacts and the relative importance of effects additional to those already identified.

For the inland waters of Washington, federal rules on vessel traffic to protect Southern Residents from vessel effects were adopted in 2011 (76 FR 20870). Outreach and enforcement of these regulations will reduce the vessel effects (as described in Ferrara et al. (2017)) of recreational and commercial whale watching vessels in U.S. waters of the action area. There is currently a voluntary ¼ mile "Whalewatch Exclusion Zone" along the west side of San Juan Island from Mitchell Bay to Eagle Point (and ½ mile around Lime Kiln) as part of the San Juan County Marine Resources Committee Marine Stewardship Area; these are key summer foraging areas for the whales. San Juan County expanded this area to include a ¼ mile no vessel zone to Cattle Point starting in 2018 and WDFW has been increasing education and outreach regarding this area, including with the fishing community.

On March 14, 2018, WA Governor's Executive Order 18-02 was signed and it orders state agencies to take immediate actions to benefit Southern Resident killer whales and established a Task Force to identify, prioritize, and support the implementation of a longer term action plan need for Southern Resident killer whale recovery. The Task Force provided recommendations in a final Year 1 report in November 2018[14]. In 2019, a new state law was signed that increases vessel viewing distances from 200 to 300 yards to the side of the whales and reduces vessel speed within ½ nautical mile of the whales to seven knots over ground. SB 5918 amends RCW 79A.60.630 to require the state's boating safety education program to include information about the Be Whale Wise guidelines, as well as all regulatory measures related to whale watching,

[14] Available here:
https://www.governor.wa.gov/sites/default/files/OrcaTaskForce_reportandrecommendations_11.16.18.pdf

which is expected to decrease the effects of vessel activities to whales in state waters. NMFS initiated scoping in 2019 to evaluate the need to revise existing federal regulations.

On November 8, 2019, the task force released its Year 2 report[15] that assessed progress made on implementing Year 1 recommendations, identified outstanding needs and emerging threats, and developed new recommendations. Some of the progress included increased hatchery production to increase prey availability. In response to recommendations of the Washington State Southern Resident Killer Whale Task Force, the Washington State Legislature provided approximately $13 million in funding "prioritized to increase prey abundance for southern resident orcas" (Engrossed Substitute House Bill 1109) for the 2019-2021 biennium (July 2019 through June 2021). Hatcheries are in the midst of enumerating the spring 2020 releases, but the planned production associated with this legislative action is a release of an additional 13.5 million Chinook salmon (approximately 6.4 million from Puget Sound facilities, approximately 5.6 million from Washington coastal facilities, and approximately 1.5 million from Columbia River facilities). A similar level of Chinook production funded by this legislative action is anticipated in the spring of 2021. The released smolts would return as adults and be part of the prey base 3 – 5 years later.

The state passed House Bill 1579 that addresses habitat protection of shorelines and waterways (Chapter 290, Laws of 2019 (2SHB 1579)), and funding was included for salmon habitat restoration programs and to increase technical assistance and enforcement of state water quality, water quantity, and habitat protection laws. Other actions included measures to increase survival through the hydropower system on the lower Snake and Lower Columbia rivers, passed legislation to decrease impacts of predatory fish on salmon (Chapter 290, Laws of 2019 (2SHB 1579)), passed the federal Endangered Salmon Predation Prevention Act (PL 115-329) to provide state and tribal managers more flexibility to manage sea lion predation on the Columbia River, provided funding to the Washington State Department of Transportation to complete fish barrier corrections, and funding to implement a lower Snake River dams stakeholder engagement process. Although these measures won't improve prey availability in 2020/2021, they are designed to improve conditions in the long term.

A joint DFO-NOAA Prey Availability Workshop was held in November 2017 that focused on identifying short-term management actions that might be taken to immediately increase the abundance and accessibility of Chinook salmon. Priority management actions identified in the workshop that should be considered included 1) targeted, area-based fishery management measures designed to improve Chinook salmon availability, and 2) reducing acoustic and vessel disturbance in key Southern Resident foraging areas. There was little support for broad scale coast-wide reductions in fishing to increase the prey available to the whales, which was consistent with the findings of the previous transboundary panel (i.e. Hilborn et al. 2012). In 2019, Canada implemented some of these actions, including interim sanctuary zones, as part of an interim order to protect the whales and they are currently reviewing measures to protect the whales in 2020[16].

[15] Available here: https://www.governor.wa.gov/sites/default/files/OrcaTaskForce_FinalReportandRecommendations_11.07.19.pdf

[16] https://www.tc.gc.ca/eng/mediaroom/interim-order-protection-killer-whales-waters-southern-british-columbia.html

2.7. Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

The SRKW DPS, composed of J, K, and L pods, was listed as endangered under the ESA on November 18, 2005 (70 FR 69903). The limiting factors affecting this population include reduced prey availability and quality, high levels of contaminants from pollution, and disturbances from vessels and sound (NMFS 2008e). Oil spills and disease as well as the small population size are also risk factors. It is likely that multiple threats are acting together to impact SRKWs.

In the early 1970s following live-captures for aquaria display, the SRKW population was at its lowest known abundance (68 whales). The highest recorded abundance since the 1970s was in 1995 (98 whales), though the population declined to 81 whales by 2001. The population experience a growth between 2001 and 2006, but has been generally declining since then. However, in 2014 and 2015, the SRKW population increased from 78 to 81 as a result of multiple successful pregnancies that occurred in 2013 and 2014. At present, the SRKW population has declined to near historically low levels (Figure 2). As of April 2020, the population is 72 whales (one whale is missing and presumed dead since the 2019 summer census).

The NWFSC has updated the population viability analysis and the results now suggest a downward trend in population size projected over the next 50 years (although there is increased uncertainty around the estimates the further out the model projects). The downward trend is in part due to the changing age and sex structure of the population. If the population of SRKW experiences demographic rates (e.g. fecundity and mortality) that are more similar to 2016 than the recent 5-year average (2011-2016), the population will decline faster as shown in Figure 3 (NMFS 2016c).

SRKWs occur throughout the coastal waters off Washington, Oregon, and Vancouver Island and are known to travel as far south as central California and as far north as Southeast Alaska (Figure 4). During the spring, summer, and fall months, SRKWs have typically spent a substantial amount of time in the inland waterways of Washington and British Columbia (Bigg 1982; Ford et al. 2000; Krahn et al. 2002; Hauser et al. 2007). In November 2006, NMFS issued a final rule designating approximately 2,560 square miles of inland waters of Washington State as critical habitat for the SRKW DPS. Although seasonal movements are somewhat predictable, there can be large inter-annual variability in arrival time and days present in inland waters from spring through fall, with late arrivals and fewer days present in inland waters in recent years (Hanson and Emmons 2010; The Whale Museum unpubl. data).

Land- and vessel-based opportunistic and survey-based visual sightings, satellite tracking, and passive acoustic research conducted have provided an updated estimate of the whales' coastal geographic range. Satellite tagging results indicate J pod has high use areas in inland waters of British Columbia and Washington during winter months, whereas K and L pods occur almost exclusively in coastal waters, primarily off Washington, and also in coastal waters off Oregon, and California during December to mid-May with only occasional visits into inland waters. Similarly, passive acoustic recorders have corroborated the results from the satellite tagging efforts and detected SRKWs along the coast, particularly off Washington coast (although acoustic effort was higher off Washington). On September 19, 2019 NMFS proposed to revise the critical habitat designation for the SRKW DPS under the ESA by designating six new areas along the U.S. West Coast (84 FR 49214) in addition to maintaining critical habitat designation in inland waters. Specific new areas proposed along the U.S. West Coast include 15,626 square miles of marine waters from the U.S. international border with Canada south to Point Sur, California.

The available prey samples collected in coastal waters indicate Chinook salmon are the primary species detected and consequently an important dietary component. Prey other than Chinook salmon detected in diet samples on the outer coast have included steelhead, chum, lingcod, and halibut (Hanson et al. in prep). The samples collected opportunistically in winter and spring in coastal waters showed that over half the Chinook salmon consumed originated in the Columbia River (Hanson et al. in prep). Columbia River, Central Valley, Puget Sound, and Fraser River Chinook salmon collectively comprised over 90 percent of the diet samples collected for SRKW's in coastal waters.

The abundance, productivity, spatial structure, and diversity of Chinook salmon are affected by a number of natural and human actions and these actions also affect prey availability for SRKWs. Natural actions can include changes in climate and ocean conditions (e.g. the Pacific Decadal Oscillation and the El Nino/Southern Oscillation). The potential impacts of climate and oceanographic change on whales and other marine mammals will likely involve effects on habitat availability and food availability. Changing ocean conditions driven by climate change may influence ocean survival and distribution of Chinook and other Pacific salmon further affecting the prey available to SRKWs. The most notable human activities that cause adverse effects on salmon include land use activities that result in habitat loss and degradation, hatchery practices, harvest and hydropower systems.

Harvest that affects prey availability in the action area occurs in Southeast Alaska and British Columbia as well as in the action area. These fisheries are subject to the Pacific Salmon Treaty. The 2019 PST Agreement includes reductions to harvest impacts in all Chinook salmon fisheries within its scope. These reductions will result in larger proportions of annual salmon abundance returning to more southerly U.S. Pacific Coast Region portion of the EEZ than under previous PST Agreements. Additional hatchery production of Chinook funded through the programmatic PST- related funding initiative for domestic actions associated with the new PST Agreement is designed to conserve Puget Sound critical populations, increase hatchery production to provide additional prey for SRKW and restore habitat for Puget Sound Chinook populations. The funding initiative, consulted on at a programmatic level in NMFS 2019c, is expected to result in a 4-5% increase in available prey throughout inland and coastal waters frequented by SRKW's range and affected by fisheries managed under the PST in the next 3 – 5 years. To accomplish this percent increase in prey availability would require the release of 20 million additional smolts from hatcheries located in Puget Sound, the Columbia River, and coastal Washington areas. WDFW is contributing toward the goal of producing additional Chinook as prey for SRKW, planning for annual release of an additional 13.5 million Chinook salmon. Hatcheries in Washington State are in the midst of enumerating the spring 2020 release and a similar level of Chinook production funded by legislative action is anticipated in the spring of 2021.

In addition to increased hatchery production, the PST-related funding initiative is expected to fund projects to improve habitat conditions for specified populations of Puget Sound Chinook salmon, which we anticipate would increase Puget Sound Chinook abundance, also benefiting SRKW. Furthermore, the Washington State passed House Bill 1579 that included addressing habitat protection of shorelines and waterways, and funding was included for salmon habitat restoration programs and to increase technical assistance and enforcement of state water quality, water quantity, and habitat protection laws, along with other actions. By improving conditions for these populations, we anticipate abundance would increase, also benefiting SRKW.

Coastal salmon fisheries managed under PFMC FMP will affect SRKWs and their critical habitat through direct effects of vessel activities, and through indirect effects from reduction in prey availability. We have analyzed the effects of the 2020/2021 fisheries managed under the FMP on prey of SRKWs and these form the basis for the critical habitat analysis.

Because the whales are observed in the NOF area in all seasons, there is some potential for direct overlap with the fisheries, particularly in this area (PFMC 2020a). Although predicting the whales' movements and habitat use in any particular area is uncertain and the limited data seems to suggest considerable year-to-year variation, the current data suggest overlap may be more likely to occur during the 2020 fisheries season off Oregon from March through May and off California in April, May, and October when fisheries are open. In previous years off Oregon, the effort for commercial fishing has been highest but the effort for recreational fishing is lowest during the period of higher potential of overlap with the whales. Off California, the effort for commercial fishing has been relatively high in May and relatively low in October and the effort for recreational fishing is at average levels in April and May and relatively low in October. In the 2020/2021 fishing season, vessel traffic and fishing effort associated with the Council fisheries are not anticipated to be higher than past levels in the Action Area and in some cases less due to reduced coho quotas.

Although there is some potential for direct interaction between SRKWs and salmon fishing vessels and gear in the whales' coastal range because of the potential spatial and temporal overlap between the whales' distribution and the distribution of the Council salmon fisheries, vessel strikes or reports of entanglement in general are rare and have not been observed in association with PFMC ocean salmon fisheries and are therefore unlikely. If direct interactions resulting in disturbance from vessel proximity and sound were to occur, the highest likelihood for interaction is during the entire season NOF and in the beginning months of the season off Oregon and California (i.e., April and May). Vessel and acoustic disturbances may cause short-term behavioral changes, avoidance, or a decrease in foraging (if interactions were to occur). However, based on the operation of fishing vessels we expect that any transitory small amount of disturbance caused by the fishing vessels is not likely to disrupt normal behavioral patterns, cause harm to the whales or impair the prey (i.e., availability) and passage features of their existing and proposed critical habitat.

Intuitively, at some low Chinook abundance level, the prey available to the whales will not be sufficient to forage successfully leading to adverse effects (such as reduced body condition and growth and/or poor reproductive success). When prey is scarce, whales likely spend more time foraging than when it is plentiful. Increased energy expenditure and prey limitation can cause nutritional stress. Nutritional stress is the condition of being unable to acquire adequate energy and nutrients from prey resources and as a chronic condition can lead to reduced body size and condition of individuals and lower birth and survival rates of a population (e.g., Trites and Donnelly 2003). This could affect SRKW survival and fecundity. Several studies in the past have found correlations between Chinook salmon abundance indices and SRKW demographic rates (Ford et al. 2005; Ford et al. 2009; Ward et al. 2009; Ward et al. 2013). In recent years, the relationship between Chinook salmon abundance and SRKW demographic rates have weakened (e.g. SRKW status continues to decline with varying levels of Chinook abundance) and uncertainty remains. There are several challenges to quantitatively characterize the relationship between SRKWs and Chinook salmon including 1) there are multiple, interacting factors at play, and 2) the strength of any one effect likely varies through time leading to a situation known as "non-stationarity". The multiple threats affect SRKW's demographic performance through time, in addition to random chance, and these effects can confound the analysis of the effects of prey abundance.

As described in its risk assessment report, the Workgroup related past SRKW demographic performance with estimates of Chinook salmon abundances in specific time (October – April, May – June, and July – September) and areas (off the coasts of Washington, Oregon, California and in the Salish Sea and off SWVCI) (PFMC 2020a). However, similar to past efforts, they also found predicting the relationship between SRKWs and Chinook salmon to be challenging. They found one of the fitted regressions met the criterion of statistical significance ($p \leq 0.05$) (winter Chinook abundance NOF and SRKW survival with one year time lag). The Workgroup also estimated the mean change in SRKW survival, fecundity, and occurrence of peanut head across the time series if PFMC salmon-directed fisheries did not occur, as predicted using the regressions in PFMC (2020a) Appendix C and the fishery removals provided in Table 6. In general, in any given year, these mean estimated changes in fecundity and survival from changes to NOF abundance from Council fisheries are generally very small ($\leq$ 0.2% change in survival and fecundity). The Workgroup noted the regression results should be interpreted with caution and also found that overall, the PFMC salmon fishery impacts on NOF abundance are relatively small relative to both annual variation in abundance and the total abundance in a given year. Given that we are limited in our interpretation of the regression analyses, and the relationship between Chinook abundance and SRKWs is not linear and has a degree of non-stationarity, we apply a relatively low weight to the regression analyses.

Based on the whales' distribution and diet (and supported by the Workgroup's regression analysis), Chinook salmon abundance in NOF coastal areas is to likely be most consistently important to the whales. Given NOF Chinook abundance is consistently important to SRKWs, NMFS identified a low abundance threshold for Council salmon fisheries in Washington, Oregon, and California waters that affect the abundance of Chinook salmon north of Cape Falcon. Although there is currently no quantitative model that identifies a low abundance threshold that will cause adverse effects to the whales or appreciably alter the value of their habitat, there is evidence SRKW and other killer whale populations that are known to consume Chinook salmon may have experienced adverse effects from low prey availability in the late 1990s. NMFS used the abundances from this time period to develop a low abundance threshold for use in determining if additional measures were needed to avoid 2020 fisheries exacerbating a low abundance scenario. In its guidance to the Council, NMFS noted if the NOF abundance was below the threshold, the Council should implement precautionary conservation measures to benefit SRKW. The 2020 pre-season estimated Chinook salmon abundance NOF of 1,250,900 exceed the Chinook abundance threshold of approximately 972,000 adult Chinook (PFMC 2020c). The post-season NOF Chinook abundance estimate will also likely exceed the low abundance threshold.

For 2020/2021, the percent reduction in prey coastwide (EEZ) is estimated to be 9.6%. Percent reductions NOF, Salish Sea, SWCVI, Oregon coast, and California coast is estimated to be 3.5%; 1.9%, 1.6%, 8.6% and 25.3%, respectively. To put this year's prey reduction from the proposed action in context, we compared to the range of percent reductions in the most recent 10 year time period (Figure 20). This year's percent reductions are within the range of what has been observed in the most recent 10 year period, therefore consistent with the pattern of the PFMC salmon fisheries taking a lower proportion of the available abundance over that decade.

There are several limitations and uncertainties of the analysis including uncertainty in Chinook stock abundances and distributions, effects of changes in Chinook salmon size and age structure, uncertainty in SRKW distribution and the factors that drive changes in distribution, differential responses to changes in Chinook abundance among pods, ability of SRKW to switch to alternative prey, and patterns of temporal variation in competing threats (refer to PFMC 2020a for more details on these uncertainties).

With these uncertainties in mind, for PFMC fishing in 2020/2021, the expected reductions in prey quantity and availability, are consistent with a trend of decreasing fishery impacts. For the area with the largest amount of overlap with the whales (NOF), the reductions or alteration of habitat value are expected to be relatively small, and for reductions in all areas, the impacts on fitness are also expected to be very small. The projected abundance of Chinook salmon prey during the 2020/2021 fishing season is above the threshold that would raise heightened concerns about the whales' ability to survive and reproduce based on past patterns. While the benefits of the programmatic funding initiative related to U.S. domestic actions associated with the new PST Agreement, as described in the Environmental Baseline, in improving habitat and increasing hatchery production won't be realized during the 2020/2021 season, there are other ongoing measures intended to support SRKW recovery efforts in the long term as described in the Cumulative Effects section. We cannot quantify the direct benefits of these actions in offsetting reductions from PFMC harvest at this time and will continue to develop ways to evaluate the effectiveness of protective measures.

Part of our effects analysis on the impacts from the PFMC fisheries on prey availability relies on harvest being set at sustainable levels for all affected salmon stocks, measured with respect to the applicable FMP objectives and standards. For ESA-listed stocks affected by the fishery, NMFS has concluded that the action is consistent with proposed actions, RPAs and RPMs for long-term biological opinions addressing fishery effects to ESA-listed salmonids thus the proposed action is not likely to appreciably reduce the survival and recovery of Chinook and all other ESA-listed salmon species affected by the action. For the 2020 management season under the Council's recommended salmon fisheries, salmon stocks originating from Washington, Oregon, and California meet all of the applicable conservation objectives in the FMP (PFMC 2020c).

The Klamath River Fall and Sacramento River Fall Chinook stocks are classified as overfished under the provisions of the MSA. Although Chinook salmon abundance SOF may not be consistently important to SRKW as compared to NOF abundance, SRKW require healthy

Chinook salmon stocks throughout their geographic range and these rebuilding plans support improved status of these stocks. In 2020, fisheries will be managed consistent with the proposed rebuilding plans for the Klamath River Fall Chinook harvest and Sacramento River Fall Chinook salmon stocks. Implementation of the Klamath River Fall Chinook harvest control rule has led to the limited seasons south of Cape Falcon that employ restrictive time/area closures. The spawning escapement for Sacramento River Fall Chinook salmon after Council fisheries is estimated to be 233,174 fish in 2020, well above the control-rule defined minimum of 141,955 hatchery and natural adult spawners (PFMC 2020c).

Lastly, the PFMC Ad Hoc Workgroup is currently developing draft recommendations for FMP management measures based on the Risk Assessment outcome. Moving forward we will incorporate those recommendations as well as benefits from mitigation into future analyses to continue to inform our long-term assessment. However, we view this one year biological opinion as part of the first step in assessing the fisheries using a long-term adaptive approach.

In conclusion, there appears to be a declining trend with the status of the whales likely due to a combination of the three top limiting factors: prey availability, vessel noise and disturbance, and toxic contaminants. Chinook salmon are likely the predominant prey species and there is likely a linkage between Chinook abundance and the whales' status. There is likely a spectrum of risk and at some low level of Chinook abundance there is higher risk to adversely affect the whales' status. While past studies found a relationship between Chinook abundance and whale health and status, that relationship has become less clear with more recent data and studies. Earlier biological opinions relied heavily on this relationship, but the best available science and data does not support such heavy reliance. The environmental baseline and cumulative effects show a continuation of effects of human activities in the action area that contribute to the top three limiting factors for the whales' status, but there are improvements in recent years that are expected to continue, such as reductions in northern fishery impacts under the new PST Agreement, the beginnings of additional hatchery production to provide increased prey for the whales, increased restrictions on vessel traffic near the whales, and state efforts to improve salmon habitat conditions in Washington.

This proposed action adds one year of limited fisheries to this backdrop. We considered whether the overall Chinook abundance in the action area for 2020 is above the levels observed in particularly low abundance years when there is a higher risk of low Chinook abundance negatively affecting whale health. The 2020 abundance is well above this level. Even with the expected effects of the 2020 fisheries, Chinook abundance is expected to stay well above the low abundance threshold. Particularly in NOF, the area with the most overlap with the whales and likely of most importance, the expected fishery reduction to Chinook availability is quite low. The Workgroup found a very low magnitude of mean annual changes in fecundity related to reductions in prey from Council-area fisheries based on the regression analyses described in the Effects analysis, however, as discussed above, we give low weight to this result due to underlying assumptions (i.e., the relationship between Chinook abundance and SRKWs is not linear and has a degree of non-stationarity) and the overall limitations in interpreting the results. In light of the fisheries' expected reduction and taking into account the most recent data on abundance and whale health, we anticipate that even with the 2020 fisheries, the abundance of Chinook will be well above any low abundance threshold and therefore there is likely relatively low risk between abundance and adverse whale health in 2020.

It is possible that there is a measurable effect to the whales' behavior in terms of possible additional foraging effort given that small prey reductions will occur in a year with moderate Chinook abundance. For purposes of this opinion, we assume there is a measurable effect on additional foraging effort. However, we do not expect these changes to persist or be so large that they result in more than a minor change to the overall health of any individual whale, or that they change the status of the population. Thus, even assuming a measurable effect, this would not rise to the level of an appreciable reduction in the likelihood of survival of any individual whale or the population.

Similarly, we do not expect the 2020 fisheries to affect the whales' likelihood of recovery. Even though this biological opinion only addresses the 2020 fisheries, we have also analyzed the effect of similar fisheries into the foreseeable future (see NMFS 2019c), and considered the long-term effects of the 2020 fisheries on the affected salmon stocks that are prey for SRKW. The Council's recommended salmon fisheries are designed to be consistent with FMP objectives and biological opinions for ESA listed stocks and thus we anticipate that these stocks will maintain or improve serving as continued prey base for whales. The management measures are also consistent with the rebuilding plans NMFS has proposed to approve for Klamath River Fall and Sacramento River Fall Chinook stocks, supporting Chinook salmon stocks throughout SRKW's geographic range and thus we anticipate that these stocks will rebuild as well. Efforts are underway to produce additional hatchery fish to increase prey availability for the whales, and to offset to some extent the effects of the salmon fisheries in future years. In recent years, Canada and Washington State have increased vessel measures to reduce sound and disturbance to the whales and NMFS initiated scoping in 2019 to evaluate the need to revise existing federal regulations. These efforts along with voluntary measures are underway to reduce impacts of vessels on foraging. In light of these ongoing efforts addressing the three primary limiting factors and projecting into the future beyond 2020 with reasonably certain assumptions, we do not expect that the 2020 fisheries will impede the recovery of the whales. With these efforts to ensure that recovery progresses, we find that the 2020 fisheries do not appreciably reduce the likelihood of survival and recovery of SRKW over the long run.

2.8. Conclusion

After reviewing and analyzing the current status of the listed species and proposed critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of the Southern Resident killer whale DPS or destroy or adversely modify its designated critical or proposed habitat.

We intend to consider adopting the conference opinion portion of this document as part of the biological opinion once NMFS has issued a final rule regarding the proposed designation of coastal critical habitat for SRKWs. We will review the final rule for the critical habitat designation and if we find there have been no significant changes to the designation that would alter the contents of the opinion and no significant new information has been developed (including during the rulemaking process), we may adopt the conference opinion portion as part of the biological opinion on the proposed action and no further consultation will be necessary.

2.9. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1. Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

The harvest of salmon that may occur under the proposed action is likely to result in some level of harm constituting take to SRKW by reducing prey availability, which may cause animals to forage for longer periods, travel to alternate locations, or abandon foraging efforts. All individuals of the SRKW DPS have the potential to be adversely affected in the action area. However, K and L pods are known to use coastal waters off Washington, Oregon, and California where greater prey reduction occurs than in inland waters of the Salish Sea where J pod primarily occurs. There are no data available to help NMFS quantify impacts to foraging behavior or any changes to health of individual killer whales in the population from a specific amount of removal of potential prey resulting from the PFMC salmon fisheries. Therefore, NMFS is using Chinook salmon quotas in PFMC salmon fisheries and the season structure, bag limits, and other management measures in NOF and SOF (as presented PFMC 2020c) as surrogates for incidental take of SRKW. Catch relates directly to the extent of effects on prey availability as we would expect catch to be proportional to the reduction in prey in a given year given the preseason forecasts.

Fisheries will be managed to keep catch levels within Chinook salmon overall quotas (i.e., North of Falcon commercial troll) in the action area consistent with the impact to those Chinook stocks as assessed in PFMC 2020c. We can quantify and monitor catches relative to overall quotas inseason. Implementation of the season structured fisheries can also be tracked inseason for consistency with the management measures described in PFMC 2020c. As described above, NMFS anticipates PFMC salmon fisheries occurring in 2020/2021 will be implemented and managed based on what is described in PFMC 2020c. These measures, such as season structure and bag limits are designed to meet the conservation objectives for salmon stocks managed under the FMP, including provisions for inseason adjustments, and to be responsive to the abundance of salmon stocks similar to that over this last decade when the whale status has declined.

2.9.2. Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of proposed critical habitat.

2.9.3. Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

1. NMFS will continue to participate in the PFMC Ad Hoc Workgroup to develop recommendations for the Council to be implemented, if necessary, in a longer term approach.
2. In-season management actions taken during the course of the fisheries shall consider the extent of incidental take described in the Incidental Take Statement. NMFS will consult with the states and tribes to track implementation of the PFMC fisheries, including landed catch relative to the quotas, including provisions for inseason adjustments, through the season to ensure they are consistent with the extent of take as described in 2.9.1 above.
3. Catch shall be monitored using the best available measures. Although NMFS is the federal agency responsible for carrying out this reasonable and prudent measure, in practical terms, it is the states and tribes that monitor catch impacts.

2.9.4. Terms and Conditions

The terms and conditions described below are non-discretionary, and the NMFS or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). NMFS or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1:

   1a. NMFS will attend Ad Hoc Workgroup calls and meetings, participate in drafting reports and developing management recommendations, and present updates and reports to the PFMC as appropriate.

2. The following terms and conditions implement reasonable and prudent measure 2:

   2a. NMFS shall confer with the affected states and tribes, and the PFMC chair, as appropriate, to ensure that in-season management actions taken during the course of the PFMC fisheries are consistent with the management measures and provisions described in PFMC 2020c. Fisheries will be managed and monitored to ensure catch does not exceed the overall Chinook quotas as described in Tables 1 – 3 of PFMC 2020c. Season structured fisheries will be managed consistent with the management measures described in PFMC 2020c, including provisions for inseason adjustments.

3. The following terms and conditions implement reasonable and prudent measure 3:

   3a. Monitoring of catch in the PFMC commercial and recreational fisheries by states and tribes shall be sufficient to provide statistically valid estimates of the catch of salmon to the extent possible. The catch monitoring program shall be stratified by time, and management area.

3b. NMFS, in cooperation with the affected states and tribes, and the PFMC chair, as appropriate, shall monitor the catch and implementation of other management measures using the best available methods. The monitoring is to ensure full implementation of, and compliance with, management actions specified to control the FMP fisheries within the scope of the action.

2.10. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

NMFS has broad authority that can be used to further the survival and recovery of SRKWs and their prey. We recommend that NMFS implements the following measures to reduce the risks of the proposed action and provide information for future consultations involving the implementation of fisheries regulations that may affect SRKWs, as well as reduce the adverse effects associated with fishing activities:

1. Continue filling data gaps for specific pods, which includes assessing the different spatial and temporal distributions among pods to inform diet studies and evaluation of priority prey for the whales.
2. Work with researchers, states and tribal fishery managers on tools to evaluate effectiveness of harvest management and potential mitigation measures (habitat restoration and hatchery production) to contribute to the prey base of SRKWs.
3. Continue and expand education and outreach for fishing communities through promoting Be Whale Wise guidelines and regulations, online training for professional mariners, and encouraging reports of killer whale sightings.
4. Improve understanding of foraging efficiency to validate estimates of metabolic needs and inform evaluation of levels of abundance and distribution of prey needed to support growth and reproduction.

2.11. Reinitiation of Consultation

This concludes formal consultation for Reinitiation on the Pacific Fishery Management Council Salmon Fishery Management Plan Impacts on Southern Resident Killer Whales and their Proposed Critical Habitat.

As 50 CFR 402.16 states, reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (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 biological opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

After critical habitat is designated for SRKWs—and subsequent adoption of this conference opinion—reinitiation of consultation shall be requested if any of the above conditions are met.

3. Data Quality Act Documentation and Pre-Dissemination Review

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

3.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are applicants and action agencies listed on the first page. Other interested users could include agencies, applicants, and the American public. Individual copies of this opinion were provided to the NMFS. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

3.1.1. Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

3.2. Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

4. Appendices

APPENDIX A

Figure A.1. Council adopted 2020 non-Indian commercial salmon seasons (PFMC 2020c).

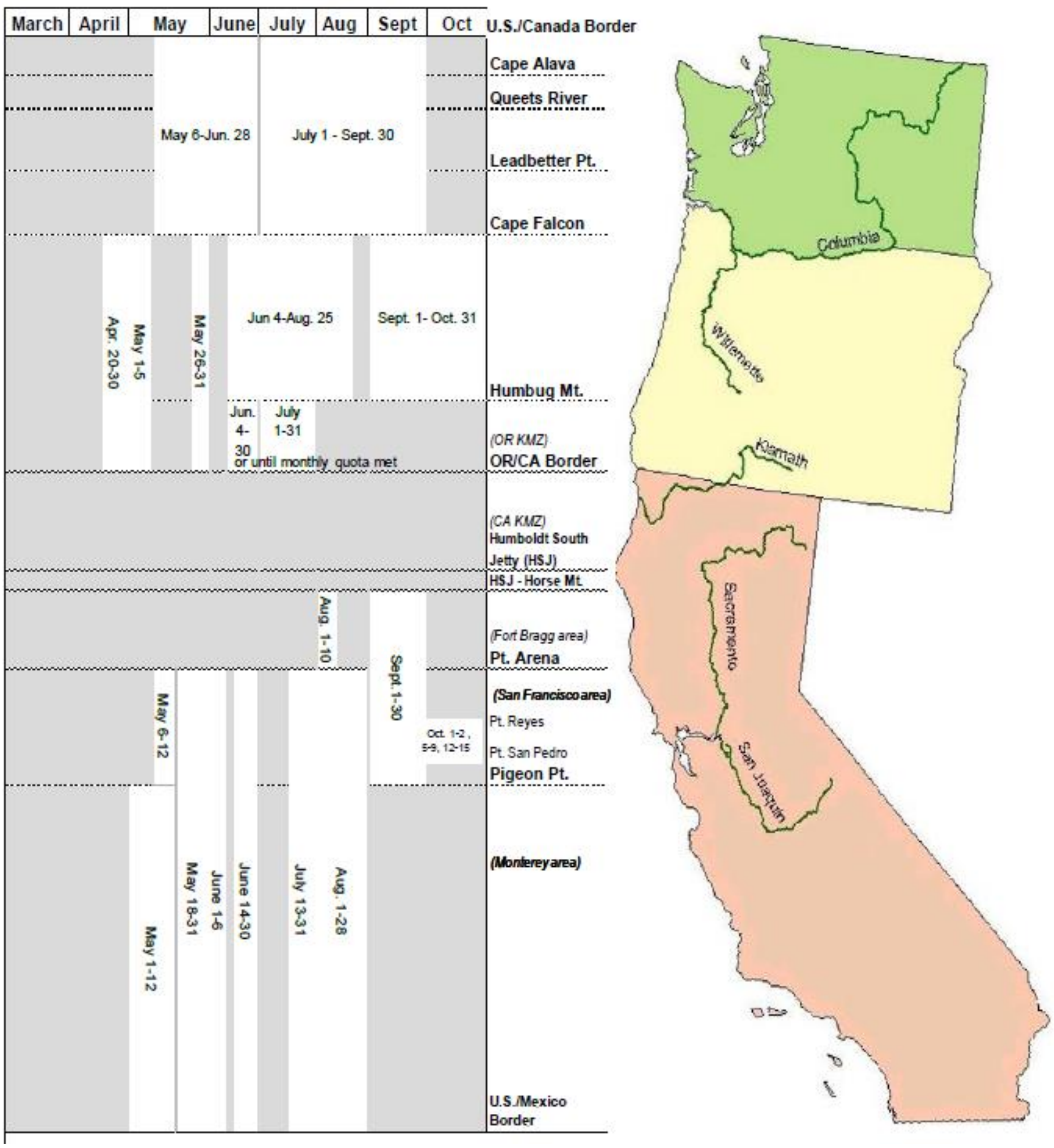
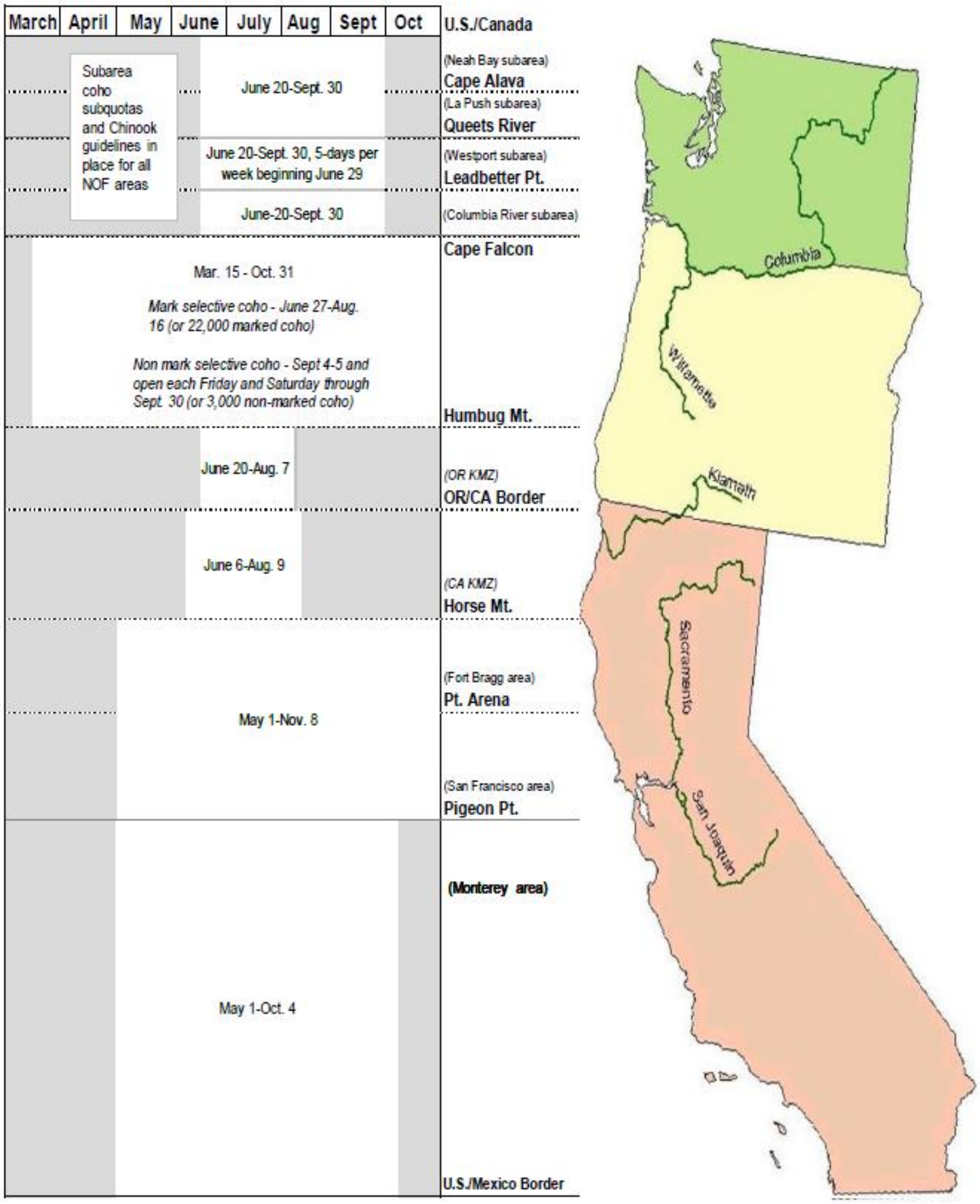


Figure A.2. Council adopted 2020 recreational salmon seasons (reprinted from PFMC 2020c).



APPENDIX B

Table B.1. Hatchery programs that have been addressed in previously completed ESA Section 7 consultations.

Biological Opinion	Programs Authorized in Opinion	Signature Date	Citation
USFWS Artificial Propagation Programs in the Lower Columbia and Middle Columbia River	Little White Salmon/Willard National Fish Hatchery Complex Coho	November 27, 2007	NMFS (2007), NMFS (2016a)
	Little White Salmon/Willard National Fish Hatchery Complex spring Chinook		
	Little White Salmon/Willard National Fish Hatchery Complex URB fall Chinook		
	Carson National Fish Hatchery spring Chinook		
	Spring Creek National Fish Hatchery fall Chinook (tule)		
	Eagle Creek National Fish Hatchery coho		
	Eagle Creek National Fish Hatchery winter steelhead		
	Warm Springs National Fish Hatchery Warm Springs River spring Chinook		
Consultation for Operation of the Federal Columbia River Hydropower System	Yakima River kelt reconditioning program	May 5, 2008	NMFS (2008a); NMFS (2014a)
	Upper Columbia River kelt reconditioning program		
Consultation on the Willamette River Basin Flood Control Project	North Santiam spring Chinook	July 11, 2008	NMFS (2008b)
	South Santiam spring Chinook		
	McKenzie spring Chinook		
	Middle Fork spring Chinook		
	Upper Willamette summer steelhead		

Biological Opinion	Programs Authorized in Opinion	Signature Date	Citation
Letter: Request for Concurrence with the Yakima Nation Fisheries' assessment of potential impacts	Lake Cle Elum/ Yakima Basin Lakes	July 1, 2009	Turner (2009)
Umatilla River Spring Chinook Salmon, Fall Chinook Salmon, and Coho Salmon Hatchery Programs	Umatilla spring Chinook	April 19, 2011	NMFS (2011; 2016b)
	Umatilla fall Chinook		
	Umatilla coho		
Snake River Fall Chinook Salmon Hatchery Programs, ESA Section 10(a)(1)(A) permits, numbers 16607 and 16615	Lyons Ferry Hatchery Snake River fall Chinook	October 9, 2012	NMFS (2012a)
	Fall Chinook salmon Acclimation program		
	Idaho Power Company fall Chinook		
	Nez Perce Tribal Hatchery Snake River fall Chinook		
Entiat National Fish Hatchery Summer Chinook Salmon Hatchery Program	Entiat summer Chinook	April 18, 2013	NMFS (2013a)
Snake River Sockeye Salmon Hatchery Program	Snake River sockeye	September 28, 2013	NMFS (2013b)
Yakima River Spring Chinook Salmon, Summer/Fall Chinook Salmon, and Coho Salmon Hatchery Programs	Upper Yakima River spring Chinook/Cle Elum Supplementation and Research Facility (CESRF)	November 25, 2013	NMFS (2013c)
	Yakima River summer and fall run Chinook production program		
	Yakima River coho Reintroduction program		
Sandy River Spring Chinook Salmon,	Sandy River spring Chinook	August 7, 2014	NMFS (2014b)
	Sandy River coho		

Biological Opinion	Programs Authorized in Opinion	Signature Date	Citation
Coho Salmon, Winter Steelhead, and Summer Steelhead Programs	Sandy River winter steelhead		
	Sandy River summer steelhead		
Issuance of Section 10(a)(1)(A) Permit 18928 for the Chief Joseph Hatchery Okanogan Spring Chinook Salmon Program	Chief Joseph Hatchery Okanogan spring Chinook	October 27, 2014	NMFS (2014c)
Reinitiation of the Issuance of Three Section 10(a)(1)(A) Permits for the Upper Columbia River Chiwawa River, Nason Creek, and White River Spring Chinook Salmon Hatchery Programs	Chiwawa spring Chinook	May 29, 2015 (original signed July 3, 2013)	NMFS (2015a)
	Nason Creek spring Chinook		
Six Lower Snake River Spring/Summer Chinook Salmon Hatchery Programs	Catherine Creek spring/summer Chinook	June 24, 2016	NMFS (2016c)
	Upper Grande Ronde spring/summer Chinook		
	Imnaha River spring/summer Chinook		
	Lookingglass Creek spring Chinook		
	Lostine spring/summer Chinook		
	Tucannon River Endemic spring Chinook		
Issuance of a Section 10(a)(1)(A) Permit 18583 for the Upper Columbia Wenatchee River Summer	Wenatchee summer steelhead	July 20, 2016	NMFS (2016d)

Biological Opinion	Programs Authorized in Opinion	Signature Date	Citation
Steelhead Hatchery Program			
Issuance of Four Section 10(a)(1)(A) Permits for Spring Chinook Salmon Hatchery Programs in the Methow Subbasin	Methow Hatchery spring Chinook	October 13, 2016	NMFS (2016e)
	Winthrop National Fish Hatchery spring Chinook		
Mitchell Act Funded Hatchery Programs	Bonneville coho	January 15, 2017	NMFS (2017a)
	Bonneville fall Chinook (tule)		
	Big Creek Chinook (tule)		
	Big Creek coho		
	Big Creek chum		
	Big Creek winter steelhead		
	Gnat Creek winter steelhead		
	Klaskanine winter steelhead		
	Klaskanine coho		
	Klaskanine fall Chinook (tule)		
	Clackamas summer steelhead		
	Clackamas winter steelhead		
	Clackamas spring Chinook		
	Grays River coho		
	N. F. Toutle fall Chinook (tule)		
	N. F. Toutle coho		
	Kalama fall Chinook (tule)		
	Kalama coho (type N)		
	Kalama summer steelhead		

Biological Opinion	Programs Authorized in Opinion	Signature Date	Citation
	Kalama winter steelhead		
	Washougal fall Chinook (tule)		
	Washougal coho		
	Walla Walla spring Chinook		
	Ringold Springs steelhead		
	Ringold Springs coho[1]		
	Clearwater River coho restoration project		
	Lostine River coho restoration project;		
	Deep River coho (MA/SAFE)		
	Deep River fall Chinook		
	Klickitat coho		
	Klickitat URB fall Chinook		
	Klickitat spring Chinook		
	Klickitat (Skamania) summer steelhead		
	Beaver Creek summer steelhead		
	Beaver Creek winter steelhead		
	Beaver Creek (Elochoman) coho[1]		
	South Toutle summer steelhead		
	Coweeman winter steelhead		
	Cathlamet Channel Net-pen spring Chinook		
	Klineline winter steelhead (Salmon Cr.)		
	Washougal summer steelhead (Skamania Hatchery)		

Biological Opinion	Programs Authorized in Opinion	Signature Date	Citation
	Washougal winter steelhead (Skamania Hatchery)		
	Rock Creek winter steelhead		
	Kalama spring Chinook		
	Umatilla River coho		
	Sandy River spring Chinook		
	Sandy River winter steelhead		
	Sandy River summer steelhead		
	Sandy River coho		
	Carson National Fish Hatchery spring Chinook		
	Little White Salmon National Fish Hatchery spring Chinook		
	Willard National Fish Hatchery fall Chinook		
	Eagle Creek National Fish Hatchery winter steelhead		
	Eagle Creek National Fish Hatchery coho		
Issuance of a Tribal 4(d) Rule Determination for a Tribal Resource Management Plan (TRMP) submitted by the Confederated Tribes of the Colville Reservation (CTCR), and Funding and Carrying out Activities Pursuant to that TRMP	Chief Joseph summer/fall Chinook	February 24, 2017	NMFS (2017b)
	Chief Joseph spring Chinook		
	Okanogan River steelhead		

Biological Opinion	Programs Authorized in Opinion	Signature Date	Citation
Mid-Columbia Coho Salmon Restoration Program: Operation and Construction	Mid-Columbia Coho Restoration Program	February 28, 2017	NMFS (2017c)
Four Lower Snake River Steelhead Hatchery Programs	Wallowa summer steelhead	July 11, 2017	NMFS (2017d)
	Little Sheep Creek/Imnanha summer steelhead		
	Lyons Ferry summer steelhead		
	Tucannon River summer steelhead		
Leavenworth National Fish Hatchery Spring Chinook Salmon Program (Reinitiation 2016)	Leavenworth National Fish Hatchery Spring Chinook	September 29, 2017	NMFS (2017e)
Little White Salmon National Fish Hatchery Upriver Bright Fall Chinook Salmon Program	Little White Salmon National Fish Hatchery URB fall Chinook (Corps)	October 5, 2017	NMFS (2017f)
Two Steelhead Hatchery Programs in the Methow River	Wells Complex summer steelhead	October 10, 2017	NMFS (2017g)
	Winthrop National Fish Hatchery summer steelhead		
Five Snake River Basin Spring/Summer Chinook Salmon Hatchery Programs	Rapid River spring Chinook	November 27, 2017	NMFS (2017h)
	Hells Canyon spring Chinook		
	South Fork Salmon River (SFSR) summer Chinook		
	Johnson Creek Artificial Propagation and Enhancement Project summer Chinook		
	South Fork Chinook Eggbox Project summer Chinook		

Biological Opinion	Programs Authorized in Opinion	Signature Date	Citation
Five Clearwater River Basin Spring/Summer Chinook Salmon and Coho Salmon Hatchery Programs	Kooskia spring Chinook	December 12, 2017	NMFS (2017i)
	Clearwater Fish Hatchery spring/summer Chinook		
	Nez Perce Tribal Hatchery spring/summer Chinook		
	Dworshak spring Chinook		
	Clearwater River coho (at Dworshak and Kooskia)		
Nine Snake River Steelhead Hatchery Programs and one Kelt Reconditioning Program in Idaho	Steelhead Streamside Incubator (SSI) Project	December 12, 2017	NMFS (2017j)
	Dworshak National Fish Hatchery B-Run Steelhead		
	East Fork Salmon Natural A-run Steelhead		
	Hells Canyon Snake River A-run Summer Steelhead		
	Little Salmon River A-run Summer Steelhead		
	Pahsimeroi A-run Summer Steelhead		
	South Fork Clearwater (Clearwater Hatchery) B-Run Steelhead		
	Upper Salmon River A-Run Steelhead		
	Salmon River B-Run		
	Snake River Kelt Reconditioning		
Four Summer/Fall Chinook Salmon and Two Fall Chinook Salmon Hatchery Programs in the	Chelan Falls summer/fall Chinook	December 26, 2017	NMFS and USACE (2017)
	Wenatchee summer/fall Chinook		
	Methow summer/fall Chinook		
	Wells summer/fall Chinook		

Biological Opinion	**Programs Authorized in Opinion**	**Signature Date**	**Citation**
Upper Columbia River Basin	Priest Rapids fall Chinook		
	Ringold Springs fall Chinook		
Four Salmon River Basin Spring/Summer Chinook Salmon Hatchery Programs in the Upper Salmon River Basin	Yankee Fork spring Chinook	December 26, 2017	NMFS (2017k)
	Panther Creek summer Chinook		
	Panther Creek summer Chinook egg box		
	Upper Salmon River spring Chinook		
	Pahsimeroi summer Chinook		
Hood River Spring Chinook Salmon and Winter Steelhead Hatchery Programs	Hood River spring Chinook	February 2018	NMFS (2017l)
	Hood River winter steelhead		
Five Middle Columbia River Summer Steelhead and Spring Chinook Hatchery Programs	Touchet endemic summer steelhead	February 2018	NMFS (2017m)
	Umatilla summer steelhead		
	Round Butte spring Chinook		
	Touchet River spring Chinook		
	Walla Walla spring Chinook		
Five Elwha River Hatchery Programs	Elwha Channel Hatchery summer/fall Chinook	December 2014	NMFS 2014d
	Lower Elwha Fish Hatchery steelhead		
	Lower Elwha Fish Hatchery coho		
	Lower Elwha Fish Hatchery chum		
	Lower Elwha Fish Hatchery odd and even year pink salmon		
Three Dungeness River Hatchery Programs	Dungeness River Hatchery spring Chinook	May 31, 2016	NMFS 2016f
	Dungeness River Hatchery coho		

Biological Opinion	Programs Authorized in Opinion	Signature Date	Citation
	Dungeness River Hatchery pink		
Four Snake River fall Chinook Hatchery Programs	Lyons Ferry Hatchery	August 2018	NMFS 2018c
	Fall Chinook Acclimation Project		
	Nez Perce Tribal Hatchery		
	Idaho Power Company		
Ten Hood Canal Hatchery Programs	Hoodsport Fall Chinook	September 30, 2016	NMFS 2016g
	Hoodsport fall chum		
	Hoodsport pink		
	Enetai Hatchery fall chum		
	Quilcene National Fish Hatchery coho		
	Quilcene Bay net pens coho		
	Port Gamble Hatchery fall chum		
	Hamma Hamma Chinook		
	Hood Canal steelhead supplementation		
	Port Gamble Bay net pens coho		
Three Early Winter Steelhead Programs in Dungeness, Nooksack, and Stillaguamish River Basins	Dungeness early winter steelhead	April 13, 2016	NMFS 2016h;
	Kendall Creek winter steelhead		
	Whitehorse Ponds (Stillaguamish) early winter steelhead		
Ten Hatchery Programs in the Green/Duwamish Basin	Soos Creek Hatchery fall Chinook	April 15, 2019	NMFS 2019a
	Keta Creek coho (w/ Elliot Bay net pens)		
	Soos Creek Hatchery coho		
	Keta Creek Hatchery coho		
	Soos Creek Hatchery coho		

Biological Opinion	Programs Authorized in Opinion	Signature Date	Citation
	Keta Creek Hatchery chum		
	Marine Technology Center coho		
	Fish Restoration Facility (FRF) coho		
	FRF fall Chinook		
	FRF steelhead		
	Green River native late winter steelhead		
	Soos Creek Hatchery summer steelhead		
Four Hatchery Programs in the Stillaguamish River Basin	Stillaguamish summer Chinook	June 20, 2019	NMFS 2019b
	Stillaguamish fall Chinook		
	Stillaguamish coho		
	Stillaguamish fall chum		
Six Hatchery Programs in the Snohomish River Basin	Bernie Kai-Kai Gobin Salmon Hatchery “Tulalip Hatchery” subyearling summer Chinook	September 27, 2017	NMFS 2017n
	Wallace River Hatchery summer Chinook		
	Tulalip Bay Hatchery coho		
	Wallace River Hatchery coho		
	Everett Bay net pen coho		
	Tulalip Bay Hatchery chum		
Hatchery Programs for Lake Ozette Sockeye	Lake Ozette sockeye	June 9, 2015	NMFS 2015b
Six Hatchery Programs for Spring Chinook, Summer Steelhead, and Rainbow Trout in the Upper Willamette River Basin	North Santiam spring Chinook	May17, 2019	NMFS 2019c
	South Santiam spring Chinook		
	McKenzie spring Chinook		
	Middle Fork Willamette spring Chinook		

Biological Opinion	Programs Authorized in Opinion	Signature Date	Citation
	Upper Willamette summer steelhead		
	Upper Willamette rainbow trout		
Hatchery Programs for Hatchery Programs on the Oregon Coast	Rogue River spring Chinook	October 19, 2017	NMFS 2017o
	Rogue River summer steelhead		
	Rogue/Applegate River winter steelhead		
	Indian Creek STEP fall Chinook		
	Elk River fall Chinook		
	Chetco River fall Chinook		
	Chetco River winter steelhead		
	Coquille River winter steelhead		
	Coquille River fall Chinook		
	Coos River fall Chinook		
	Coos River winter steelhead		
	Tenmile Lakes winter steelhead		
	Tenmile Lakes rainbow trout		
	North Umpqua River spring Chinook		
	North Umpqua River summer steelhead		
	Calapooya Creek fall Chinook		
	Lower Umpqua River fall Chinook		
	Umpqua River coho		
	South Umpqua River winter steelhead		
	Munsel Creek coho (STEP)		
	Siuslaw River winter steelhead		
	Alsea Hatchery/Lakes rainbow trout		

Biological Opinion	Programs Authorized in Opinion	Signature Date	Citation
	Alsea River winter steelhead		
	Yaquina Bay fall Chinook		
	Siletz River winter steelhead		
	Siletz River summer steelhead		
	Salmon River fall Chinook		
	Nestucca River summer Steelhead		
	Nestucca River spring Chinook		
	Little Nestucca River spring Chinook		
	Nestucca River STEP fall Chinook		
	Nestucca River winter steelhead		
	Wilson River winter steelhead		
	Trask River coho		
	Trask River fall Chinook		
	Trask River spring Chinook		
	Wilson River winter steelhead		
	Trask River Spring Chinook (Whiskey Creek STEP)		
	North Fork Nehalem coho		
	Nehalem River winter steelhead		
Rogue River Coho Hatchery Program	Rogue River coho	January 1999	NMFS 1999
Two Rowdy Creek Hatchery Programs	Rowdy Creek steelhead	June 11, 2019	NMFS 2019d
	Rowdy Creek Chinook		
Two Trinity River Hatchery Programs	Trinity River steelhead	August 20, 2018	NMFS 2018a
	Trinity River Chinook		

Biological Opinion	Programs Authorized in Opinion	Signature Date	Citation
One Mad River Hatchery Program	Mad River steelhead	December 22, 2016	NMFS 2016i
One Iron Gate Hatchery Program	Iron Gate coho	October 29, 2014	NMFS 2014e
Three Hatchery Programs at Coleman National Fish Hatchery	Central Valley fall-run Chinook salmon	February 6, 2014	NMFS 2014f
	Central Valley late-fall Chinook salmon		
	California Central Valley steelhead		
Two Hatchery Programs at Livingston Stone National Fish Hatchery	Sacramento River Winter Chinook (Integrated-Recovery Supplementation)	September 27, 2017	NMFS 2017p
	Sacramento River Winter Chinook (Captive Broodstock)		
One San Joaquin Hatchery Program	Central Valley spring-run Chinook	August 22, 2018	NMFS 2018b

[1]Proposed future program.

Appendix B References

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NMFS. 2008b. Endangered Species Act Section 7(a)(2) Consultation Biological Opinion & Magnuson-Stevens Fishery Conservation & Management Act Essential Fish Habitat Consultation. Consultation on the "Willamette River Basin Flood Control Project". July 11, 2008. NMFS Consultation No.: NWR-2000-02117. 1205p.

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NMFS. 2014d. Endangered Species Act Section 7 Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Reinitiated Consultation. Elwha Channel Hatchery Summer/Fall Chinook Salmon Fingerling and Yearling, Lower Elwha Fish Hatchery Steelhead, Lower Elwha Fish Hatchery Coho Salmon, Lower Elwha Fish Hatchery Fall Chum Salmon, and Elwha River Odd and Even Year Pink Salmon Programs. December 15, 2014. NMFS Consultation No.: WCR-2014-1841.

NMFS. 2014e. Issuance of an Endangered Species Act (ESA) Section 10(a)(1)(A) Permit for Enhancement and Scientific Purposes to the California Department of Fish and Wildlife (CDFW) for Implementation of the Coho Salmon Program at the Iron Gate Hatchery (IGH) under a Hatchery and Genetic Management Plan (HGMP) October 29, 2014; SWR-2013-9615

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APPENDIX C

Table C.1. List of Chinook salmon stocks in Fishery Regulation Assessment Model (FRAM).

1. UnMarked Nooksack/Samish Fall
2. Marked Nooksack/Samish Fall
3. UnMarked North Fork Nooksack Spr
4. Marked North Fork Nooksack Spr
5. UnMarked South Fork Nooksack Spr
6. Marked South Fork Nooksack Spr
7. UnMarked Skagit Summer/Fall Fing
8. Marked Skagit Summer/Fall Fing
9. UnMarked Skagit Summer/Fall Year
10. Marked Skagit Summer/Fall Year
11. UnMarked Skagit Spring Year
12. Marked Skagit Spring Year
13. UnMarked Snohomish Fall Fing
14. Marked Snohomish Fall Fing
15. UnMarked Snohomish Fall Year
16. Marked Snohomish Fall Year
17. UnMarked Stillaguamish Fall Fing
18. Marked Stillaguamish Fall Fing
19. UnMarked Tulalip Fall Fing
20. Marked Tulalip Fall Fing
21. UnMarked Mid Puget Sound Fall Fing
22. Marked Mid Puget Sound Fall Fing
23. UnMarked UW Accelerated
24. Marked UW Accelerated
25. UnMarked South Puget Sound Fall Fing
26. Marked South Puget Sound Fall Fing
27. UnMarked South Puget Sound Fall Year
28. Marked South Puget Sound Fall Year
29. UnMarked White River Spring Fing
30. Marked White River Spring Fing

31. UnMarked Hood Canal Fall Fing
32. Marked Hood Canal Fall Fing
33. UnMarked Hood Canal Fall Year
34. Marked Hood Canal Fall Year
35. UnMarked Juan de Fuca Tribs. Fall
36. Marked Juan de Fuca Tribs. Fall
37. UnMarked Columbia River Oregon Hatchery Tule
38. Marked Columbia River Oregon Hatchery Tule
39. UnMarked Columbia River Washington Hatchery Tule
40. Marked Columbia River Washington Hatchery Tule
41. UnMarked Lower Columbia River Wild
42. Marked Lower Columbia River Wild
43. UnMarked Columbia River Bonneville Pool Hatchery
44. Marked Columbia River Bonneville Pool Hatchery
45. UnMarked Columbia River Upriver Summer
46. Marked Columbia River Upriver Summer
47. UnMarked Columbia River Upriver Bright
48. Marked Columbia River Upriver Bright
49. UnMarked Cowlitz River Spring
50. Marked Cowlitz River Spring
51. UnMarked Willamette River Spring
52. Marked Willamette River Spring
53. UnMarked Snake River Fall
54. Marked Snake River Fall
55. UnMarked Oregon North Coast Fall
56. Marked Oregon North Coast Fall
57. UnMarked West Coast Vancouver Island Total Fall
58. Marked West Coast Vancouver Island Total Fall
59. UnMarked Fraser River Late
60. Marked Fraser River Late
61. UnMarked Fraser River Early
62. Marked Fraser River Early

63. UnMarked Lower Georgia Strait
64. Marked Lower Georgia Strait
65. UnMarked White River Spring Year
66. Marked White River Spring Year
67. UnMarked Lower Columbia Naturals
68. Marked Lower Columbia Naturals
69. UnMarked Central Valley Fall
70. Marked Central Valley Fall
71. UnMarked WA North Coast Fall
72. Marked WA North Coast Fall
73. UnMarked Willapa Bay
74. Marked Willapa Bay
75. UnMarked Hoko River
76. Marked Hoko River
77. UnMarked Mid Oregon Coast Fall
78. Marked Mid Oregon Coast Fall

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