UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

Refer to NMFS Consultation No.:
WCRO-2014-00005

September 30, 2021

Jacalen Printz
Corps of Engineers, Seattle District
Regulatory Branch CENWS-OD-RG

Seattle, Washington 98124-3755

Re: Endangered Species Act Section 7 and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for BP Cherry Point Refinery North Wing Pier Reauthorization, Whatcom County, Washington. (Terrell Creek Frontal Birch Bay, 6th Field HUC 171100020203).

Dear Ms. Printz:

Thank you for your letter of June 16, 2017, requesting initiation of informal consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for reauthorization of the North Wing of BP Cherry Point Refinery pier. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

In this biological and conference opinion, we conclude that the proposed action is not likely to jeopardize the continued existence of multiple species as shown on the cover page of the opinion. As required by section 7 of the ESA, we are providing an incidental take statement with the opinion. The incidental take statement describes reasonable and prudent measures we consider necessary or appropriate to minimize incidental take associated with this action. The take statement sets forth nondiscretionary terms and conditions, including reporting requirements that the USACE and any person who performs the action must comply with to carry out the reasonable and prudent measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA take prohibition. We have also included a conference opinion on proposed critical habitat in the action area.

NMFS also reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)), and concluded that the action would adversely affect the EFH of Pacific Coast groundfish, coastal pelagic species, and Pacific Coast salmon. The action area also includes estuarine habitat area of particular concern (HAPC). Therefore, we have provided one conservation recommendation that can be taken by the FERC to avoid, minimize, or otherwise offset potential adverse effects on EFH. Because the NMFS concurs with the FERC's determination that the action would not adversely affect EFH for coastal pelagic species and Pacific Coast groundfish, consultation under the MSA is not required for those EFHs.

Section 305(b) (4) (B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving this recommendation. If the response is inconsistent with the EFH conservation recommendations, the FERC must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the action and recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we request that in your statutory reply to the EFH portion of this consultation you clearly identify that you have accepted one conservation recommendation.

Please contact Janet Curran in the North Puget Sound Branch of the Oregon Washington Coastal Office at janet.curran@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Kim W. Kratz, Ph.D
Assistant Regional Administrator
Oregon Washington Coastal Office

cc: David Martin, USACE
Juliana Houghton, USACE
Matthew Bennett, USACE

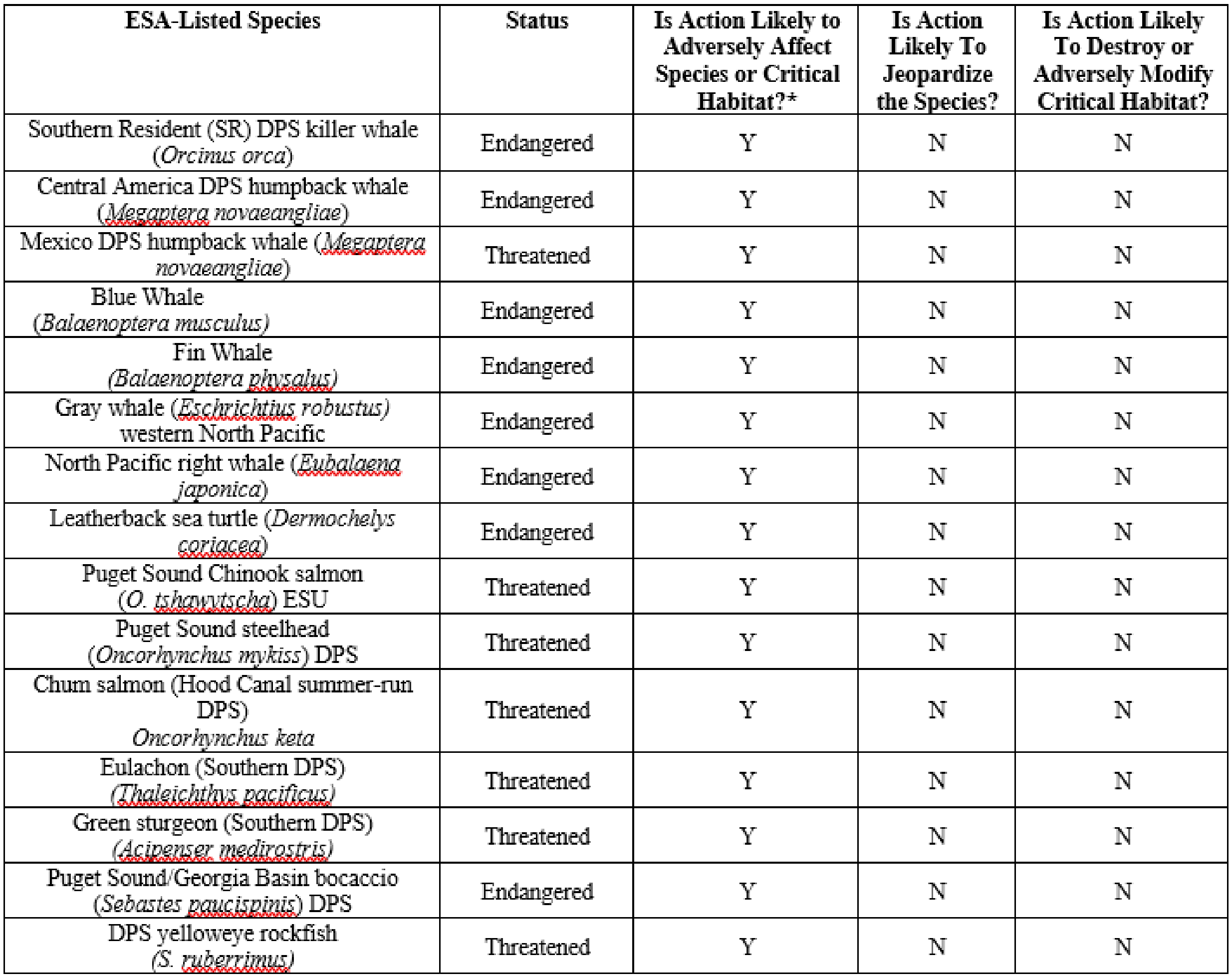
Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion, Conference Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the

BP Cherry Point Refinery Pier Reauthorization, Whatcom County, Washington. (Terrell Creek Frontal Birch Bay, 6th Field HUC 171100020203)

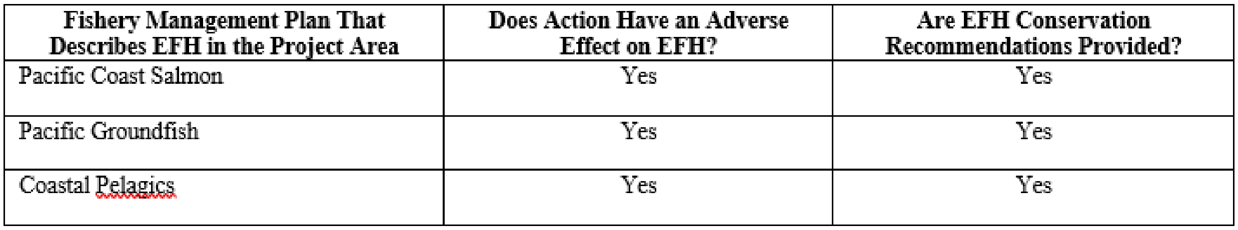
NMFS Consultation Number: WCRO-2014-00005

Action Agency: U.S. Army Corps of Engineers, Seattle District

Affected Species and NMFS' Determinations:



ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species or Critical Habitat?*	Is Action Likely To Jeopardize the Species?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Southern Resident (SR) DPS killer whale (*Orcinus orca*)	Endangered	Y	N	N
Central America DPS humpback whale (*Megaptera novaeangliae*)	Endangered	Y	N	N
Mexico DPS humpback whale (*Megaptera novaeangliae*)	Threatened	Y	N	N
Blue Whale (*Balaenoptera musculus*)	Endangered	Y	N	N
Fin Whale (*Balaenoptera physalus*)	Endangered	Y	N	N
Gray whale (*Eschrichtius robustus*) western North Pacific	Endangered	Y	N	N
North Pacific right whale (*Eubalaena japonica*)	Endangered	Y	N	N
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	Y	N	N
Puget Sound Chinook salmon (*O. tshawytscha*) ESU	Threatened	Y	N	N
Puget Sound steelhead (*Oncorhynchus mykiss*) DPS	Threatened	Y	N	N
Chum salmon (Hood Canal summer-run DPS) *Oncorhynchus keta*	Threatened	Y	N	N
Eulachon (Southern DPS) (*Thaleichthys pacificus*)	Threatened	Y	N	N
Green sturgeon (Southern DPS) (*Acipenser medirostris*)	Threatened	Y	N	N
Puget Sound/Georgia Basin bocaccio (*Sebastes paucispinis*) DPS	Endangered	Y	N	N
DPS yelloweye rockfish (*S. ruberrimus*)	Threatened	Y	N	N



Fishery Management Plan That Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes
Pacific Groundfish	Yes	Yes
Coastal Pelagics	Yes	Yes

West Coast Region

Issued By:

Kim W. Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office

Date: September 30, 2021

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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 opinion (opinion), conference 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 also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600.

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 Oregon Washington Coastal Office.

1.2 Consultation History

No new construction is proposed with this project. The USACE's proposed action is reauthorization of the existing North Wing of the Marine Terminal (dock/pier) at BP's refinery at Cherry Point, Washington (See Section 1.3 Proposed Federal Action for a more complete description of the action). Figure 1 shows the existing configuration of the facility that will remain unchanged under this action.

Figure 1. BP Cherry Point Pier. The older South Wing (lower right) was constructed in 1971 and can transfer both refined petroleum products and crude oil. The newer North Wing (upper left) was constructed in 2001 and is configured to only handle refined oil.

The BP Marine Terminal consists of a dock with two wings (South and North) and mooring dolphins that are connected to the shore and the BP Cherry Point Refinery Tank Farm with a trestle and pipelines. The general configuration of the terminal is shown in Figure 1. The figure shows a “Y” shaped facility that is located approximately 655 meters (2,150 feet) offshore where water depths are approximately 15 to 21 meters (49 to 69 feet) mean sea level (msl). The existing trestle connecting both wings of the dock is approximately 548.64 meters (1,800 feet) long and includes a roadway and piping. Each wing consists of a single vessel berth, a loading platform, and a connecting trestle. The loading platform for the North Wing is 58.67 meters (192.48 feet) long and 27.43 meters (90 feet) wide. It is positioned at the center of the 296-meter (971 foot) long berth, which has mooring positions that allow for both tankers and barges to call at the BP Marine Terminal for unloading and loading operations. Water depth at the loading platform is 18.28 meters (60 feet) msl. The connecting trestle is 290 meters (951 feet) long and includes a platform for vehicle maneuvering, oil spill response equipment, and two hoists for support vessels (workboats/oil spill response vessels).

All mooring dolphins and piles supporting the loading platform and connecting trestle that were constructed as part of the North Wing are steel caissons. With the North Wing in place, the tasks of crude oil unloading and refined product handling have largely been separated. The pipelines connecting the dock facility to the BP Cherry Point Refinery tank farm are configured so that crude oil can only be loaded or unloaded in commercially sustainable quantities at the South Wing. The North Wing is used exclusively to load or unload refined petroleum products, and BP has stipulated that the North Wing will not be used for the transfer of crude oil cargoes. While the South Wing retains the capability to load or unload refined petroleum products, such operations are rare, and the South Wing is used almost exclusively for unloading or loading crude oil.

The pipelines connecting the dock facility to the BP Cherry Point Refinery tank farm are configured so that crude oil can only be unloaded in commercially sustainable quantities at the South Wing. The North Wing is used exclusively for loading and unloading refined petroleum products. While the South Wing retains the capability to load and unload refined petroleum products, such operations on this wing now rarely occur.

Between 2001 when the North Wing became operational and 2010, throughput at the BP facility has averaged 102,773,472 barrels (bbls) per year (note-bbl is the abbreviation for a single barrel of oil which is equivalent to 42 US gallons). BP's throughput of 102,773,472 bbls per year consisted of the sum of an average of 70,457,034 bbls of crude oil and 32,316,438 bbls of refined product. With operations at both wings underway, all crude deliveries occur at the South Wing and most refined product loading occurs at the North Wing. The subject of this consultation is reauthorization of the North Wing.

1.2.1 Project Permit History

The BP Cherry Point facility, previously owned and operated by Atlantic Richfield Company (ARCO), was built in 1971 as a petroleum refinery and marine terminal. Although the USACE Section 10 authorization (permit) (NWS-1992-00435) issued by the U.S. Army Corps of Engineers (USACE) in 1969 authorized ARCO to construct a two-wing (North Wing and South Wing) marine terminal, only the South Wing was constructed and began operating in 1971. The South Wing consists of a single ship berth connected to the shore by a trestle that includes a causeway and pipelines for transfer of crude oil and refined petroleum products between the dock and the refinery. As previously stated, the South Wing was used for both unloading of crude oil and loading of refined petroleum products. In addition to marine transportation, ARCO used the Olympic pipeline to transport products from the refinery.

In 1977, ARCO requested reissuance of the previous 1969 USACE Section 10 permit to allow for construction of the North Wing, as originally permitted. ARCO withdrew its 1977 request to construct the North Wing and continued operations at the facility with only the South Wing. In 1992, ARCO submitted a new application for construction of the North Wing to the USACE. On March 1, 1996, ARCO obtained the USACE Section 10 permit to construct the North Wing. In April 2000, BP Products North America, Inc. entity, purchased the ARCO refinery and pier. On June 19, 2000, a 1-year time extension of the USACE permit was granted to ARCO to complete construction of the North Wing. Construction of the North Wing was completed in 2001, and it went into service in September 2001. Both wings are currently in operation. The North Wing is dedicated to loading and occasional unloading of refined petroleum products, and the South Wing is used primarily for unloading crude oil and the occasional loading of refined petroleum products when vessel loading requirements are better met by use of the equipment on the South Wing.

The purpose for construction of the North Wing was to increase the product vessel handling capability of the facility, reduce tanker standby time in Puget Sound anchorage zones, improve the operational efficiency of the existing BP Cherry Point pier while loading and unloading petroleum transport vessels, and reduce demurrage[1] costs (Cardno, June 2017 Final BP Cherry Point Biological Evaluation, 2017). The addition of the second berth (North Wing) allows the South Wing to primarily be dedicated to unloading crude oil and the North Wing to be dedicated to loading and unloading refined products. BP asserts that this separation of tasks improves the efficiency and safety of operations at the pier.

1.2.2 Prior ESA Consultation History on the North Wing Construction in 2001

As part of the original USACE Section 10 permit issuance process for the North Wing, ARCO[1] submitted a biological evaluation (BE) on March 31, 2000, to assist the USACE in fulfilling its obligation to consult with National Marine Fisheries Service (NMFS) under section 7(a)(2) of the ESA. The 2000 BE reached the following conclusions for the species noted:

- Puget Sound Chinook salmon-Threatened, NMFS, may affect but is not likely to adversely affect.
- Puget Sound/Strait of Georgia Coho (*O. kisutch*) – Candidate, NMFS, may affect but is not likely to adversely affect.
- Humpback whale– Endangered, NMFS, no effect.
- Leatherback sea turtle– Endangered, NMFS, no effect.

Based on the analysis in the 2000 BE, the USACE requested informal consultation with NMFS on May 24, 2000, and sought concurrence with their “not likely to adversely affect” findings for PS Chinook salmon. On June 19, 2000, NMFS concurred with the NLAA finding for Puget Sound Chinook salmon for the USACE’s authorization for construction of the North Pier and the Cherry Point facility.

1.2.3 USACE Request for New ESA Consultation

Since the project was constructed and informal consultation was concluded in 2000, additional species were listed and critical habitats were either designated or proposed under the ESA in the action area (action area is defined in Section 2.1.1). The new species and/or critical habitats that were not considered in the former consultation include SR killer whale, green sturgeon, PS steelhead, eulachon, and Puget Sound/Georgia Basin bocaccio and yelloweye rockfish. The USACE also did not request consultation for humpback, sperm, blue, fin whales, sei whales, and leatherback sea turtles in our previous consultation.

In June 2014, following litigation on the USACE’s previous authorization of North Wing, the USACE initiated consultation with NMFS for a new action to re-authorize the North Wing. This new action of re-authorizing the existing North Wing is the subject of this opinion and it is the preferred alternative in the USACE’s draft Environmental Impact Statement (DEIS) (Cardno & USACE, 2014) for the proposed re-authorization of the North Wing.

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[1] *Demurrage* is a fee paid by the owner of the marine terminal to the vessel owner when a vessel provides the marine terminal a Notice of Readiness and the marine terminal is not ready to accept the vessel.

The proposed action does not involve any new construction. The USACE requested informal consultation with NMFS in May 2014 for the USACE's Preferred Alternative from its Draft Environmental Impact Statement (DIES) to reauthorize the newer wing (the North Wing) at the BP Cherry Point Refinery (Cardno & USACE, 2014). The USACE submitted a Biological Evaluation to support their determinations of effects to species (Appendix G in DEIS) (Cardno and USACE 2014).

As a result of the aforementioned litigation, The U.S. Court of Appeals for the Ninth Circuit ordered (402 F. 3d 846 (9th Cir. 2005) the USACE to prepare an Environmental Impact Statement (EIS) and reexamine the compliance of the permit under the Magnuson Amendment to the Marine Mammal Protection Act (Magnuson Amendment) (33 USC § 476). The USACE proposes to reauthorize the North Wing. As part of that EIS process, the USACE requested informal consultation with NMFS for the following species and their associated critical habitats if applicable: humpback whale, blue whale, fin whale, Southern Resident killer whale, eulachon, North American green sturgeon, Puget Sound Chinook salmon, Hood Canal summer chum, Puget Sound steelhead, Puget Sound/Strait of Georgia bocaccio and yelloweye rockfish, and leatherback turtle. The USACE determined that the proposed action is "not likely to adversely affect" (NLAA) these species and critical habitats as described in their Biological Evaluation (BE) (Cardno 2017). The USACE also determined that the proposed action would not adversely affect Essential Fish Habitat (EFH) for Pacific Coast groundfish (PFMC, Amendment 18 (bycatch mitigation program), Amendment 19 (essential fish habitat) to the Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington groundfish fishery. Pacific Fishery Management Council, Portland, Oregon. N, 2005), coastal pelagic species (PFMC 1998) and/or Pacific Coast salmon (PFMC 2014).

The NMFS does not concur with these effects determinations as documented in this opinion. We initiated formal consultation with the USACE on October 27, 2017. The USACE made "no effect" determinations for loggerhead, olive ridley, and green sea turtles, as well as sei and sperm whales. The NMFS does not agree with the "no effect" determination for sperm whales and has included sperm whales in this opinion. We have also included in our analysis western North Pacific (WNP) gray whales and North Pacific right whales. We have included sei whales under Section 2.12 Species Not Likely to be Adversely Affected.

1.2.4 Meetings and other Coordination

On July 11, 2014, we received an email from the Lummi Nation informing NMFS that the Lummi Nation entered into a mitigation agreement with BP related to the North Wing in the 1990s. Because that agreement is in place and no new construction will occur, the Lummi Nation did not provide comments (related to the DEIS) about vessel traffic interference nor the impacts to fishing grounds from the newer wing of the pier. However, the Lummi Nation expressed concerns about ballast water discharge if BP exports refined (or crude) products from the facility – in particular, the increased risk of introducing invasive species. On May 25, 2016, the Lummi Nation confirmed to NMFS that they do not oppose the USACE's reauthorization of the North Wing (pers comm Jeremy Freimund).

On December 17, 2014, NMFS attended a meeting with the USACE, U.S. Fish and Wildlife Services (USFWS), and the applicant's consultants. We discussed the proposed action, the USACE's DEIS; Magnuson Amendment compliance and analysis; the ESA consultation, the vessel traffic studies, and additional information needed to complete the consultation record.

On March 9, 2016, NMFS sent a letter to the USACE explaining why we did not concur with their effects determination in the 2014 BE and we requested additional information.

On April 25, 2016, NMFS met again with the USACE to discuss Magnuson Amendment compliance and the timing for finalizing the EIS and issuing the USACE's authorization to BP. The USACE explained that the only condition on the authorization for the proposed action is that the newer North Wing must remain as it is, without future modification to handle crude oil. The North Wing is only "plumbed" for handling refined petroleum products, while the South Wing can handle both refined and crude oil, but it is primarily used for crude oil since the new North Wing was constructed. The USACE explained that it could add additional conditions to the final permit, but will not make that decision until after the EIS is finalized and they issue a Record of Decision (ROD) and authorization (USACE permit) to BP. As such, NMFS consulted on the proposed action as it is described in the DEIS- reauthorization of the North Wing in its current configuration to handle refined petroleum products with the condition that it cannot be reconfigured to handle crude oil.

On May 5, 2016, we met with representatives of the Tulalip Tribes, the Swinomish Indian Tribal Community, and the Suquamish tribe and their legal counsel. The subject of the meeting was the proposed Gateway Pacific Terminal (GPT) at Cherry Point (permits for the GPT project were since denied by the USACE so this is no longer an active proposal). During this meeting, we also discussed the BP Cherry Point proposal in general and the Tulalip Tribes gave us a copy of a Congressional Staff Briefing entitled, "In Defense of Western Washington Tribal Treaty Rights, Transportation of Unrefined Fossil Fuels, December 4, 2015". This document mentions the BP Cherry Point facility in the context of potential crude oil exports, which are not contemplated in this opinion as BP does not export crude. BP receives crude oil and sells refined petroleum products. In general, the report is focused on a number of pipeline, rail, and marine export facilities, both existing and proposed at the time that could interfere with Tribal Treaty fishing and affect the health of the Salish Sea. The document is particularly focused on the GPT proposal, which has since been denied by the USACE and is no longer proposed at Cherry Point. The GPT proposal was for a new dry goods export facility and completely separate from BP's facility.

On May 27, 2016, NMFS met with BP and their consultants to discuss the NMFS's non-concurrence letter of March 9, 2016. The discussion centered on additional information needed to complete the consultation. NMFS requested more information about small oil spills (cups to gallons or more) that regularly occur at the BP facility and how these small spills may affect fish in the local area. We also requested additional information on consequences of a large oil spill to Southern Resident killer whales, and potential cumulative effects. BP agreed to update the BE and resubmit a revised copy through the USACE.

On February 1, 2017, we had a conference call with the USACE manager to get an update on their progress revising the BE.

On May 26, 2017, we met at the USACE Seattle District to discuss additional potential conditions that might be added to the final permit authorization to address the NMFS’s concern with Magnuson Amendment compliance. The USACE did not disclose additional information and again asked the NMFS to consult on the proposed action as it is described in the DEIS.

In June, 2017, we received a revised BE from the USACE. The revised BE again concluded NLAA for all species and critical habitat, and EFH. The revised BE addressed some of our concerns, but the NMFS does not concur with the NLAA conclusions. We informed the USACE that we would initiate formal consultation.

On June 12, 2018, we attended a site visit with the USACE. We toured the facility and observed a mock booming operation at the North Pier.

1.2.5 New Information Provided- Updated Vessel Calls at Cherry Point

On November 14, 2019, representatives of BP met with NMFS and USACE representatives to discuss what additional information would help inform NMFS's preparation of this biological opinion. BP agreed to provide that additional information, which has been incorporated into this opinion as revised project descriptions and noted where appropriate in this document. Specifically, BP provided: (1) updated ESA environmental baseline information reflecting the maximum vessel calls of the BP Cherry Point Marine Terminal's South Wing alone, based on BP's current/projected practices and market conditions as assessed in 2019; (2) a forecast of future annual vessel calls at the BP Marine Terminal; and (3) a description of additional spill risk reduction measures that BP began implementing since development of the 2017 Biological Evaluation (BE) provided to NMFS by the USACE (Cardno 2017).

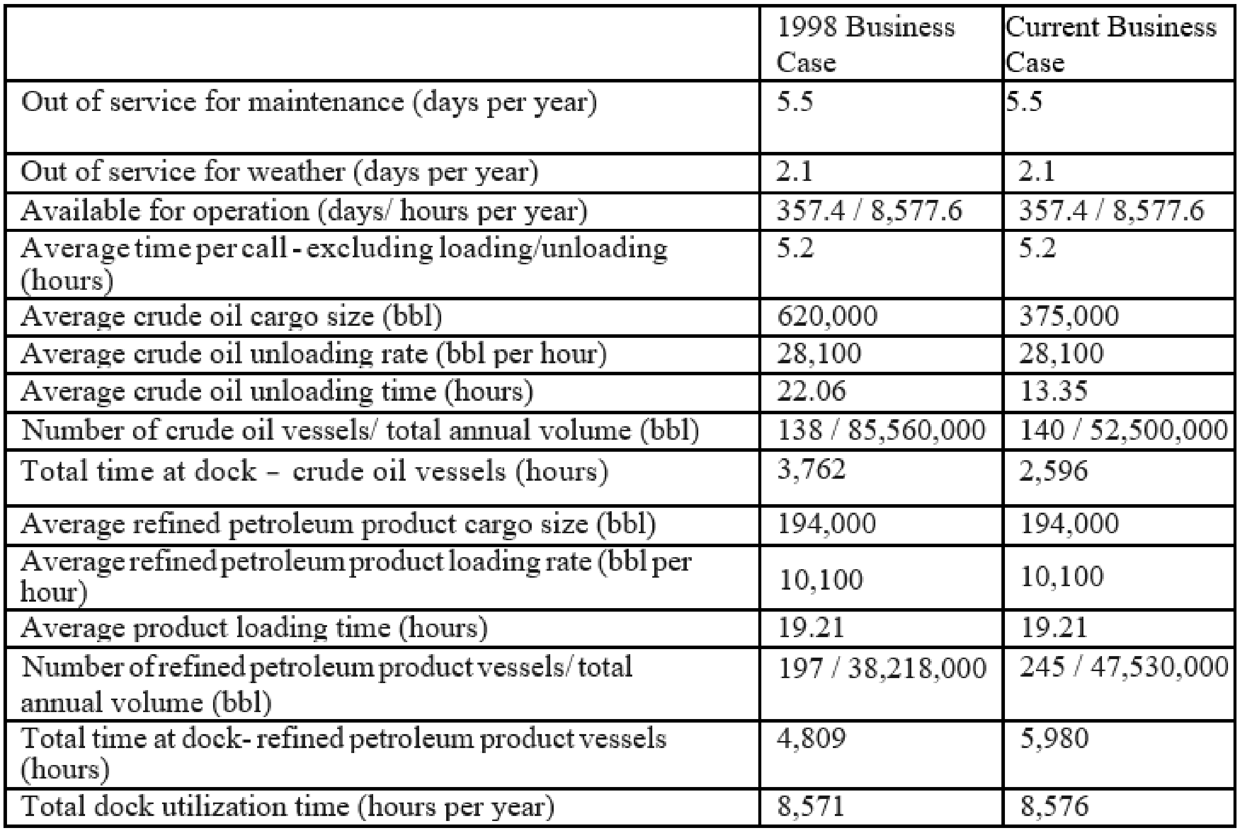
The BE included an estimate of South Wing vessel calls prior to construction of the dock's North Wing. This estimated baseline of 335 vessel calls was based on operational assumptions provided in Table 3.1-3 of the BE (Cardno 2017). These assumptions were developed by BP in 2009 to support the USACE's development of the DEIS. BP revisited these estimates in 2019 and revised their estimated baseline total ship calls at a one-winged pier to 385 ships per year (see Table 1) based on changes in shipping behavior, particularly the load sizes, at the facility in recent years. According to BP, the company has made no physical changes to the South Wing since 2009 that have affected its original vessel calls estimate of 335 ships per year. BP’s revised estimate reflects the maximum vessel calls of the South Wing today, if the North Wing did not operate. This estimate is based on a current business case, utilizing 2018 data to update key assumptions as appropriate, and thus reflects the most recent information available to BP. Therefore, this opinion relies on BP’s calculated estimate of up to 385 ships per year as the baseline ship calls with operations confined to a one-winged pier. The BE also included a vessel traffic growth forecast which assumed use of both wings of the BP Marine Terminal and considered vessel size, crude availability, refinery operations, and market conditions. The "high traffic" forecast developed by BP in 2011of 420 ships per year at the two-winged pier remains accurate according to BP, but BP proposes a voluntary commitment to not exceed 385 vessel calls per year on a rolling five-year average basis among the North and South Wing. This commitment is now incorporated into this opinion as part of the proposed action.

In order to provide updated information on the maximum vessel calls of the South Wing, BP updated the information provided in the BE for market conditions in 2019. BP considered changes in market conditions and refinery operations since 1998, the year upon which the BE's baseline calculations were formulated. In particular, BP has considered each of the factors in Table 3.1-3 of the BE (Cardno 2017), which were the basis for its original South Wing estimate of 335 vessel calls per year. The revised Table 3.1-3 (Table 1), below, reflects changes in two areas based on BP's current practices, economic drivers, and market conditions:

> “(1) Smaller crude parcel sizes. Cherry Point was designed to run entirely on Alaska North Slope (ANS) crude. In 1998, ANS crude shipments averaged 620 kB in size. Over the past 15 years, ANS supplies have decreased, requiring BP to import a variety of different crudes in smaller volumes and blend them together to simulate the properties of ANS crude. The smaller crude shipments today average approximately 375 kB, a decrease in parcel size of approximately 40 percent. This decrease in crude shipment size results in higher overall vessel call numbers.
>
> (2) Proportion of product-to-crude vessel calls. In developing its previous estimates based on the 1998 business case, BP estimated that the proportion of product to crude vessels would be 1.43:1. Today, more crude is delivered to Cherry Point via rail and pipeline, leaving additional dock capacity for product vessel deliveries. Product vessels are much smaller on average than crude ships, resulting in shorter unloading time and higher overall vessel calls. The current business case shows a shift in dock utilization resulting in the proportion of product to crude vessels increasing from 1.43:1 in 1998 to 1.75:1, the approximate past seven-year average (letter from BP to USACE dated December 6, 2019).”

These changes, reflected in Table 1 (Revised Table 3.1-3 from BE), below, result in an updated calculated maximum number of vessel calls for the South Wing of 385 vessel calls (140 crude oil ships and 245 refined product ships).

Table 1. Revised Table 3.1-3 from BE - Calculation of Maximum Single-Wing Dock Use for the BP Cherry Point Dock (copied from Letter from BP to USACE dated December 6, 2019)



	1998 Business Case	Current Business Case
Out of service for maintenance (days per year)	5.5	5.5
Out of service for weather (days per year)	2.1	2.1
Available for operation (days/ hours per year)	357.4 / 8,577.6	357.4 / 8,577.6
Average time per call - excluding loading/unloading (hours)	5.2	5.2
Average crude oil cargo size (bbl)	620,000	375,000
Average crude oil unloading rate (bbl per hour)	28,100	28,100
Average crude oil unloading time (hours)	22.06	13.35
Number of crude oil vessels/ total annual volume (bbl)	138 / 85,560,000	140 / 52,500,000
Total time at dock – crude oil vessels (hours)	3,762	2,596
Average refined petroleum product cargo size (bbl)	194,000	194,000
Average refined petroleum product loading rate (bbl per hour)	10,100	10,100
Average product loading time (hours)	19.21	19.21
Number of refined petroleum product vessels/ total annual volume (bbl)	197 / 38,218,000	245 / 47,530,000
Total time at dock- refined petroleum product vessels (hours)	4,809	5,980
Total dock utilization time (hours per year)	8,571	8,576

Additional Factors Not Included in Ship Number Calculations

In developing the Revised Table 3.1-3 from the BE (Table 1, above) BP considered whether to update other numbers in the Table related to dock maintenance time, average product cargo size, and average product loading rate. BP noted that:

> "Efficiencies in these operational areas would be manageable today and would result in additional increases in the vessel call capacity of the South Wing. For example, Table 3.1-3 identifies maintenance activities as time that the dock is out of service, but today some maintenance can be accomplished while the dock is in service. Similarly, the Table assumes that products will be loaded sequentially, while in fact two products can be loaded onto a vessel simultaneously, thus increasing the average product loading rate. In addition, product vessel cargo sizes have decreased approximately 5% based on a review of historic numbers. Each of these operational changes results or could result in an increase in the number of vessels capable of being received at a single wing dock; however, these increases would be minor compared to the significant increase resulting from the changes in the crude parcel sizes and proportion of product-to-crude vessel calls, discussed in paragraphs (1) and (2), above. Therefore, in order to focus on change that have had an unquestionably significant impact on the maximum vessel call capacity of the South Wing, and to err conservatively by making fewer changes that increase baseline

> vessel traffic numbers, BP has not modified the estimates in Table 3.1-3 to assume fewer out-of-service hours, simultaneous loading or smaller product vessel cargo sizes (Letter from BP to USACE dated December 6, 2019)."

Updated Vessel Call Forecast at BP Marine Terminal

To support the spill risk analysis in the DEIS, the Corps asked BP to estimate future vessel traffic in 2025 and 2030 under low, medium, and high traffic scenarios. The DEIS analyzed environmental impacts under all three scenarios, with the high range forecast being the foundation for development of the BE. BP's high range forecast of future traffic growth projected that the BP Marine Terminal could receive between 350 and 420 vessel calls per year.
At NMFS's request for updated information, BP agreed to update its vessel traffic forecast based on a current evaluation of future vessel sizes, crude availability, refinery operations and likely fluctuations in market conditions. BP evaluated these factors and confirmed that this forecast remains accurate. According to BP:

> "There have been years since the North Wing entered service in which calls at the Marine Terminal have exceeded 400 vessels. Looking forward, however, BP does not expect the average vessel call volume to exceed 385 vessels per year. Historic vessel count data shows variability from month to month as well as from year to year. Over the past fifteen years, annual vessel calls have varied by approximately 65% depending on turnaround activities, the average size of crude and product cargos, increases or decreases in product and crude movements via rail or pipeline, economic drivers, and market conditions. Regulatory changes also drive changes in vessel traffic numbers. For example, legislation approved this year [2019] by the Washington legislature has seriously curtailed the refinery's ability to bring in crude by rail, causing deliveries to shift to the dock and resulting in increased vessel calls (Letter from BP to USACE dated December 6, 2019)."

To provide certainty to the USACE and NMFS to assess the effects of the action, BP has committed to "not to exceed a five-year rolling average of 385 vessel calls annually at the BP Marine Terminal." BP asserts that a "five-year rolling average is appropriate given the historic and predicted trends in variation and is necessary to provide BP with the flexibility necessary to optimize refinery operations. While this commitment may result in years in which BP is required to limit vessel calls to fewer than it otherwise might receive, BP anticipates such circumstances will be rare and that committing not to exceed the capacity of a single wing dock on an average basis will simplify NMFS's analysis. BP proposes that the USACE include this commitment as a binding condition of the North Wing Section 10 permit (Letter from BP to USACE dated December 6, 2019)."

With this additional information, NMFS initiated formal consultation on January 9, 2020.

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). Under the ESA, federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

No new construction is proposed for this action. This action is reauthorization of the existing North Wing. In the USACE DEIS, the Preferred Alternative is reauthorization of the North Wing (USACE permit number 92-1-00435) with a condition that the North Wing cannot be reconfigured to handle crude oil. The North Wing is configured to handle refined oil products and the applicant asserts it will remain as it is. The USACE requested ESA consultation on the Preferred Alternative. In addition, since the development of the DEIS, as previously described, BP has voluntarily committed to limit the total number of ship calls at the facility (both North and South wing combined) to 385 ships per year on a five-year rolling average. We therefore consider this limit on ship calls to be part of the proposed action for this consultation (see Table 2).

The South Wing is expected to continue to be used to offload crude oil. The South Wing permit is separate from the North Wing permit and is not the subject of this consultation, although we do consider the operations and observed and predicted increases in ship calls at the South Wing as part of the consequences of the proposed action. This is because after the addition of the North Wing, observed and predicted ship calls at the South Wing were/are greater than the calculated baseline of 140 crude oil-specific ships. (Table 1 and 2). We also note that the USACE predicted a range of 126 to 168 crude oil vessel calls per year at the South pier with both the North and South Pier in operation. Therefore, some years will likely have fewer crude oil vessel calls than the calculated baseline. The actual maximum observed crude oil vessel calls with two wings in operation was 191 in 2007.

BP has only used the North Wing to load and unload refined petroleum products since the North Wing became operational in 2001. The South Wing is used to receive crude oil. Prior to the North Wing construction, the South Wing handled both crude and refined oil products. BP does not currently export crude oil through the BP Cherry Point dock and has no plans to do so in the foreseeable future (Cardno 2017). The 40-year old ban on crude oil exportation was lifted by Congress on December 18, 2015. Because this ban was lifted, more crude oil tankers may transit through the Salish Sea[2] in the future from other US or Canadian companies. We do not contemplate crude oil export from the BP Cherry Point facility as part of the proposed action. More discussion of crude oil exports is in the Baseline and Cumulative Effects Sections 2.3 and 2.6. In addition, the proposed action does not include oil or gas exploration, so potential effects of this type of activity are not considered in this opinion.

No new construction will occur with this proposed action. If this action were for a new pier, we would consider the potential effects of future construction (temporary disturbance to the environment) and the long-term effects that a new structure and its operations would have on the environment (future consequences to species and habitat). Because no new construction will occur with the action, we consider past construction related effects of the North Wing to be a part

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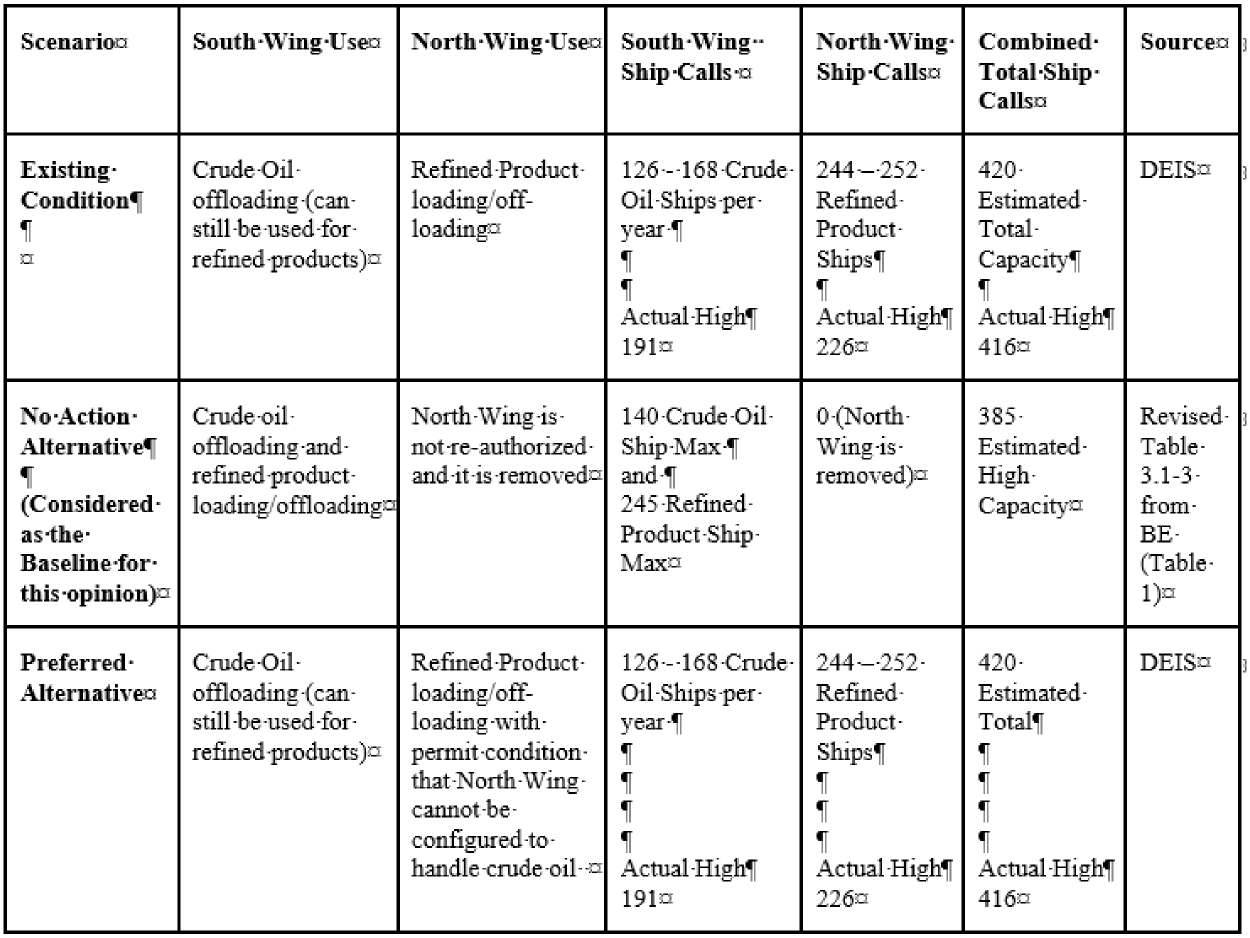
[2] The SALISH SEA extends from the north end of the Strait of Georgia and Desolation Sound to the south end of the Puget Sound and west to the mouth of the Strait of Juan de Fuca, including the inland marine waters of southern British Columbia, Canada and northern Washington, USA. These separately named bodies of water form a single estuarine ecosystem. Formally adopted by British Columbia and Washington State in 2009.

of the baseline conditions. However, because the No Action alternative in the DEIS is to revoke the permit for the North Wing, which would require removing it, we consider the existence of the North Wing to be additive to the environmental baseline[3]. That is, for analyzing effects of the action, we consider the continued existence of the "newer" North Wing to cause "new" or additive effects to the environment (i.e. effects of the proposed action) from its past and currently-permitted existence and operations, compared to the continued existence and operation of a one-winged pier. For example, we consider the operational changes associated with a two winged pier (See Table 2) and the associated differences in ship calls to be an effect of the action.

Table 2. Comparison of Ship Calls for Facility Configuration under Various Scenarios including the Proposed Action (Projected Ranges based on Combined Total Ship Calls)



Scenario	**South Wing Use**	**North Wing Use**	**South Wing Ship Calls**	**North Wing Ship Calls**	**Combined Total Ship Calls**	**Source**
Existing Condition	Crude Oil offloading (can still be used for refined products)	Refined Product loading/off-loading	126 - 168 Crude Oil Ships per year Actual High 191	244 – 252 Refined Product Ships Actual High 226	420 Estimated Total Capacity Actual High 416	DEIS
No Action Alternative **(Considered as the Baseline for this opinion)**	Crude oil offloading and refined product loading/offloading	North Wing is not re-authorized and it is removed	140 Crude Oil Ship Max and 245 Refined Product Ship Max	0 (North Wing is removed)	385 Estimated High Capacity	Revised Table 3.1-3 from BE (Table 1)
Preferred Alternative	Crude Oil offloading (can still be used for refined products)	Refined Product loading/off-loading with permit condition that North Wing cannot be configured to handle crude oil	126 - 168 Crude Oil Ships per year Actual High 191	244 – 252 Refined Product Ships Actual High 226	420 Estimated Total Actual High 416	DEIS

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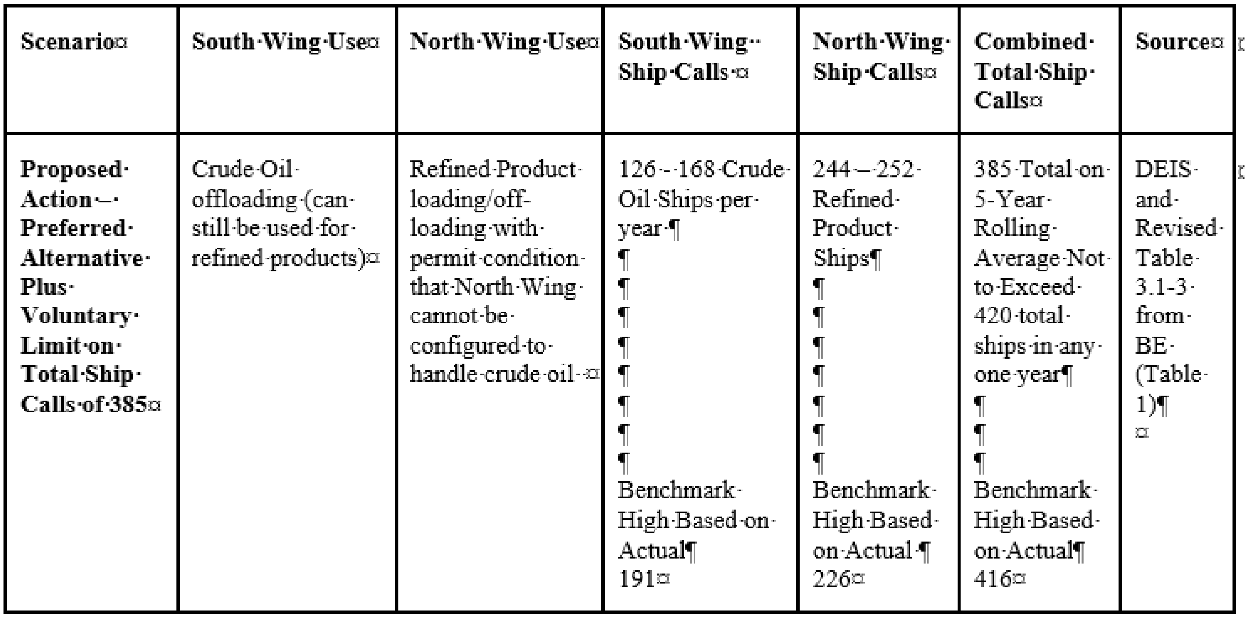
[3] The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 C.F.R. § 402.02).



Scenario	South Wing Use	North Wing Use	South Wing Ship Calls	North Wing Ship Calls	Combined Total Ship Calls	Source
Proposed Action – Preferred Alternative Plus Voluntary Limit on Total Ship Calls of 385	Crude Oil offloading (can still be used for refined products)	Refined Product loading/off-loading with permit condition that North Wing cannot be configured to handle crude oil	126 - 168 Crude Oil Ships per year Benchmark High Based on Actual 191	244 – 252 Refined Product Ships Benchmark High Based on Actual 226	385 Total on 5-Year Rolling Average Not to Exceed 420 total ships in any one year Benchmark High Based on Actual 416	DEIS and Revised Table 3.1-3 from BE (Table 1)

1.3.1 NMFS' Assumptions Regarding Number of Vessel Calls per Year Under the Proposed Action

Although BP will limit the rolling average number of ships to match its estimated baseline of 385 total ships per year at a one-winged facility, the USACE estimates that operations at the facility would likely include 126 to 168 crude oil ship calls per year at the South Wing with both the North and South wing operating (Table 2). Therefore, NMFS assumes that some years, the proposed action will include greater crude oil ship calls over the calculated baseline of 140 and some years will include fewer. In addition, with the North Wing in operation, the estimated capability of the facility as a whole increases from 385 to 420 (+35 ships) (Table 2). After the addition of the North Wing, the maximum number of crude oil ship calls observed at the facility was 191 crude oil ships in 2007 (+51 crude oil ships over the calculated baseline).

NMFS recognizes that the maximum ship numbers of 385 for one wing and 420 for both wings are based on estimates of the operational capabilities and that BP typically has not operated at near capacity (e.g. the total maximum observed actual ship calls at the two wing facility was 416 in 2007). The actual average number of vessel calls per year for the two-winged pier between 2000 and 2014 was 317, with varying proportions of crude oil ships to refined product ships. The number of crude oil ships ranged from a low of 108 in 2000 to a high of 191 in 2007. The average crude oil vessel calls for this period was 148. The USACE identified a future projected range of crude oil ship calls of 126 to 168 per year at the two-winged facility (Table 2). Within the proposed rolling average number of ships, the NMFS assumes that the number of crude oil ships may make up a larger or smaller proportion of the total vessel calls in any one year. Therefore, NMFS assumes that with the proposed action, the total number of ship calls and the proportion of crude oil to refined product ships will vary over time and exceed the baseline capacity of 140 crude oil ships per year with some regularity, and the total number of ship calls may exceed the baseline total capacity of 385 in some years within the 5-year rolling average of the proposed action. Likewise, some years will have fewer total shipments and/or lesser proportions of crude oil to refined product ships. For example, crude oil ships will likely make up a larger or smaller proportion of the total ship calls in any one year. Based on the actual number of crude oil ship calls in the past, we assume that the highest number of 191 crude oil vessel calls that occurred in 2007 is a reasonable maximum number (+51 crude oil ships over the calculated baseline), with actual numbers of crude oil calls likely to vary over time and generally be in the range of 126 (below baseline calculated operations) to 168 crude oil ships (above baseline calculated operations) (Table 2, bottom row). Because crude oil cargo is inherently more dangerous to aquatic life than refined products, much of the analysis in this opinion is centered on crude oil shipping.

1.3.2 Other Activities Caused by the Proposed Action

We considered whether or not the proposed action would cause any other activities and determined that it would cause additional activities associated with operations at the marine facility. These include oil spill preparedness and response which involves the staging and deployment of work boats for pre-booming operations; deployment of oil spill containment booms for pre-booming during loading and unloading operations; and the staging of additional oil spill booms. At the upland area of the marine facility sorbent pads and two oil spill skimmers are available. BP conducts regular oil spill drills to ensure a quick and appropriate response to an unintentional release.

As discussed in the 2017 BE, BP has several site-specific spill prevention measures that are in place to reduce risk. In addition to these measures, a number of new safety measures that further reduce the risk of a spill are either in place or are being implemented. These measures were not described in the BE and are described below:

> “Dock maintenance. Annual maintenance of dock equipment occurs in the summer and consists of equipment inspection, replacement, cleaning, painting, and repair, as appropriate. Regular maintenance of the dock and associated equipment is a key component of the Refinery's spill prevention program. In 2017, BP identified an opportunity to improve the dock maintenance program through a detailed analysis of the product and crude loading arms. Each major component of the loading arms is now cataloged to include specifications and replacement frequency. For example, the loading arm hydraulic hoses are now replaced more frequently. The hoses are now wrapped in a protective sheath (new technology) that prevents UV damage and also reduces the likelihood of a spill to the water if the hose breaks. Additionally, the loading arm hydraulic drive cylinders are being inspected on a more frequent basis to identify potential issues and to conduct repairs or replacement as needed.
>
> Improved Safety Transportation of Oil. The 2019 Washington legislature enacted ESHB 1578 to protect southern resident killer whales by reducing the risk of oil spills. Among other requirements the new law strengthens tug escort requirements in the Puget Sound. BP is monitoring the rule making process and will comply with the regulatory changes (Letter from BP to USACE dated December 6, 2019)”.

Vessels transiting to the BP Marine Terminal from Alaska, Oregon, California, and international origins enter the Strait of Juan de Fuca, utilize the U.S. Coast Guard (USCG) Vessel Traffic Service Puget Sound, and abide by the USCG requirements for the Strait of Juan de Fuca and Puget Sound traffic Separation Scheme. Likewise, tank vessels and barge traffic calling at the BP Cherry Point facility from, or departing to, other destinations within the greater Puget Sound must participate in and abide by the requirements of the USCG vessel traffic management provisions.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION, 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 provides 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 incidental take statement (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.

NMFS also completed an Essential Fish Habitat (EFH) consultation. It was prepared in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. § 1801, *et seq.*) and implementing regulations codified at 50 C.F.R. § 600. As described in more detail in the consultation below, the action adversely affects EFH.

2.1 Analytical Approach

This biological opinion includes both a jeopardy analysis and/or an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of “to jeopardize the continued existence of” a listed species, which is “to engage in an action that 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 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological 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 designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace 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. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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:

- Identify the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an “exposure-response-risk” approach.
- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.
- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.
- If necessary, suggest a RPA to the proposed action.

2.1.1 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). The proposed action is broken into two major components: (1) Vessel Traffic and (2) Operation and Maintenance at the BP Marine Terminal. Each of these activities has distinct effects, some of which overlap. The O&M activities have effects which are likely limited to the facility’s immediate surrounding area, while the vessel traffic has effects that are likely to extend much further in geographic scope. The most far-reaching effects of the proposed action derive from the ocean-going vessel (OGV) traffic within the inland waters of the Salish Sea out to the outer coast of Washington. OGVs carrying crude oil to Cherry Point transit from the Pacific Ocean, often originating from Alaska, through the Salish Sea, sometimes making stops at multiple other refineries within the Salish Sea (Figures 2, 3, 4). Crude oil OGVs leaving Cherry Point exit the Salish Sea through the Strait of Juan de Fuca and then disperse along the coast to the north, south, and open ocean to the west. OGVs departing Cherry Point with refined products may also travel to other locations within the Salish Sea and/or transit out of the Salish Sea and then disburse along the outer coast to the north, south, or open ocean to the west. Therefore, the action area encompasses the inland waters of the Salish Sea from the Canadian waters of the Strait of Georgia near Vancouver, British Columbia, through the Salish Sea, past the "J" buoy at the mouth of the Strait of Juan de Fuca and out into the Pacific Ocean in a fan defined by OGV travel routes. It extends to the continental shelf approximately 40 miles offshore and along the outer coast to the north and south by 40 miles. Within this action area, encounters, OGV collisions, and impact from ship noise and oil spill are reasonably certain to occur between OGVs and marine mammals and leatherback sea turtles. The OGVs that travel through this area will continue on to various destinations, with the density of marine mammals and leatherback sea turtles being substantially lower beyond the continental shelf. Beyond this area in the Pacific Ocean, the risk of a ship strike with a marine mammal or sea turtle becomes increasingly unlikely as density of ship traffic becomes lower. Along the coast to the north and south of the Strait of Juan de Fuca, the specific destinations of ships becomes uncertain. This action area delimits the geographic location where the proposed action is likely to result in effects on listed species and critical habitat. For some of the species addressed in this opinion, the action area overlaps with a significant portion of their range.

The action area includes aquatic habitats identified as Essential Fish Habitat (EFH) for Pacific Coast groundfish, coastal pelagic species (CPS), and Pacific Coast salmon.

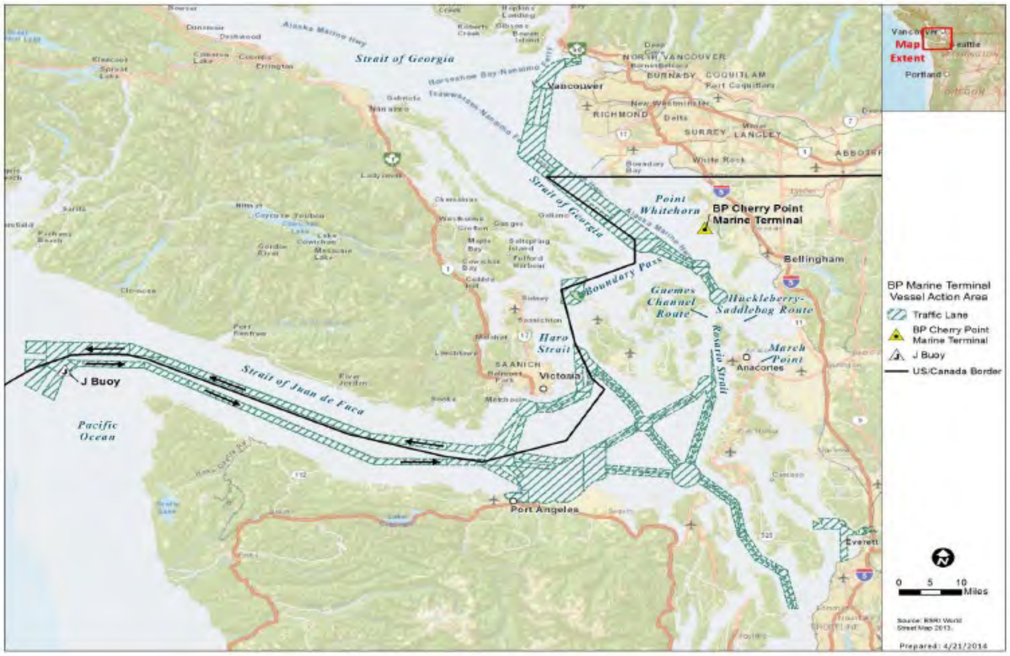


Figure 2. Action Area Shipping Lanes from Cherry Point to J Buoy at the Entrance to the Strait of Juan de Fuca/Salish Sea

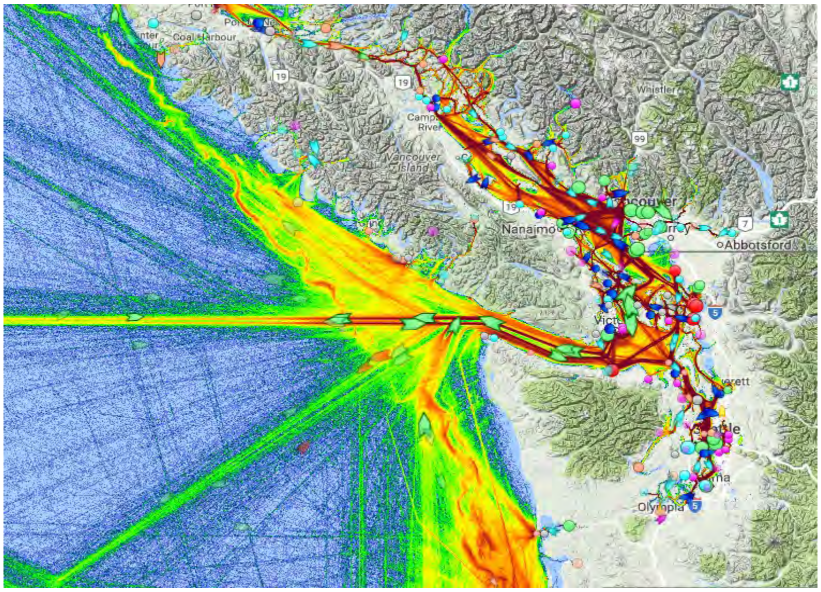


Figure 3. Action area for OGV traffic from the BP Cherry Point facility and out to the Pacific Ocean. The action area extends outward in a 40-mile fan to the north, south, and west. The map depicts all ship and boat traffic combined: Red = highest density, grading to orange, yellow, green, then blue as density decreases (Data/Image from www.marinetraffic.com, November 8, 2017).

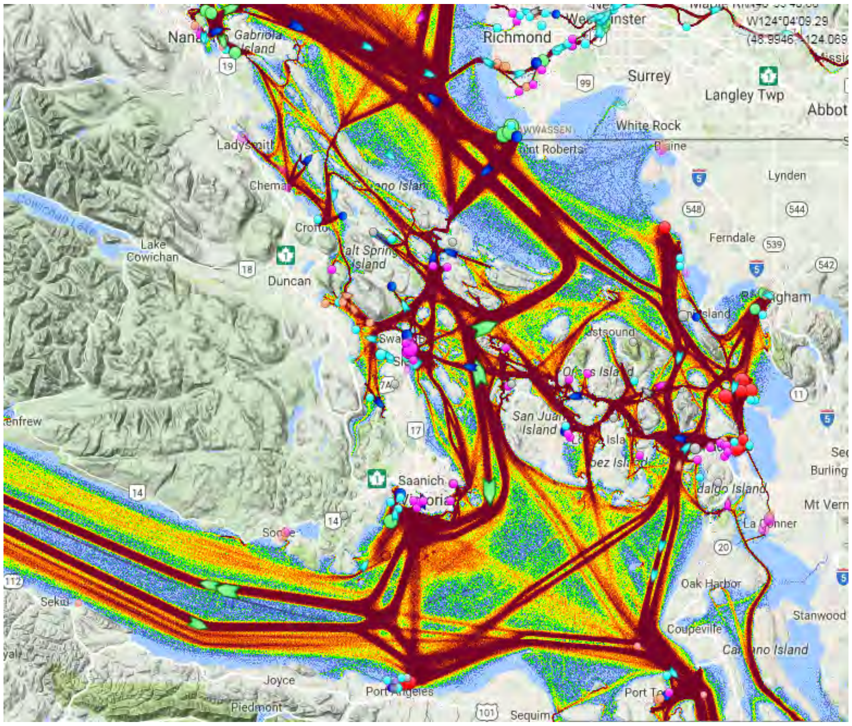


Figure 4. Closer view of traffic density in Puget Sound/Salish Sea. Cherry Point is located west of Ferndale on the map near the small red circle. The map depicts all ship and boat traffic combined: Red = highest density, grading to orange, yellow, green, then blue as density decreases (Data/Image from www.marinetraffic.com, November 8, 2017).

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be 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' current "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 current function of the essential physical and biological features that help to form that conservation value.

2.2.1. Climate Change

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. The largest hydrologic responses are expected to occur in basins with significant snow accumulation, where warming decreases snowpack, increases winter flows, and advances the timing of spring melt (Mote et al. 2014, Mote 2016). Rain-dominated watersheds and those with significant contributions from groundwater may be less sensitive to predicted changes in climate (Tague et al. 2013, Mote et al. 2014).

During the last century, average regional air temperatures in the Pacific Northwest increased by 1-1.4°F as an annual average, and up to 2°F in some seasons (based on average linear increase per decade; Abatzoglou et al. 2014; Kunkel et al. 2013). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10°F, with the largest increases predicted to occur in the summer (Mote et al. 2014). Decreases in summer precipitation of as much as 30 percent by the end of the century are consistently predicted across climate models (Mote et al. 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB 2007; Mote et al. 2013; Mote et al. 2014). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; Mote et al. 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez et al. 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote et al. 2014).

Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 2009). Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available habitat (Mantua et al. 2010; Isaak et al. 2012). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic food webs (Crozier et al. 2011; Tillmann and Siemann 2011; Winder and Schindler 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can also result in reduced oxygen (Meyer et al. 1999; Winder and Schindler 2004, Raymondi et al. 2013). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al. 2008; Wainwright and Weitkamp 2013; Raymondi et al. 2013). Crozier et al. (2019) assessed and ranked the vulnerability of listed Pacific salmon and steelhead population units to climate change and found that nearly all units faced high exposures to projected increases in stream temperature, sea surface temperature, and ocean acidification. Puget Sound Chinook salmon and PS steelhead ranked as having high vulnerability on a scale of very high, high, moderate, to low.

As more basins become rain-dominated and prone to more severe winter storms, higher winter stream flows may increase the risk that winter or spring floods in sensitive watersheds will damage spawning redds and wash away incubating eggs (Goode et al. 2013). Earlier peak stream flows will also alter migration timing for salmon smolts, and may flush some young salmon and steelhead from rivers to estuaries before they are physically mature, increasing stress and reducing smolt survival (McMahon and Hartman 1989; Lawson et al. 2004). Summer steelhead stocks within the Puget Sound DPS may be more vulnerable to climate change since there are few summer run populations that reside in the DPS as compared to winter run populations, they exhibit relatively small abundances, and they occupy limited upper river tributary habitat.

In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote et al. 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by 1.0-3.7^{o}C by the end of the century (IPCC 2014). Habitat loss, shifts in species' ranges and abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (Tillmann and Siemann 2011, Reeder et al. 2013). Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. Acidification also impacts sensitive estuary habitats, where organic matter and nutrient inputs further reduce pH and produce conditions more corrosive than those in offshore waters (Feely et al. 2012, Sunda and Cai 2012).

Global sea levels are expected to continue rising throughout this century, reaching likely predicted increases of 10-32 inches by 2081-2100 (IPCC 2014). These changes will likely result in increased erosion and more frequent and severe coastal flooding, and shifts in the composition of nearshore habitats (Tillmann and Siemann 2011, Reeder et al. 2013). Estuarine-dependent salmonids such as chum and Chinook salmon are predicted to be impacted by significant reductions in rearing habitat in some Pacific Northwest coastal areas (Glick et al. 2007).

Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances, and therefore these species are predicted to fare poorly in warming ocean conditions (Scheuerell and Williams 2005; Zabel et al. 2006). This is supported by the recent observation that anomalously warm sea surface temperatures off the coast of Washington from 2013 to 2016 resulted in poor coho and Chinook salmon body condition for juveniles caught in those waters (NWFSC 2015). Changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to impact a wide range of listed aquatic species (Tillmann and Siemann 2011, Reeder et al. 2013).

In marine habitat (including Puget Sound/Salish Sea), scientists are not certain of all the factors impacting salmon and steelhead survival but several ocean-climate events are linked with fluctuations in steelhead health and abundance such as El Niño/La Niña, the Aleutian Low, and coastal upwelling (Pearcy and Mantua 1999). Steelhead, along with Chinook and coho salmon, have experienced tenfold declines in survival during the marine phase of their lifecycle, and their total abundance remains well below what it was 30 years ago[4]. The marine survival of coastal steelhead, as well as Columbia River Chinook and coho, do not exhibit the same declining trend as the Salish Sea populations. Specifically, marine survival rates for steelhead in Washington State have declined in the last 25 years with the Puget Sound steelhead populations declining to a greater extent than other regions (i.e., Washington Coast and Lower Columbia River) and are at near historic lows (Moore et al. 2014). Climate changes have included increasing water temperatures, increasing acidity, more harmful algae, the loss of forage fish and some marine commercial fishes, changes in marine plants, increased populations of seals and porpoises, etc. (LLTK 2015). Preliminary work conducted as part of the Salish Sea Marine Survival Project reported that approximately 50 percent of the steelhead smolts that reach the Hood Canal Bridge did not survive in the 2017 and 2018 outmigration years. Of these steelhead that did not survive, approximately 80 percent were consumed by predators which display deep diving behavior, such as pinnipeds (Moore and Berejikian 2019). Climate change plays a part in steelhead mortality but more studies are being conducted to determine the specific causes of this marine survival decline in Puget Sound.

The Northwest Fishery Science Center (NWFSC 2015) reported that climate conditions affecting Puget Sound salmonids were not optimistic; recent and unfavorable environmental trends are expected to continue. A positive pattern in the Pacific Decadal Oscillation[5] is anticipated to continue. This and other similar environmental indicators suggest the continuation of warming ocean temperatures; fragmented or degraded freshwater spawning and rearing habitat; reduced snowpack; altered hydrographs producing reduced summer river flows and warmer water; and low marine survival for salmonids in the Salish Sea (NWFSC 2015). Specifically, the exceptionally warm marine water conditions in 2014 and 2015 combined with warm freshwater stream temperatures lowered steelhead marine and freshwater survival (NWFSC 2015) in the most recent years. Any rebound in VSP parameters for Puget Sound steelhead are likely to be constrained under these conditions (NWFSC 2015).

The potential impacts of climate and oceanographic change on Southern Resident killer whales and humpback whales will likely affect habitat availability and food availability. For species that depend on salmon for prey, such as SRKWs, the fluctuations in salmon survival that occur with

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[4] Long Live the Kings 2015: http://marinesurvivalproject.com/the-project/why/

[5] A positive pattern in the Pacific Decadal Oscillation (PDO) has been in place since 2014.

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. Any changes in these factors could render currently used habitat areas unsuitable. Changes to climate and oceanographic processes may also lead to decreased prey productivity and different patterns of prey distribution and availability. Different species of marine mammals will likely react to these changes differently. For example, 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 (Learmonth et al. 2006). Macleod (2009) estimated, based on expected shifts in water temperature, 88 percent of cetaceans would be affected by climate change, with 47 percent likely to be negatively affected. Variation in fish populations in Puget Sound may reflect broad-scale shifts in natural limiting conditions, such as predator abundances and food resources in ocean rearing areas. NMFS has noted that predation by marine mammals has increased as marine mammal numbers, especially harbor seals (*Phoca vitulina*) and California sea lions (*Zalophus californianus*) increase on the Pacific Coast (Myers et al. 1998; Jeffries et al. 2003; Pitcher et al. 2007; Department of Fish and Oceans 2010; Jeffries 2011; Chasco et al. 2017). In addition to predation by marine mammals, Fresh (1997) reported that 33 fish species and 13 bird species are predators of juvenile and adult salmon, particularly during freshwater rearing and migration stages.

The adaptive ability of these threatened and endangered species is depressed due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. Without these natural sources of resilience, systematic changes in local and regional climatic conditions due to anthropogenic global climate change will likely reduce long-term viability and sustainability of many populations (NWFSC 2015). New stressors generated by climate change, or existing stressors with effects that have been amplified by climate change, may also have synergistic impacts on species and ecosystems (Doney et al. 2012). These conditions will possibly intensify the climate change stressors inhibiting recovery of ESA-listed species in the future.

For the large whales considered in this opinion, climate change is a concern and there is much uncertainty as to how various species might be affected. Much is still unknown about how climate change will ultimately affect large whales and their prey base. Each species may adapt and respond differently, with some species potentially suffering, while others may adapt to different food sources or adjust their range. For example, for North Pacific right whales, long-term trends of warming sea surface temperatures in the California Current Ecosystem have been linked to major changes in zooplankton abundance (Roemmich and McGowan 1995) that could also affect this species (NMFS 2013a) and there is evidence that humpback whales track their prey and their distribution can shift from offshore to nearshore in warm years when prey availability distribution shifts (Santora et al., 2020).

Based upon available information, it is likely that leatherback sea turtles are being affected and will be further affected by climate change. Similar to other sea turtle species, leatherbacks are likely affected by rising temperatures that may affect nesting success and skew sex ratios, and rising sea surface temperatures that may affect available nesting beach areas as well as ocean productivity. Leatherbacks are known to travel within specific isotherms and these could be affected by climate change. Climate change may also alter their migration and prey availability

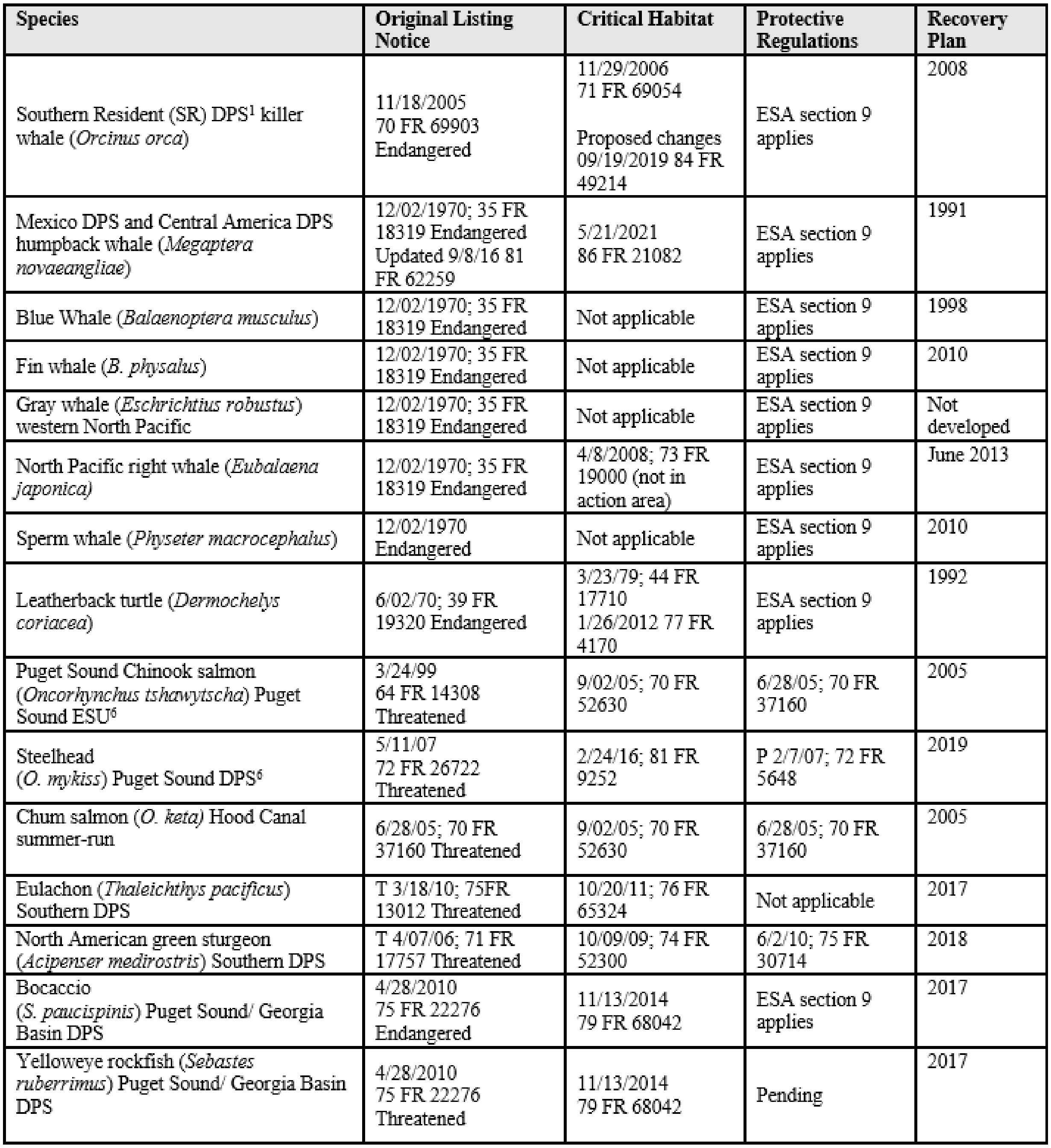
(Robinson et al. 2009). Unlike other sea turtle species which may be prey limited due to climate changes to their forage base, leatherbacks feed primarily on jellyfish and some species are expected to increase in abundance due to ocean warming (Attrill et al. 2007; Purcell et al. 2005; Richardson et al. 2009).

2.2.2 ESA Listing and Recovery Information

Table 3 below provides a summary of listing and Recovery Plan information, status summaries and limiting factors for the fish species addressed in this opinion. For marine mammals and leatherback turtles, this information follows in text format after Table 3. More information can be found in Recovery Plans and status reviews for these species. These documents are available on the NMFS West Coast Region website (http://www.westcoast.fisheries.noaa.gov/). The terminology for a unique "species" used for ESA listing is either distinct population segment (DPS) or evolutionarily significant unit (ESU). For example, the PS steelhead listing is for a DPS, which describes the "species" or "population" unit that is listed under the ESA, while the listing for PS Chinook salmon uses the term ESU to define the unique species.

Recovery is defined under the ESA as an improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the Act (50 CFR §402.02). The recovery of listed species is the cornerstone and ultimate purpose of the Endangered Species Program and an underlying premise for all recovery actions. It is the process by which listed species and their ecosystems are restored and their future is safeguarded to the point that protections under the Endangered Species Act are no longer needed.

Table 3. References for Species Listings, Critical Habitat Designations, Protective Regulations, and Recovery Plans.



Species	Original Listing Notice	Critical Habitat	Protective Regulations	Recovery Plan
Southern Resident (SR) DPS[1] killer whale (*Orcinus orca*)	11/18/2005 70 FR 69903 Endangered	11/29/2006 71 FR 69054 Proposed changes 09/19/2019 84 FR 49214	ESA section 9 applies	2008
Mexico DPS and Central America DPS humpback whale (*Megaptera novaeangliae*)	12/02/1970; 35 FR 18319 Endangered Updated 9/8/16 81 FR 62259	5/21/2021 86 FR 21082	ESA section 9 applies	1991
Blue Whale (*Balaenoptera musculus*)	12/02/1970; 35 FR 18319 Endangered	Not applicable	ESA section 9 applies	1998
Fin whale (*B. physalus*)	12/02/1970; 35 FR 18319 Endangered	Not applicable	ESA section 9 applies	2010
Gray whale (*Eschrichtius robustus*) western North Pacific	12/02/1970; 35 FR 18319 Endangered	Not applicable	ESA section 9 applies	Not developed
North Pacific right whale (*Eubalaena japonica)*	12/02/1970; 35 FR 18319 Endangered	4/8/2008; 73 FR 19000 (not in action area)	ESA section 9 applies	June 2013
Sperm whale (*Physeter macrocephalus*)	12/02/1970 Endangered	Not applicable	ESA section 9 applies	2010
Leatherback turtle (*Dermochelys coriacea*)	6/02/70; 39 FR 19320 Endangered	3/23/79; 44 FR 17710 1/26/2012 77 FR 4170	ESA section 9 applies	1992
Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*) Puget Sound ESU[6]	3/24/99 64 FR 14308 Threatened	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160	2005
Steelhead (*O. mykiss*) Puget Sound DPS[6]	5/11/07 72 FR 26722 Threatened	2/24/16; 81 FR 9252	P 2/7/07; 72 FR 5648	2019
Chum salmon (*O. keta)* Hood Canal summer-run	6/28/05; 70 FR 37160 Threatened	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160	2005
Eulachon (*Thaleichthys pacificus*) Southern DPS	T 3/18/10; 75FR 13012 Threatened	10/20/11; 76 FR 65324	Not applicable	2017
North American green sturgeon (*Acipenser medirostris*) Southern DPS	T 4/07/06; 71 FR 17757 Threatened	10/09/09; 74 FR 52300	6/2/10; 75 FR 30714	2018
Bocaccio (*S. paucispinis*) Puget Sound/ Georgia Basin DPS	4/28/2010 75 FR 22276 Endangered	11/13/2014 79 FR 68042	ESA section 9 applies	2017
Yelloweye rockfish (*Sebastes ruberrimus*) Puget Sound/ Georgia Basin DPS	4/28/2010 75 FR 22276 Threatened	11/13/2014 79 FR 68042	Pending	2017

2.2.3 Rangewide Status of Species

Marine Mammals- NMFS recognizes geographic stocks of whales under the Marine Mammal Protection Act (MMPA) (section 117, 16 U.S.C. § 1386),[6] and requires the monitoring and management of marine mammals on a stock-by-stock basis, rather than entire species, populations, or DPSs. Although the stock identification is not recognized as part of the ESA-listing, it does provide a meaningful framework for analyzing the impacts of the proposed action on whale populations as a whole.

2.2.3.1 Rangewide Status of Southern Resident Killer Whales

This section describes the rangewide status of SRKW. More information is presented for this species under the Environmental Baseline (Section 2.3) for conditions more specific to the action area and related to the proposed action. The action area overlaps a significant portion of their range in the Salish Sea, including their Summer Core habitat area in the San Juan Islands. The action area (defined in Section 2.1.1) encompasses nearly all of their range within the Salish Sea.

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 2016a). NMFS considers SRKWs to be currently among nine of the most at-risk species as part of the Species in the Spotlight initiative[7] 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 Recovery Plan for Southern Resident Killer Whales included reduced prey availability and quality, high levels of contaminants from pollution, and disturbances from vessels and sound (NMFS 2008a). The Recovery Plan also describes the on-going and potentially catastrophic threat of major oil spills. This section summarizes the status of SRKWs throughout their range and summarizes information taken largely from the Recovery Plan (NMFS 2008a), most recent 5-year review (NMFS 2016a), the PFMC SRKW Ad Hoc Workgroup's report (PFMC 2020), as well as newly available data.

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[6] Section 117. Stock Assessments 16 U.S.C. 1386: Each draft stock assessment, based on the best scientific information available shall (1) Describe the geographic range of the affected stock, including any seasonal or temporal variation in such range; (2) provide for such stock the minimum population estimate, current and maximum net productivity rates, and current population trend, including a description of the information upon which these are based; (3) estimate the annual human-caused mortality and serious injury of the stock by source and, for a strategic stock, other factors that may be causing a decline or impeding recovery of the stock, including effects on marine mammal habitat and prey; (4) describe commercial fisheries that interact with the stock, including the approximate number of tanker actively participating in each such fishery, the estimated level of incidental mortality and serious injury of the stock by each such fishery on an annual basis, seasonal or area differences in such incidental mortality or serious injury; and the rate, based on the appropriate standard unit of fishing effort, of such incidental mortality and serious injury, and an analysis stating whether such level is insignificant and is approaching a zero mortality and serious injury rate; (5) categorize the status of the stock as one that either has a level of human-caused mortality and serious injury that is not likely to cause the stock to be reduced below its optimum sustainable population, or is a strategic stock, with a description of the reasons therefor; and (6) estimate the potential biological removal level for the stock, describing the information used to calculate it, including the recovery factor.

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

Geographic Range and Distribution/Spatial Structure/Diversity - SRKW

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 2008a; Carretta et al. 2019; Ford et al. 2017) (Figure 5). 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).

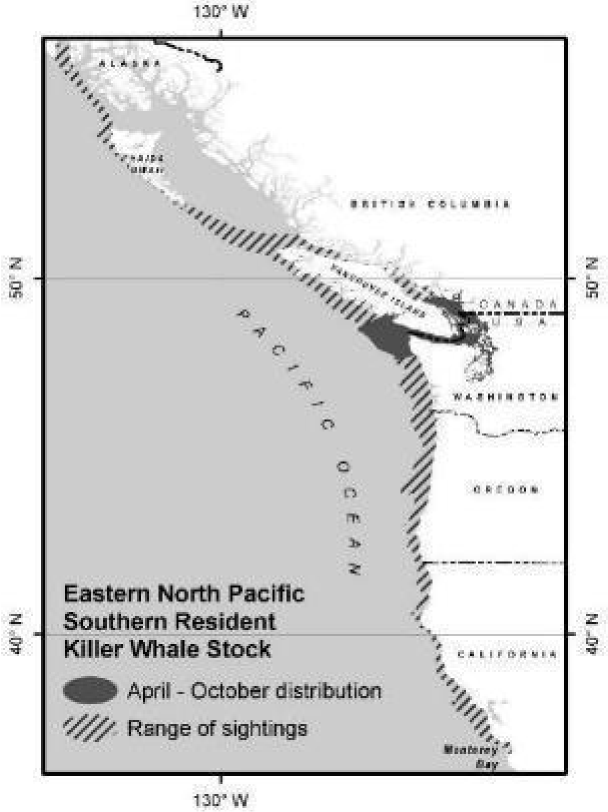


Figure 5. Approximate April – October distribution of Southern Resident killer whales (shaded area) and range of sightings (diagonal lines) (reprinted from Carretta et al. (2019).

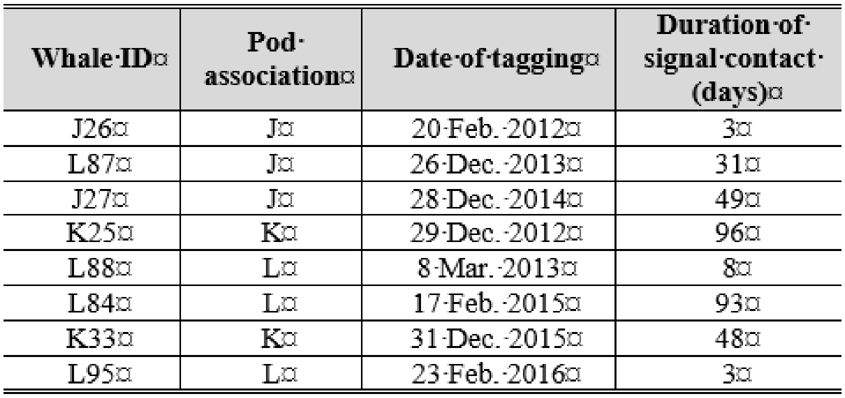
Land- and vessel-based opportunistic and survey-based visual sightings, satellite tracking, and passive acoustic research conducted have provided an updated estimate of the whales' coastal range that extends from the Monterey Bay area in California, north to Chatham Strait in southeast Alaska. Since 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 2019a).

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 4). 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 4). 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 4. 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
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

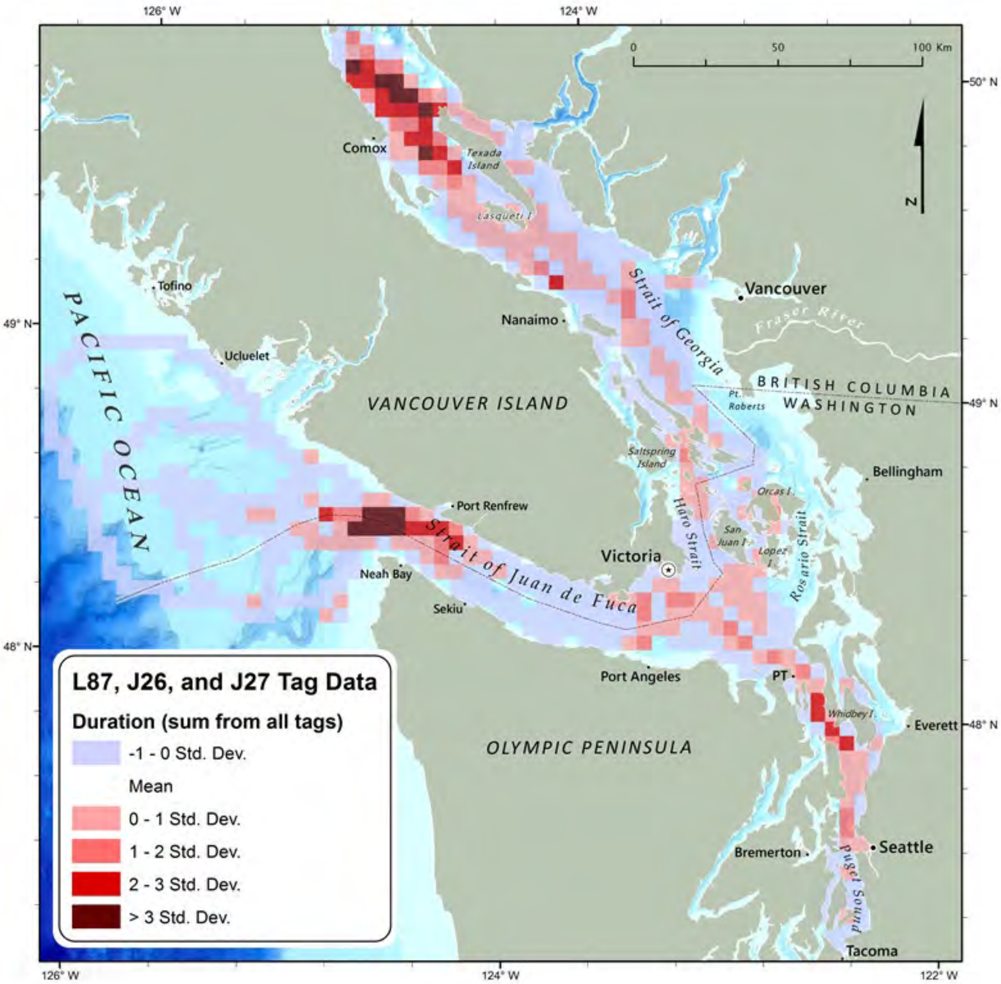


Figure 6. Duration of occurrence model output for J pod tag deployments (Hanson et al. 2017). “High use areas” are illustrated by the 0 to > 3 standard deviation pixels.

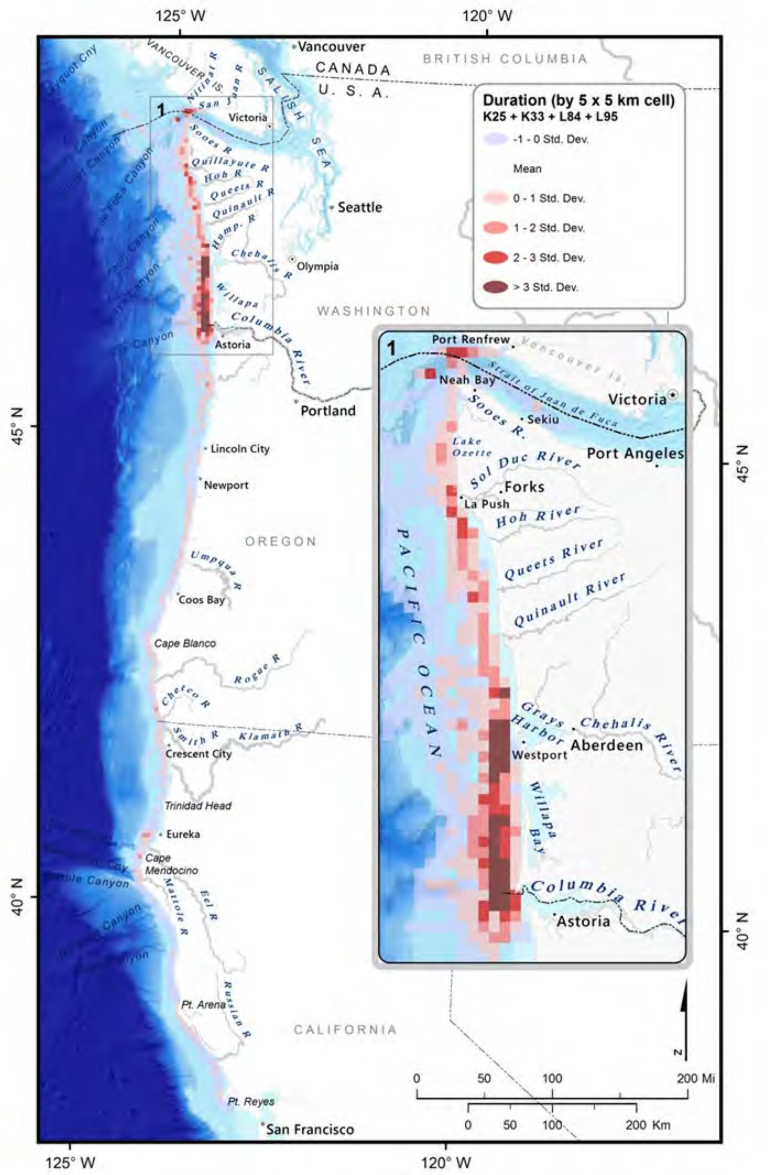


Figure 7. Duration of occurrence model for all unique K and L pod tag deployments (Hanson et al. 2017). "High use areas" are illustrated by the 0 to > 3 standard deviation pixels.

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).

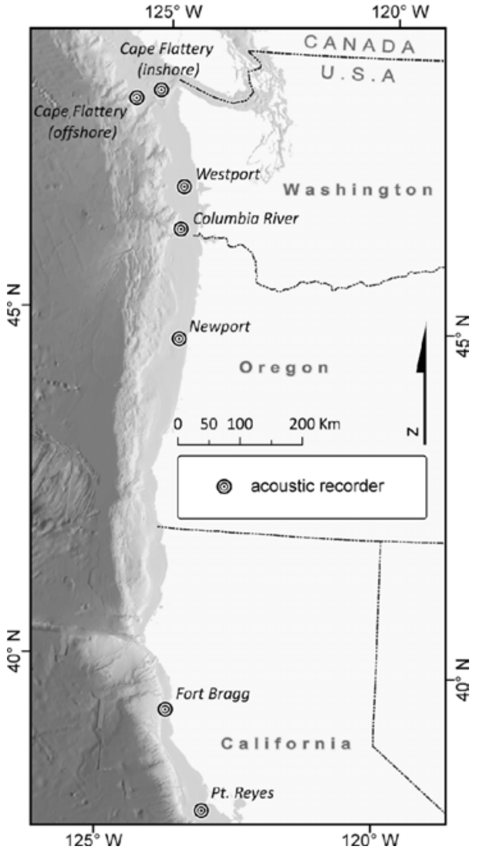


Figure 8. Deployment locations of acoustic recorders on the U.S. west coast from 2006 to 2011 (Hanson et al. 2013).

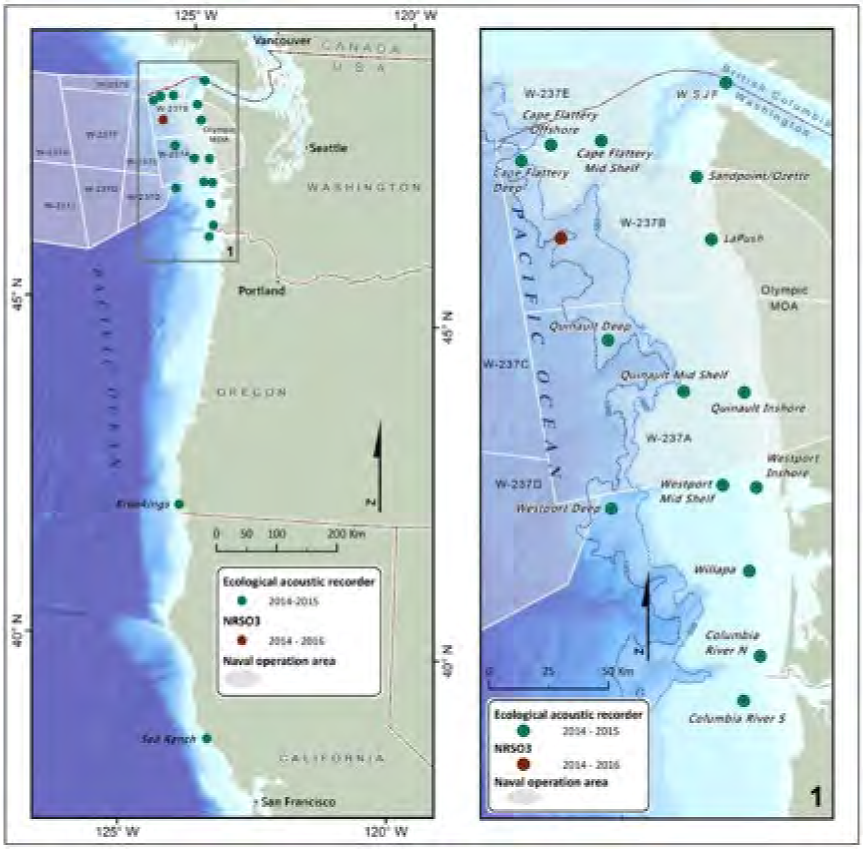


Figure 9. Locations of passive acoustic recorders deployed beginning in the fall of 2014 (Hanson et al. 2017).

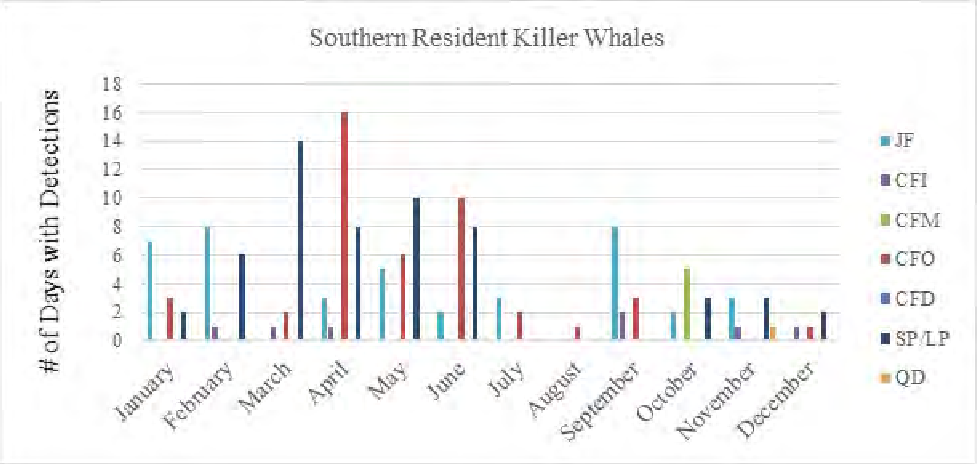


Figure 10. Counts of detections at each northern recorder site by month from 2014-2017 (Emmons et al. 2019). Areas include Juan de Fuca (JF); Cape Flattery Inshore (CFI); Cape Flattery Mid Shelf (CFM); Cape Flattery Offshelf (CFO); Cape Flattery Deep(CFD); Sand Point and La Push (SP/LP); and Quinault 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).

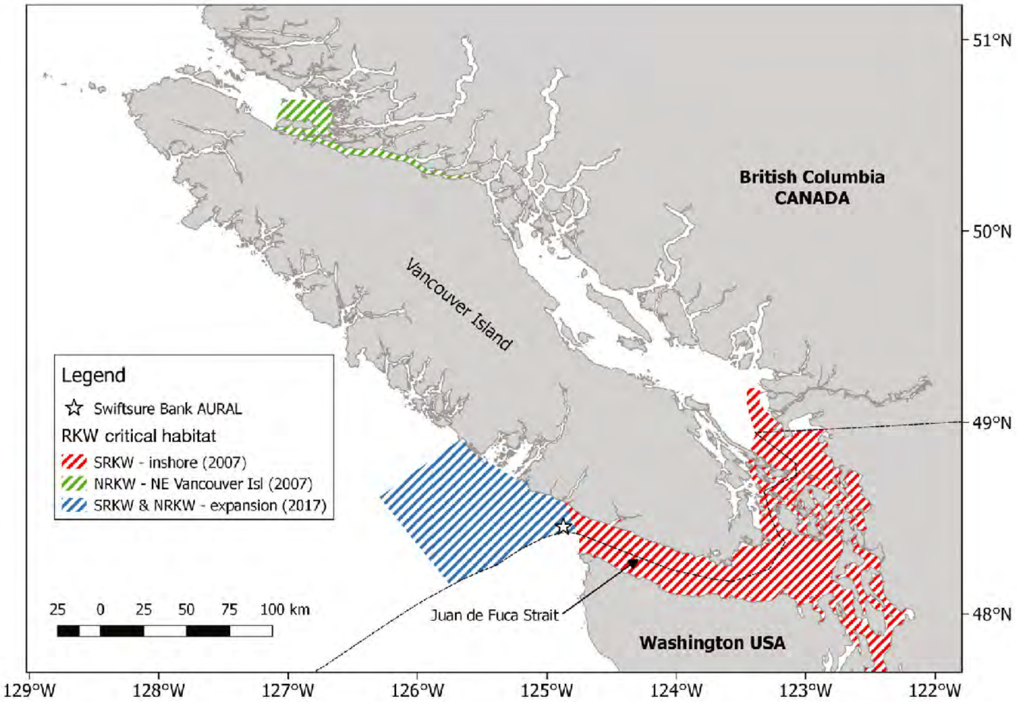


Figure 11. Swiftsure Bank study site off the coast of British Columbia, Canada in relation to the 2007 Northern Resident critical habitat in Canadian waters (NE Vancouver Island) and 2007 Southern Resident killer whale critical habitat (inshore waters, both U.S. and Canadian jurisdictions) and the 2017 Northern Resident and Southern Resident expansion of critical habitat in Canadian Waters (Riera et al. 2019).

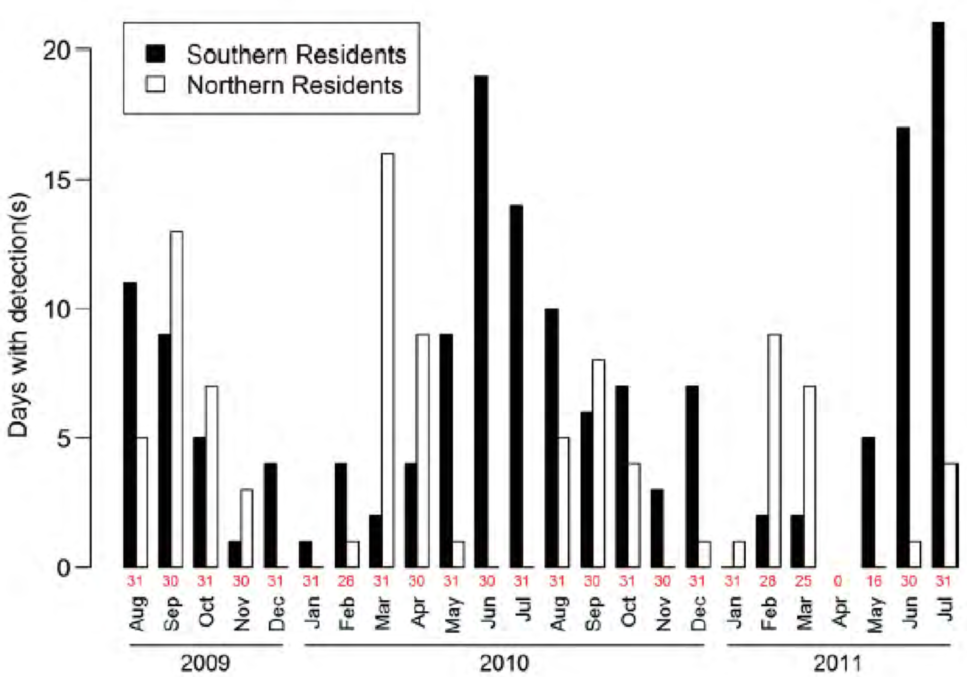


Figure 12. Number of days with acoustic detections of SRKWs at Swiftsure Bank from August 2009 – July 2011. Red numbers indicate days of effort. (Riera et al. 2019).

Abundance, Productivity, and Trends – Southern Resident Killer Whale

Killer whales – including SRKWs - are a long-lived species and sexual maturity can occur at age 10 (review in NMFS 2008a). Females produce a small number of surviving calves (n < 10, but 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 increased between 2001 and 2006 and 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 (n = 9) that occurred in 2013 and 2014. At present, the SRKW population has declined to near historically low levels (Figure 13). As of April 2020, the population is 72 whales (one whale is missing and presumed dead since the 2019 summer census), plus two calves born in September 2020 that have not been added to the census yet. The previously published historical estimated abundance of SRKW is

140 animals (NMFS 2008a). 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.

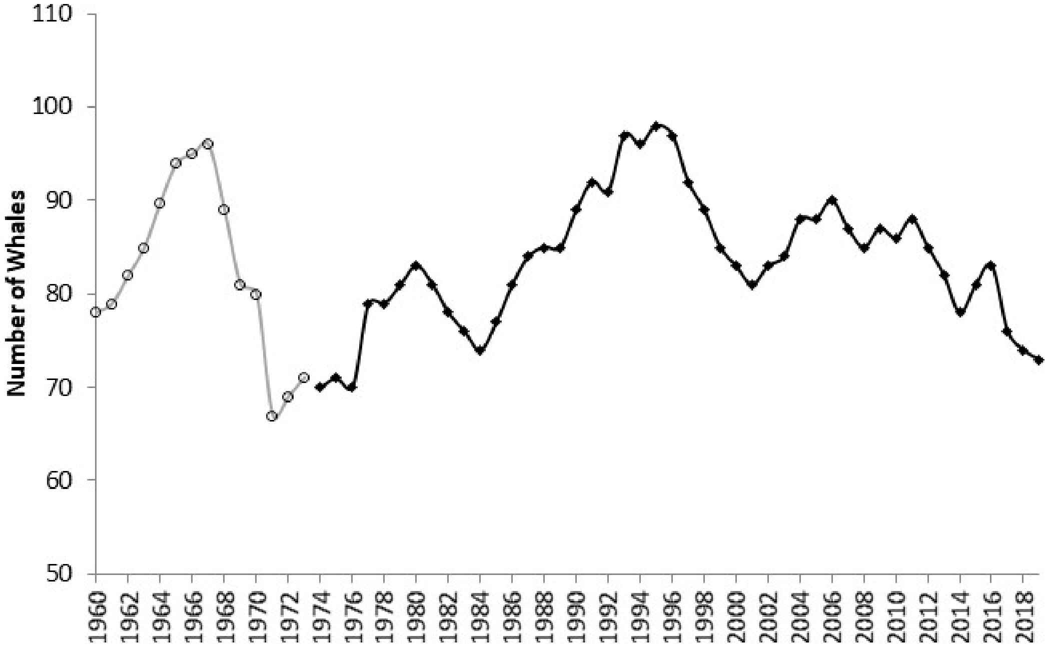


Figure 13. Population size and trend of Southern Resident killer whales, 1960-2019. Data from 1960-1973 (open circles, gray line) are number projections from the matrix model of Olesiuk et al. (1990). Data from 1974-2019 (diamonds, black line) were obtained through photo-identification surveys of the three pods (J, K, and L) in this community and were provided by the Center for Whale Research (unpublished data) and NMFS (2008a). 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 suggest 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 14 (NMFS 2016a). 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 2016a).

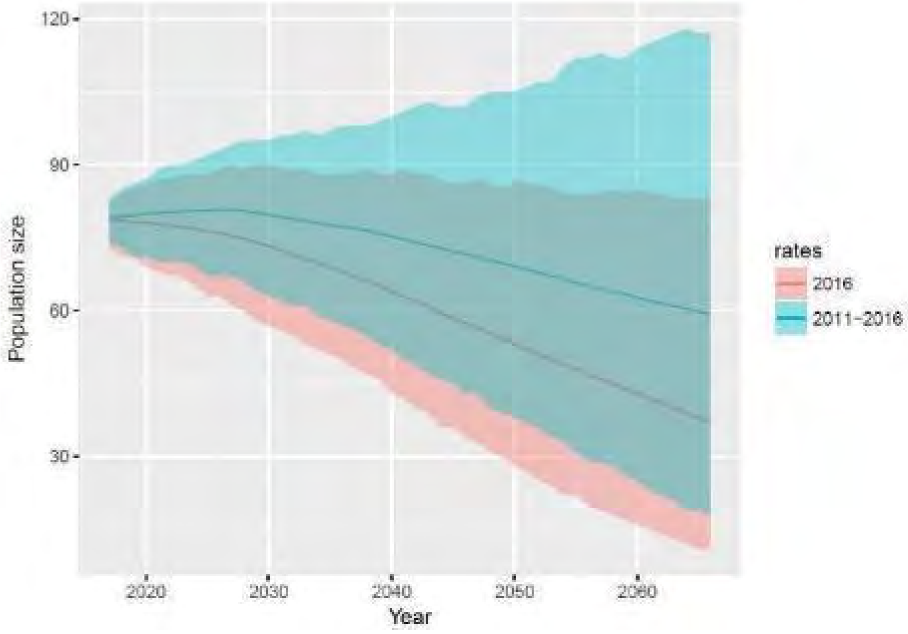


Figure 14. Southern Resident killer whale population size projections from 2016 to 2066 using two scenarios: (1) projections using demographic rates held at 2016 levels, and (2) projections using demographic rates from 2011 to 2016. The pink line represents the projection assuming future rates are similar to those in 2016, whereas the blue represents the scenario with future rates being similar to 2011 to 2016 (Figure 2, NMFS (2016a).

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).

Limiting Factors and Threats – Southern Resident Killer Whale

Several factors identified in the Recovery Plan for SRKW may be limiting recovery (NMFS 2008a). 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. Oil spills are also a risk factor. The small size of the Southern Resident killer whale population and their reliance on the inland waters of the Salish Sea also makes them highly susceptible to oil spills. The Recovery Plan describes major oil spills as "potentially catastrophic to killer whales and their environment" (NMFS 2008a). The threat of oil spills is described in more detail in Environmental Baseline Sections 2.3.4 and 2.3.7. 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 2008a).

Quantity and Quality of Prey - 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, Hanson et al. in review). 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.

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.
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.

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 time frames. Prior to 2013, only three prey samples for SRKW on the U.S. outer coast had been collected (Hanson et al. in review). From 2013 to 2016, satellite tags were used to locate and follow the whales to obtain predation and fecal samples during the winter and spring months. A total of 55 samples were collected from northern California to northern Washington (Figure 15). Results of the 57 coastal prey sample items indicate that, as is the case in inland waters, Chinook are the primary species detected in diet samples on the outer coast making up 80 percent of the prey remains samples and 69 percent of the fecal samples, although steelhead, chum, lingcod, and halibut were also detected in samples (Hanson et al, in review). 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 review). Columbia River, Central Valley, Puget Sound, and Fraser River Chinook salmon collectively comprised over 90 percent of the 33 prey items determined to be Chinook (and where genetic origin could be determined) 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 15) 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.

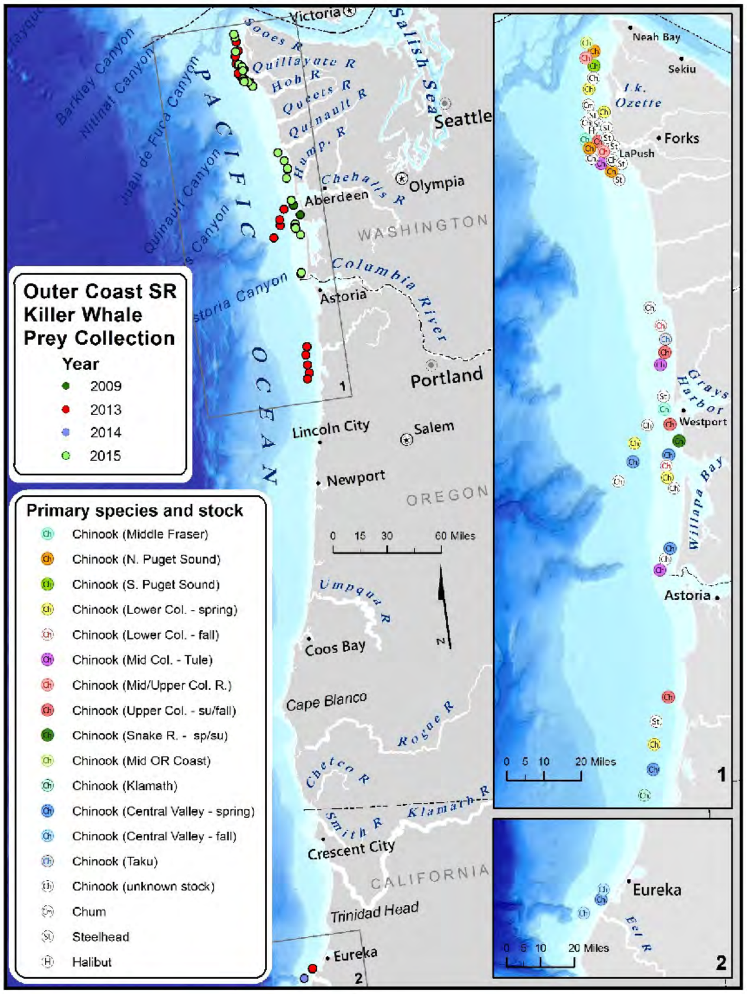


Figure 15. Location and species for scale/tissue samples collected from Southern Resident killer whale predation events in outer coastal waters (NMFS 2019a).

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)[8]. 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; 2008). 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,

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

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 review). 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.

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) has 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 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[9]. 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).

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; de Swart et al. 1996; Bonefeld-Jørgensen et al. 2001; Reddy et al. 2001; Schwacke et al. 2002; Darnerud 2003; Legler and 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 (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

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

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 2015a). 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.

Oil Spills and Southern Resident Killer Whales - 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. More information is presented on oil spill in the action area under Environmental Baseline 2.3 and 2.3.7.

Contaminants from Boat and Ship Operations - Contaminants can be released during normal boat and ship operations, including oil and gasoline affecting nearshore water quality, sea grasses and nearshore fauna. The normal operation of vessels in the Salish Sea likely to have small incidental discharges caused by drippage from engines, which individually introduce very small amounts of fuels, oils, or lubricants into the water. Incidental discharge of oils or fuels, and polycyclic aromatic hydrocarbons (PAHs) may also result from exhaust. Because these materials can disperse quickly, they can become quite widespread at very low concentration. The environmental fate of each type of PAH depends on its molecular weight. In surface water, PAHs can volatilize, photolyze, oxidize, biodegrade, bind to suspended particles or sediments, or accumulate in aquatic organisms.

SRKWs likely experience low level direct exposure to these contaminants as well as through the food web. There are two pathways for PAH exposure to fish species in the action area, direct uptake through the gills and dietary exposure (Lee and Dobbs 1972; Neff et al. 1976; Karrow et al. 1999; Varanasi et al. 1993; Meador et al. 2006; McCain et al. 1990; Roubal et al. 1977). Fish rapidly uptake PAHs through their gills and food but also efficiently remove them from their body tissues (Lee and Dobbs 1972; Neff et al. 1976). Juvenile Chinook salmon prey, including amphipods and copepods, uptake PAHs from contaminated sediments (Landrum and Scavia 1983; Landrum et al. 1984; Neff 1982). Varanasi et al. (1993) found high levels of PAHs in the stomach contents of juvenile Chinook salmon in the Duwamish estuary, a highly contaminated industrial waterway. The primary response of exposed salmonids, from both uptake through their gills and dietary exposure, are immunosuppression and reduced growth. Karrow et al. (1999) characterized the immunotoxicity of PAHs from creosote to rainbow trout (O. mykiss) and reported a lowest observable effect concentration for total PAHs of 17 μg/l. Varanasi et al. (1993) found greater immune dysfunction, reduced growth, and increased mortality compared to control fish. In order to isolate the effects of dietary exposure of PAHs on juvenile Chinook salmon, Meador et al. (2006) fed a mixture of PAHs intended to mimic those found by Varanasi et al. (1993) in the stomach contents of field-collected fish. These fish showed reduced growth compared to the control fish. The contribution of incidental discharge of petroleum based fluids and PAHs from exhaust is likely a very small percentage of the overall PAH contaminant load in fish, but nevertheless contributes to PAH exposure among SRKWs.

Vessel Noise and Southern Resident Killer Whales - 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 2008a). 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 any species of killer whale 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).

Climate Change and Other Ecosystem Effects and Southern Resident Killer Whales

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.

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 percent of cetaceans would be affected by climate change, with 47 percent 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). More information on climate change and other whale species is presented in the Status of the Species sections for those species.

Recovery Plan – Southern Resident Killer Whale

A delisting criterion for the SR killer whale DPS is an average growth rate of 2.3 percent for 28 years (NMFS 2008a). With the current average growth rate of approximately 0.3 percent, this recovery criterion has not been met (Wiles 2016) and the low population growth rate is not sufficient to achieve recovery. There are also several demographic factors of the SR killer whale population that are cause for concern, namely the small number of breeding males (particularly in J and K pods), reduced fecundity, decreased sub-adult survivorship in L pod, and the total number of individuals in the population (NMFS 2008a).

Oil spills in Puget Sound were identified in the SR killer whale listing (70 FR 69903) as an on-going threat to the survival of the population, and the SR killer whale Recovery Plan also focuses on oil spill threats. NMFS's Southern Resident Killer Whale Recovery Plan identifies major oil spills as potentially catastrophic to killer whales and their environment, as illustrated by the probable impacts on the main resident and transient pods frequenting the area of the Exxon Valdez oil spill in Prince William Sound, Alaska, which occurred in 1989 (NMFS 2008a).

2.2.3.2 Rangewide Status of Humpback Whales

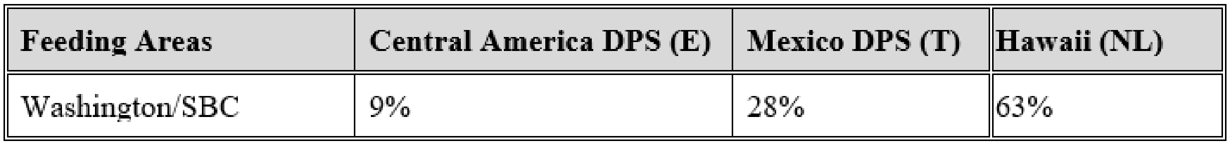
Humpback whales are found in all oceans of the world and migrate from high latitude feeding grounds to low latitude calving areas. Humpbacks primarily occur near the edge of the continental slope and deep submarine canyons, where upwelling concentrates zooplankton near the surface for feeding. Humpback whales feed on euphausiids and various schooling fishes, including herring, capelin, sand lance, and mackerel (Clapham 2009), and are considered generalists, taking a variety of prey while foraging and also switching between target prey depending on what is most abundant (Witteveen et al. 2015, Fleming et al. 2016).

Humpback whales were listed as endangered under the Endangered Species Conservation Act in June 1970 (35 FR 18319), and remained on the list of threatened and endangered species after the passage of the ESA in 1973 (35 FR 8491). The Recovery Plan for the Humpback Whale was issued in November 1991 (NMFS 1991). On September 8, 2016, NMFS published a final rule to divide the globally listed endangered humpback whale into 14 DPSs and placed four DPSs as endangered and one as threatened (81 FR 62259). The listed Humpbacks occurring in the action area are from the Central America and Mexico DPSs. The Recovery Plan (NMFS 1991) and most recent final stock assessment (NMFS 2019b) are included here by reference.

Geographic Range and Distribution/Spatial Structure/Diversity – Humpback Whale

NMFS has identified three DPSs of humpback whales that may be found off the coasts of Washington, Oregon and California. These are the Hawaiian DPS (found predominantly off the Aleutian islands/Bering Sea but extends to the Northern Washington) which is not listed under the ESA; the Mexico DPS (found all along the U.S. west coast) which is listed as threatened under the ESA; and the Central America DPS (found predominantly off the coasts of Oregon and California) which is listed as endangered under the ESA. Photo-identification matching is ongoing to assess which DPSs are present in inland waters and in what proportions. The majority of humpback whales observed in coastal waters of Washington and British Columbia are from the Hawaiian breeding population (approximately 63 percent), or Mexico (28 percent), and a few from Central American (9 percent) (Wade 2017)(Table 5). These proportions are explained in detail in a March 2021 memo outlining evaluation of the distribution and relative abundance of ESA-listed DPSs that occur in the waters off the United States West Coast as shown in Table 5 (NMFS 2021).

Table 5. Proportional estimates of each DPS that will be applied in waters off of Washington/South British Columbia. E=Endangered, T=Threatened. NL = Not Listed (adapted from Wade (2017).



Feeding Areas	Central America DPS (E)	Mexico DPS (T)	Hawaii (NL)
Washington/SBC	9%	28%	63%

This biological opinion evaluates impacts on both the Central American and Mexico DPSs of humpback whales as both are assumed to occur in the action area in the relative proportions described above. To the extent that impacts are evaluated at an individual animal level, these proportions would be used as the likelihood that the affected animal is from either DPS.

The Central America DPS is composed of humpback whales that breed along the Pacific coast of Costa Rica, Panama, Guatemala, El Salvador, Honduras and Nicaragua. Whales from this breeding ground feed almost exclusively offshore of California and Oregon in the eastern Pacific, with only a few individuals identified at the northern Washington –southern British Columbia feeding grounds.

The Mexico DPS consists of whales that breed along the Pacific coast of mainland Mexico, the Baja California Peninsula and the Revillagigedos Islands. The Mexico DPS feeds across a broad geographic range from California to the Aleutian Islands, with concentrations in California-Oregon, northern Washington – southern British Columbia, northern and western Gulf of Alaska and Bering Sea feeding grounds.

Stock Assessments - Mexico DPS and Central America DPS Humpback Whale

Current MMPA Stock Assessments for humpback whales on the west coast of the United States do not reflect the new ESA listings, thus we will refer in part to the status of the populations that are found in the action area using the existing reports (NMFS 2019b). The CA/OR/WA stock spends the winter primarily in coastal waters of Mexico and Central America, and the summer along the West Coast from California to British Columbia. As a result, both the endangered Central America DPS and the threatened Mexico DPS at times travel and feed off the U.S. west coast. The Central North Pacific stock primarily spends winters in Hawaii and summers in Alaska, and its distribution may partially overlap with that of the CA/OR/WA stock off the coast of Washington and British Columbia (Clapham 2009). There is some mixing between these populations, though they are still considered distinct stocks.

In the Stock Assessments, NMFS uses the concept of Potential Biological Removal (PBR) in the management of marine mammal stocks. The PBR level is defined as the maximum number of animals, not including in natural mortalities, that may be removed annually from a marine mammal stock [due to interactions specifically related to fisheries] while still allowing that stock to reach or maintain its optimal sustainable population level. PBRs are developed by stocks and can change over time. The MMPA requires the calculation of PBR for all stocks, including those that are considered endangered under the Endangered Species Act (ESA) and those which are managed under other authorities, such as the International Whaling Commission. However, in some cases allowable takes under these other authorities may be less than the PBR calculated under the MMPA owing to the different degrees of "risk" associated with, and the treatment of, uncertainty under each authority. Where there is a difference between the MMPA and ESA regarding the management of listed marine mammals, the more restrictive mortality requirement takes precedence.[10] Therefore, the PBR levels are discussed in this consultation to help inform the general level of risk for the overall stock, which in turn, helps to inform our biological opinion for this proposed action.

The following is copied from the Humpback Whale Stock Assessment (NMFS 2019b)

> “Approximately 15,000 humpback whales were taken from the North Pacific from 1919 to 1987 (Tonnessen and Johnsen 1982), and, of these, approximately 8,000 were taken from the west coast of Baja California, California, Oregon and Washington (Rice 1978), presumably from this stock. Shore-based whaling apparently depleted the humpback whale stock off California twice: once prior to 1925 (Clapham et al. 1997) and again between 1956 and 1965 (Rice 1974). There has been a prohibition on taking humpback whales since 1966. As a result of commercial whaling, humpback whales were listed as "endangered" under the U.S. Endangered Species Conservation Act of 1969. This protection was transferred to the U.S. Endangered Species Act (ESA) in 1973. The humpback whale ESA listing final rule (81 FR 62259, September 8, 2016) established 14 distinct population segments (DPSs) with different listing statuses. The CA/OR/WA

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[10] https://www.uscg.mil/Portals/0/Headquarters/Administrative%20Law%20Judges/NOAA%20files%202019/67.3%20Exh.%2012%20NMFS%202005%20Guidelines%20for%20Preparing%20Stock%20Assessment%20Reports%202005%20Revision%20GAMMS%20II.pdf?ver=2019-09-06-120921-687

> humpback whale stock primarily includes whales from the endangered Central American DPS and the threatened Mexico DPS, plus a small number of whales from the non-listed Hawaii DPS. Humpback whale stock delineation under the MMPA is currently under review, and until this review is complete, the CA/OR/WA stock will continue to be considered endangered and depleted for MMPA management purposes (e.g., selection of a recovery factor, stock status). Consequently, the California/Oregon/Washington stock is automatically considered as a "strategic" stock under the MMPA. The observed annual mortality and serious injury due to commercial fishery entanglements in 2013 to 2017 (17.3/yr) (Table 1 [note- this table is not reproduced in this document]), non-fishery entanglements (0.2/yr), recreational crab pot fisheries (0.35/yr), tribal fisheries (0.2/yr), serious injuries assigned to unidentified whale entanglements (2.1/yr), plus observed ship strikes (2.2/yr), equals 22.35 animals, which exceeds the PBR in U.S. waters of 16.7 animals. Estimated vessel strike deaths are 22 humpback whales annually (Rockwood et al. 2017), but this does not include vessel strikes that occur outside of the U.S. West Coast EEZ. Using this estimate of vessel strike deaths instead of the observed 2.2/yr observed value noted above, the total annual human-caused mortality of humpback whales is the sum of commercial fishery (17.3) + recreational fishery (0.35) + tribal fishery (0.2/yr) + non-fishery entanglements (0.2/yr) + serious injuries assigned to unidentified whale entanglements (2.1/yr) + vessel strikes (22/yr) or 42.1 humpback whales annually. This exceeds the range-wide PBR estimate of 33.4 humpback whales. Other than the vessel strike estimates, most data on human-caused serious injury and mortality for this population is based on opportunistic stranding and at-sea sighting data and represents a minimum count of total impacts. There is currently no estimate of the undocumented fraction of anthropogenic injuries and deaths to humpback whales on the U.S. west coast, but for vessel strikes, a comparison of observed vs. estimated annual vessel strikes suggests that approximately 10% of vessel strikes are documented. Based on strandings and at-sea observations, annual humpback whale mortality and serious injury in commercial fisheries (17.3/yr) exceeds the PBR; therefore, total fishery mortality and serious injury is not approaching zero mortality and serious injury rate. The California/Oregon/Washington stock showed a long-term increase in abundance from 1990 through approximately 2008 (Figure 2 [note-this table is not reproduced in this document]), but more recent estimates through 2014 indicate a leveling-off of the population size (Calambokidis et al. 2017)."

Abundance, Productivity and Trends – Humpback Whales

Wade (2017) estimated the abundance for the Central America DPS to be 783 individuals (Bettridge et al. 2015; Wade et al. 2016). The size of this population is relatively low compared to most other North Pacific breeding populations. The population trend for the Central America DPS is unknown (Bettridge et al. 2015). We note that the abundance estimates from Wade (2017) reflect data from surveys in 2004-2006 and there is more uncertainty in the population estimate of the Central America DPS compared to the estimates for the other two DPSs found within the project area (Carretta et al. 2019a).

Wade et al. (2016) estimated the abundance of the Mexico DPS to be 2,806 individuals based on revised analysis of the available data. Although no specific estimate of the current growth rate of this DPS is available, it is likely that the positive growth rates of humpback whales along the U.S. west coast and in the North Pacific at large that have been documented are at least somewhat reflecting positive growth of this DPS, given its relative population size. The unlisted Hawaii DPS was estimated to have a population size of 11,571 individuals (Wade 2017).

Although there are no estimates of humpback whale DPS abundance that reflect recent data, there is more recent information about humpback whale abundances along the U.S. West Coast that help shine light on how ESA-listed DPS abundances may have changed over the last 10-15 years, generally. In the most recent SARs for humpback whales that reflect data through 2014, (Carretta et al. 2019a), there are an estimated 2,374 humpback whales in the California and Oregon feeding group, and 526 in the Washington and southern British Columbia feeding group. Even more recently, Calambokidis and Barlow (2020) estimated the California and Oregon feeding group abundance of at least 3,000 humpback whales, and the Washington and southern British Columbia feeding group abundance of at least 900, using data through 2018.

Looking at these estimates produced by Calambokidis and Barlow (2020), the results suggest that the abundance of humpback whales in both feeding groups, and the U.S. West Coast collectively, has roughly doubled since the data used in the Wade (2017) analysis was collected. While it is unclear exactly how the abundance of each DPS has responded during this period, we could assume if there are at least 3,000 humpback whales off California and Oregon currently, and the previous analysis indicated Central America DPS constitutes 67 percent of the humpback whales present in the area (Wade 2017), then there should be approximately 2,000 Central American DPS humpback in just that one feeding group. Since this number of Central America DPS humpback whales is more than double the total estimate for the entire Central American DPS produced using data from 15 years ago, it is clear that current abundances and/or proportions must have changed, at least with respect to the Central America and Mexico DPSs given they are believed to constitute virtually all the whales off the coast of California and Oregon (Wade 2017). In Washington and southern British Columbia, the picture is even more complicated because of the large presence of the Hawaii DPS, although increases in the Central America and/or Mexico DPS that appear to have inevitably occurred would likely help explain part of the doubling of humpbacks that have occurred in this feeding group as well. In total we conclude it is likely that current abundance of each DPS is higher than it was 15 years ago, or that the relative proportions of humpback whale DPS in the feeding grounds have likely changed significantly, or (most likely) both to some degree. As a result, we treat the abundance estimates for each humpback whale DPS that visits U.S. West Coast feeding grounds presented in Wade (2017) as absolute minimum estimates in this biological opinion.

Limiting Factors and Threats – Humpback Whale

A comprehensive list of general threats to humpback whales is detailed in the Recovery Plan (NMFS 1991). Similar to blue and fin whales, humpbacks globally are potentially affected by a resumption of commercial whaling, loss of habitat, loss of prey (for a variety of reasons including climate variability), underwater noise, and pollutants. Entanglement in fishing gear poses a threat to individual humpback whales throughout the Pacific.

Threats Specific to the Central America and Mexico DPSs Humpback Whale - Specific threats identified for both these DPSs include human population growth in coastal communities, toxins, oil spill as it relates to offshore oil exploration, disturbance from whale watching and scientific study, disease and predation, vessel noise and vessel collisions, and entanglement in fishing gear. Additional information relevant to this opinion is presented in more detail below for some of these threats.

The estimated impact of fisheries on the CA/OR/WA humpback whale stock is likely underestimated, since the serious injury or mortality of large whales due to entanglement in gear may go unobserved because whales swim away with a portion of the net, line, buoys, or pots. Humpback whales, especially calves and juveniles, are highly vulnerable to vessel collisions, also known as ship strikes, (Stevick 1999) and other interactions with non-fishing vessels. Off the U.S. west coast, humpback whale distribution overlaps significantly with the transit routes of large commercial vessels, including cruise ships, large tug and barge transport vessels, and oil tankers in the proposed action area. Whale watching boats and research activities directed toward whales may have direct or indirect impacts on humpback whales as harassment may occur, preferred habitats may be abandoned, and fitness and survivability may be compromised if disturbance levels are too high.

Natural Threats and Humpback Whales -The most common predator of humpback whales is the killer whale, likely transient killer whales (*Orcinus orca*, Jefferson et al. (1991)). Other natural threats include exposure and effects from toxins and parasites. For example, domoic acid was detected in all 13 species examined in Alaska and had 38 percent prevalence in humpback whales. The algal toxin saxitoxin was detected in 10 of the 13 species, with the highest prevalence in humpback whales (50 percent) (Lefebvre et al. 2016). Humpback whales can also carry the giant nematode *Crassicauda boopis* (Baylis 1920), which appears to increase the potential for kidney failure in humpback whales and may be preventing some populations from recovering (Lambertsen 1992). No information specific to the various DPSs is available.

Oil Spill and Humpback Whales - The 1991 Recovery Plan (NMFS 1991) discusses oil spill threats to humpback whales, but there was not much available research at the time that the document was published in 1991. The 2015 Status Review (NMFS 2015b) that resulted in the reclassification of humpbacks into 14 different DPSs includes discussion on oil spills. Oil spill is considered a threat to humpbacks in the context of new energy exploration and associated new development of oil rigs, pipelines, and increased shipping of crude oil.

The following paragraph is taken from the 2015 Status Review:

> “Little is known about the effects of oil or petroleum on cetaceans and especially on mysticetes. Oil spills that occur while whales are present could result in skin contact with the oil, baleen fouling, ingestion of oil, respiratory distress from hydrocarbon vapors, contaminated food sources, and displacement from feeding areas (Geraci et al. 1989). Actual impacts would depend on the extent and duration of contact, and the characteristics of the oil. Most likely, the effects of oil would be irritation to the respiratory membranes and absorption of hydrocarbons into the bloodstream (Geraci et al. 1989). Polycyclic aromatic hydrocarbons (PAHs) are components of crude oil which are not easily degraded and are insoluble in water, making them quite detrimental in the

> marine environment (Pomilla et al. 2004). PAHs have been associated with proliferative lesions and alteration to the immune and reproductive systems (Martineau et al. 2002). Long term ingestion of pollutants, including oil residues, could affect reproduction, but data are lacking to determine how oil may fit into this scheme for humpback whales. Although the risk posed by operational oil rigs is likely low, failures and catastrophic events that may result from the presence of rigs pose high risks. Since the BRT had already determined that threat assessments would focus on present threats, the mere presence of oil rigs was not interpreted to warrant a threat level above low. However, the level of impact that such a catastrophic event may have on a population was considered in the evaluations."

Oil Spill Specific to Central America and Mexico DPSs Humpback Whale - In regard to oil spill, the 2015 Status Review discusses oil spill in the context of offshore energy development for both of these DPSs with the same conclusion for both DPSs: "Energy exploration and development activities are present in this population's habitat range. There are currently numerous active oil and energy leases and offshore oil rigs off the U.S. west coast. Offshore LNG terminals have been proposed for California and Baja California. The feeding grounds for [both] population[s] are therefore an active area with regard to energy exploration and development. However, there are no plans at present to open the West Coast to further drilling. . . . Currently, the threat posed to [both] population[s] by energy exploration and development is low, and is considered stable" (NMFS 2015b).

Vessel Collisions Specific to Central America and Mexico DPSs Humpback Whale. The 2015 Status Review notes that vessel collisions and entanglement in fishing gear pose the greatest threat to this population. For the Central America DPS, particularly high levels of large vessel traffic are found in this population's range off Panama, southern California, and San Francisco. Several records exist of ships striking humpback whales (Carretta et al. 2008; Douglas et al. 2008), although it is likely that not all incidents are reported. Two deaths of humpback whales were attributed to ship strikes along the U.S. West Coast in 2004-2008 (Carretta et al. 2010). Ship strikes are probably underreported and the level of associated mortality is also likely higher than the observed mortalities. Vessel collisions were determined to pose a medium risk (level 2) to this population, especially given the small population size. Shipping traffic will probably increase as global commerce increases; thus, a reasonable assumption is that the level of ship strikes will also increase. For the Mexico DPS, the 2015 Status Review noted the same two ship strikes mentioned above. It is not known what DPS those whales belonged to. The threat level of ship strikes or the certainty is not mentioned in the report for the Mexico DPS.

Vessel Noise and Humpback Whales - Anthropogenic sound has increased in all oceans over the last 50 years and is thought to have doubled each decade in some areas of the ocean over the last 30 or so years (Croll et al. 2001; Weilgart 2007). Low-frequency sound comprises a significant portion of this and stems from a variety of sources including shipping, research, naval activities, and oil and gas exploration. Understanding the specific impacts of these sounds on baleen whales, and humpback whales specifically, is difficult. However, it is clear that the geographic scope of potential impacts is vast, as low-frequency sounds can travel great distances under water. Frankel and Clark (2000) found that the distance between surfacing by humpback whales increased with a greater received sound level in Hawaii, showing some behavioral reaction to experiencing louder noises by these whales.

It does not appear that humpback whales are often involved in strandings related to noise events. There is one record of two humpback whales found dead with extensive damage to the temporal bones near the site of a 5,000-kg explosion, which likely produced shock waves that were responsible for the injuries (Weilgart 2007). Other detrimental effects of anthropogenic noise include masking and temporary threshold shifts (TTS).

The 2015 Status Review, prepared by NOAA's biologic review team (BRT) for humpback whales gives this summary for threats to the various DPSs in the Pacific Ocean. Note that Okinawa/Philippines and Second West Pacific DPS do not occur in the action area (NMFS 2015b/Bettrideg et al., 2015):

> "In the Pacific Ocean, all threats are considered likely to have no or minor impact on population size and/or the growth rate or are unknown, with the following exceptions: Energy development, whaling, and competition with fisheries are considered likely to moderately reduce the population size or the growth rate of the Okinawa/Philippines DPS. Vessel collisions are considered likely to moderately reduce the population size or the growth rate of the Central America and Okinawa/Philippines DPSs. Fishing gear entanglements are considered likely to moderately reduce the population size or the growth rate of the Hawaii, Central America, and Mexico DPSs and likely to seriously reduce the population size or the growth rate of the Okinawa/Philippines DPS. In general, there is great uncertainty about the threats facing the Second West Pacific DPS."

Vessel Noise Specific to Central America and Mexico DPSs Humpback Whale. The 2015 Status Review states both of these populations are likely exposed to relatively high levels of underwater noise resulting from human activities, including commercial and recreational vessel traffic, and activities in U.S. Navy test ranges. Exposure is likely chronic and at relatively high levels. It is not known if exposure to underwater noise affects humpback whale populations, and this threat does not appear to be significantly impacting current population growth of the Central America DPS.

For the Mexico DPS, the population is also likely exposed to relatively high levels of underwater noise resulting from human activities. The overall population-level effects of exposure to underwater noise are not well-established, but exposure is likely chronic and at relatively high levels. As vessel traffic and other activities are expected to increase, the level of this threat is expected to increase. The BRT considers the level of confidence in this information to be moderate.

Climate Change Specific to Central America and Mexico DPSs Humpback Whales - For the Central America DPS Humpback Whale, the 2015 Status Review states that, "Overall population level effects from global climate change are not known; nonetheless, any potential impacts resulting from this threat will almost certainly increase." Humpback whales feeding off southern and central California have a flexible diet that includes both krill and small pelagic fishes. Acidification of the marine environment has been documented to impact the physiology and development of krill and other calcareous marine organisms which may reduce their abundance and subsequent availability to humpback whales in the future (Kurihara 2008). However, 2015 Status Review acknowledges that, "the diet flexibility of humpback whales in this region may give this population some resilience to a climate change effect on their prey base compared to Southern Hemisphere humpback whales that have a more narrow krill-based diet. Currently, climate change does not pose a significant threat to the growth of this population."

For the Mexico DPS, overall population level effects from global climate change are not known; nonetheless, any potential impacts resulting from this threat will almost certainly increase. The BRT concluded that currently climate change is not a risk to the DPS, but the level of confidence in the magnitude of this threat is poor.

Extinction Risk Summary Central America and Mexico DPSs Humpback Whale

The 2015 Status Review for the Central America Humpback DPS concludes that this DPS is at moderate risk of extinction:

> "Extinction Risk
> [….] In light of historical records of whaling on the feeding grounds of this population and neighboring feeding grounds, this population likely remains well below preexploitation size despite observed positive population trends in other populations over the past decades. The Bay City, WA shore station took 1,331 humpback whales from 1911-1919 (Clapham et al. 1997). Shore stations at Moss Landing and Trinidad in California took 1,871 humpback whales between 1919 and 1926 (Clapham et al. 1997). When combined with records from factory ships operating off Alaska and the shore station at Bay City, WA, 5,084 humpback whales were taken from 1919-1926 (Clapham et al. 1997). From 1956-1965, a further 841 humpback whales were killed by California shore whaling stations, likely depleting this population again while numbers were still low from the earlier 1900s (Clapham et al. 1997). Entanglement scarring rates in this population indicate a significant interaction with fishing gear and vessel collisions may be impacting population growth to a small degree. The Central America DPS is therefore considered to be at moderate risk of extinction over the next three generations (a conclusion that was supported by 56% of votes by the BRT). The potential for this DPS to be at high risk of extinction was also considered and received 28% of the votes, largely reflecting uncertainty regarding population size and population trend. The potential for this DPS to not be at risk was given 16% of the votes."

The 2015 Status Review for the Mexico DPS humpback whale indicates that this DPS is not at risk of extinction:

> "Extinction Risk
> [….] Considering the current estimated size and growth of this DPS, coupled with an assessment of threats that are not expected to severely curtail growth or threaten the existence of the DPS as a whole, the BRT allocated 92% of votes to "not at risk" of extinction, and 8% of votes to "moderate risk" of extinction. The 8% of votes for "moderate risk" reflect the threat of entanglement and the unknown severity of the threats disease and parasites, but given the large (and increasing) population size, these threats are not likely to significantly impact the DPS."

Recovery Plan – Humpback Whale

The 1991 Recovery Plan for humpback whales outlines four key actions: (1) Maintain and enhance habitats used by humpback whales, (2) Identify and reduce direct human-related mortality injury, (3) Improve administration and coordination of recovery program, and (4) Measure and monitor key population parameters (NMFS 1991).

2.2.3.3 Rangewide Status of Blue Whales

The blue whale, *Balaenoptera musculus,* was listed as endangered worldwide under the precursor to the ESA, the Endangered Species Conservation Act of 1969, and remained on the list of threatened and endangered species after the passage of the ESA in 1973 (35 Fed. Reg. 8491) (June 2, 1970)) (codified at 50 C.F.R. §§ 17). The entire species remains endangered under the ESA. There is no designated critical habitat for blue whales. NMFS recognizes four different stocks of blue whales under the MMPA. See 16 USC § 1386. Blue whales were subject to intensive commercial whaling, with over 380,000 blue whales taken in 1868-1978, mostly from Antarctic waters (Branch et al. 2008). The global population abundance is estimated to be 10,000-25,000 blue whales, or between 3-11 percent of the 1911 population size (Reilly et al. 2008). Although still depleted compared to historical abundance, blue whale populations around the world show signs of growth. The blue whales most likely to be observed within the action area are identified as the Eastern North Pacific stock. The 2018 Draft Recovery Plan (NMFS 2018a) and 2019 Stock Assessment (NMFS 2019c) are incorporated here by reference.

Geographic Range and Distribution/Spatial Structure/Diversity – Blue Whale

Blue whales are globally distributed and listed under the ESA as one global population. Blue whales are found in all oceans of the world except the Arctic. The blue whales most likely to be within the action area are part of the Eastern North Pacific Stock.

Abundance, Productivity, and Trends- Eastern North Pacific Blue Whale

No ESA 5-Year Status Review is available for blue whale. The most-recent abundance estimate is 1,496 whales with a minimum population size of 1,050 whales, based on the 2014 line-transect survey within the California Current (Barlow 2016).

The following is taken from the most recent final Stock Assessment (2019c):

> “STATUS OF STOCK
>
> “As a result of commercial whaling, blue whales were listed as "endangered" under the U.S. Endangered Species Conservation Act of 1969. This protection was transferred to the U.S. Endangered Species Act in 1973. Despite a current analysis suggesting that the Eastern North Pacific population is at 97% of carrying capacity (Monnahan et al. 2015), blue whales are listed as “endangered”, and consequently the Eastern North Pacific stock is automatically considered a "depleted" and "strategic" stock under the MMPA. Conclusions about the population’s current status relative to carrying capacity depend upon assumptions that the population was already at carrying capacity before commercial

> whaling impacted the population in the early 1900s, and that carrying capacity has remained relatively constant since that time (Monnahan et al. 2015). If carrying capacity has changed significantly in the last century, conclusions regarding the status of this population would necessarily change (Monnahan et al. 2015). The observed and assigned annual incidental mortality and injury rate from ship strikes (0.4/yr) and commercial fisheries (≥ 1.44 /yr), totals 1.84 whales annually from 2013-2017. This exceeds the calculated PBR of 1.23 for this stock of blue whales. Furthermore, observations alone are not representative of impacts due to incomplete detection of vessel strikes and fishery entanglements, and the estimated vessel strike mortality (18/yr) exceeds the PBR for this stock of blue whales and does not include vessel strikes outside of the U.S. EEZ. Monnahan et al. (2015) proposed that estimated ship strike levels of 10 – 35 whales annually did not pose a threat to the status of this stock, but estimates of carrying capacity of this blue whale stock differed depending on the level of ship strikes: 97% of K with 10 annual strikes and 91% of K with 35 annual strikes. The highest estimates of blue whale ship strike mortality (35/yr; Monnahan et al. (2015) and 40/yr; Rockwood et al. (2017) are similar, and annually represent approximately 2% of the estimated population size. Observed and assigned levels of serious injury and mortality due to commercial fisheries (≥ 1.44) exceed the stock's PBR (1.23), thus, commercial fishery take levels are not approaching zero mortality and serious injury rate."

Limiting Factors and Threats – Blue Whale

The 2018 Draft Blue Whale Recovery Plan (NMFS 2018a) identifies the following limited factors and treats: directed hunting, ship strikes, entanglement in marine debris and fishing gear, anthropogenic noise, and loss of prey base due to climate and ecosystem change. The following summaries are taken from the draft plan and provide more detailed information on threats pertinent to this opinion. The draft plan notes that other stressors were identified, but it was determined that there is currently no evidence that the effects (which may even include the loss of individual blue whales) have population-level consequences or are significant enough to contribute to the species' extinction risk.

Oil Spill and Blue Whales- Because blue whales are globally distributed, oil spill is not identified in the 2018 Draft Recovery Plan as a threat that would impede recovery of the global population. The draft plan notes that individual blue whales may experience potentially severe health effects from exposure to oil and other chemicals involved in spill response, but their wide distribution blue and movements would be "expected to lessen the population-, subspecies-, or species-level impact of such spills. For this reason, oil spills are not considered to be impeding the recovery of blue whales."

Vessel Collisions and Blue Whales- Ship strikes on blue whales are of particular concern in certain areas of the world where blue whales overlap with heavy shipping lanes, particularly off California for the Eastern North Pacific stock. While blue whales do exhibit avoidance behavior to vessels at times, their responses are of limited effectiveness due to slow descents with no horizontal movements away from ships (McKenna et al. 2015).There is evidence to suggest that despite the number of ship strikes off California exceeding PBR, ship strikes do not appear to be a significant limiting factor (Monnahan et al. 2014). Models generated by Rockwood et al. (2019) suggest a higher strike level of blue whales than the models used by

Monnahan et al (2014). More information on ship strikes of blue whales in the action area is presented under Baseline Section 2.3.5.

Vessel Noise and Blue Whale- The 2018 Draft Blue Whale Recovery Plan discusses anthropogenic noise and effects to blue whales. The plan acknowledges that the effects from anthropogenic noise “may range from no effect to potentially significant effects on whales’ fitness and their habitat; likely varies by population. Research needed to determine the degree of impact.” Potential impacts include altering important behavioral patterns, physiological effects such as hearing impairment or stress, and masking critical acoustic cues, and the results of these range from no effect to potentially significant effects on the fitness of marine mammals and their habitat, depending on the context and scale of the noise exposures (Southall et al. 2007).

Recovery Plan – Blue Whale

The 2018 Draft Blue Whale Recovery Plan notes that commercial whaling was the main cause of blue whales’ historical decline, and is not a current operative threat only because an international moratorium remains in place. Therefore, a primary strategy of the Revised Recovery Plan is to maintain the international ban on commercial hunting that was instituted in 1986. Additionally, this Plan provides a strategy to improve the understanding of how potential threats may be limiting blue whale recovery. The Plan provides a research strategy to obtain data necessary to determine blue whale taxonomy, population structure, distribution, and habitat, which can then inform estimation of population abundance and trends. After the populations and their threats are more fully understood, the Plan will be modified to more specifically include actions to minimize any threats that are determined to be limiting recovery.

More information about the status of blue whales in the action area is presented in Section 2.3.9 under Baseline Conditions of Blue Whales.

2.2.3.4 Rangewide Status of Fin Whales

Fin whales, like most large baleen whales, are currently listed as endangered under the ESA. Fin whales were listed as endangered worldwide under the precursor to the ESA, the Endangered Species Conservation Act of 1969, and remained on the list of threatened and endangered species after the passage of the ESA in 1973 (35 Fed. Reg. 8491) (June 2, 1970) (codified at 50 C.F.R. § 17.11(h)). There is no designated critical habitat for fin whales. The fin whales most likely to be observed within the proposed action area are identified as the CA/OR/WA stock. The most recent Stock Assessment report (NMFS 2018b), 5- Year Status Review (NMFS 2019c1), and Recovery Plan (NMFS 2010a) are incorporated here by reference.

Geographic Range and Distribution/Spatial Structure/Diversity – Fin Whale

Fin whales are listed as one global population under the ESA. They are found in deep, offshore waters of all major oceans, primarily in temperate to polar latitudes. They are less common in the tropics. They occur year-round in a wide range of locations, but the density of individuals in any one area changes seasonally. The fin whales most likely to occur in the action area are from the California-Oregon-Washington stock.

Abundance, Productivity, and Trends – Fin Whale

The ESA 5-Year Status Review for fin whale dated February 2019 indicates that fin whale populations are increasing, particularly along the U.S. West Coast (NMFS 2019c1). The 2018 Stock Assessment for fin whales from the California-Oregon-Washington (CA/OR/WA) stock indicates that this population has increased since 1991 and it numbers approximately 9,029 animals based on line-transect observations from 1991- 2014 estimate with a minimum population estimate of 8,127 individuals (NMFS 2018b, Carretta et al., 2018). The population appears to be growing with a 5-fold increase since 1991.

The 5-Year Status Review for fin whales offers the following conclusion for the North Pacific fin whale (NMFS 2018b):

> "Before whaling, the total North Pacific fin whale population was estimated at 42,000–45,000, based on catch data and a population model (Ohsumi and Wada 1974; Omura and Ohsumi 1974). The population in the eastern North Pacific in 1973 was estimated to be 8,000–11,000 fin whales (Ohsumi and Wada 1974). From a crude analysis of catch statistics and whaling effort, Rice (1974) concluded that the population of fin whales in the eastern North Pacific declined by more than half between 1958 and 1970, from about 20,000 to 9,000 "recruited animals" (i.e., individuals longer than the minimum length limit of 50 ft.). Chapman (1976) concluded that the "American stock" had declined to about 38% and the "Asian stock" to 36% below their Maximum Sustainable Yield (MSY) levels (16,000 and 11,000, respectively) by 1975. These abundance estimates derived from CPUE techniques are not certain, therefore, the absolute values of the cited abundance estimates should not be relied upon (International Whaling Commission (IWC) 1989). An abundance estimate for 2014 off California, Oregon, and Washington based on line-transect data from 1991 through 2014 was 9,029 (CV=0.12) whales (Nadeem et al. 2016). Based on this data, NMFS (2016[b]) estimated the minimum population for fin whales to be approximately 8,127 whales. There is now evidence of recovery in California coastal waters. Fin whale abundance off California approximately doubled between 1991 and 1993, from approximately 1,744 (CV = 0.25) to 3,369 (CV= 0.21), which may suggest dispersal of animals into this area. Mean annual abundance from 1991 to 2014 increased 7.5% off California, Oregon, and Washington, although abundance appeared stable between 2008 and 2014 (NMFS 2016[b]). Fin whales were considered common off the outer coast of Washington in the 1800s and early 1900s, but whaling depleted the population, and Washington recently recommended the fin whale remain as a state endangered species (Wiles 2017). Population increases off the U.S. west coast are expected to continue, although annual fluctuations in the population growth rate are anticipated (Moore and Barlow 2011)."

Limiting Factors and Threats – Fin Whale

The 2010 Fin Whale Recovery Plan identifies the main threats to fin whales as collisions with vessels, direct harvest, and possibly competition for resources, loss of prey base due to climate change, and disturbance from anthropogenic noise (NMFS 2010a). Other potential (but likely low impact) threats include entanglement in fishing gear, disturbance from vessels and tourism, contaminants and pollutants, disease, injury from marine debris, disturbance due to research, and predation and natural mortality. Collisions with vessels are considered a high threat. Reduced prey abundance is considered a medium threat as trends in fish populations, whether driven by fishery operations, human-caused environmental deterioration, or natural processes, may strongly affect the size and distribution of fin whale populations. The effects of ever-increasing anthropogenic noise are unknown.

Fin whales off the U.S. West Coast are known to be injured or die from interactions with fishery gear and from vessel strikes. The 2018 Stock Assessment for fin whales from the California-Oregon-Washington (CA/OR/WA) stock summarizes fisheries interactions and ship strikes as PBR as follows (NMFS 2018b):

> “The total observed incidental mortality and serious injury (2.1/yr), due to fisheries (0.5/yr), and ship strikes (1.6/yr), is less than the calculated PBR (81). However, observations alone underestimate true impacts due to incomplete detection of vessel strikes and fishery entanglements. Total fishery mortality is less than 10% of PBR and, therefore, may be approaching zero mortality and serious injury rate.
>
> Estimated vessel strike mortality is 43 whales annually, or approximately 0.5% of the estimated population size. As these estimates are model-derived, they are inherently corrected for undocumented and undetected cases, but they represent only a portion of the year (July-December) for which habitat model data are available. The worst-case vessel strike estimate of mortality is 95 whales, based on no avoidance of vessels, or approximately 1% of the estimated population size. Neither vessel strike estimate includes incidents outside of the U.S. West Coast EEZ.”

The following are relevant excerpts from the Fin Whale Recovery Plan (NMFS 2010a). The main threats identified include vessel collisions, reduced prey abundance from overfishing and/or climate change, and illegal whaling or potential resumed legal whaling, and possible effects of increasing noise.

Oil Spill and Fin Whales - The 2010 Fin Whale Recovery Plan ranks oil spill as a relatively low threat/impact on recovery of the species. Oil spills that occur while fin whales are present could result in skin contact with the oil, baleen fouling, ingestion of oil, respiratory distress from hydrocarbon vapors, contaminated food sources, and displacement from feeding areas (Geraci 1990). Actual impacts would depend on the extent and duration of contact, and the characteristics (age) of the oil. Most likely, the effects of oil would be irritation to the respiratory membranes and absorption of hydrocarbons into the bloodstream (Geraci 1990). If a marine mammal was present in the immediate area of fresh oil, it is possible that it could inhale enough vapors to affect its health. Long term ingestion of pollutants, including oil residues, could affect reproductive success, but data are lacking to determine how oil may fit into this scheme for fin whales. The Plan concludes that, in general, the threat from contaminants and pollutants occurs at a low severity and there is a medium level of uncertainty. Thus, the relative impact to recovery of fin whales due to contaminants and pollution is ranked as low. However, this ranking may need to be elevated if future data indicate reproductive rates are indeed impacted by exposure to contaminants or pollution.

Vessel Collisions and Fin Whales - Fin whales generally occur far offshore which makes detecting ship strikes difficult. The 2010 Fin Whale Recovery Plan ranks this threat as having medium severity with a high level of uncertainty as to the true impact to the population. The plan concludes that the relative impact to recovery of fin whales due to ship strikes is unknown but potentially high. From 1993-2002 a minimum of five were killed off the west coast of the U.S. During 2002–2006, ship strikes were implicated in the deaths of seven fin whales from the California/Oregon/Washington stock and the injury of another (Carretta et al. 2009) and in 2008, at least one confirmed mortality by ship strike of one fin whale occurred (California Marine Mammal Stranding Database, U.S. Department of Commerce 2009). Two additional fin whales from the California/Oregon/Washington stock stranded dead in California in 2007, but cause of death was not determined. From 2006–2008, an additional five unidentified cetaceans (likely baleen whales) were killed due to ship strikes and were reported in California (California Marine Mammal Stranding Database, U.S. Department of Commerce 2009). Four fin whales were struck off the Northwest coast of the United States; three were identified in Washington and one was identified in Oregon. Because many ship strikes go either undetected or unreported, these are minimum estimates. From 2008 to 2018, vessel strikes were the cause of death for 21 fin whales, of which four of these strikes occurred in Washington (Carretta et al. 2013; Carretta et al. 2017; Carretta et al. 2020).

The possible impacts of ship strikes on recovery of fin whale populations is not well understood. The more offshore distribution of fin whales increases the overlap with shipping traffic along the West Coast, but also means that strikes are less likely to be observed. However, fin whales are more likely to be transported in on bows than blue or humpback whales (Rockwood et al. 2017). Because many ship strikes go unreported or undetected for various reasons and the offshore distribution of fin whales may make collisions with them less detectable than with other species, the estimates of serious injury or mortality should be considered minimum estimates, thus there is a high level of uncertainty associated with the evidence presented above. The threat occurs at a medium severity, but with the high level of uncertainty, the relative impact to recovery of fin whales due to ship strikes is ranked as unknown but potentially high by the BRT.

Vessel Noise and Fin Whales - Similar to the information presented for blue whales, possible impacts of the various sources of anthropogenic noise have not all been well studied on fin whales. The 2010 Fin Whale Recovery Plan states that the threat occurs at an unknown severity and there is a high level of uncertainty. Thus, the relative impact of anthropogenic noise to the recovery of fin whales due to anthropogenic noise is ranked as unknown. Effects of anthropogenic noise continue to be investigated, but whether actions are necessary to address potential effects remains unknown.

The 5 Year Status Review (NMFS 2011a) for the North Pacific population, reviewed available science and states that controlled exposure experiments are being conducted to evaluate the effect of mid-frequency sound on a variety of marine mammals, including large whale species (Southall et al. 2011). Preliminary results indicate variable responses, depending on species, type of sound, and behavioral state during the experiments. Some observations in certain conditions suggest avoidance responses, while in other cases subjects seemed unresponsive. These studies include documenting fine scale calling behavior as a baseline to understand the effects anthropogenic sources may have on fin whales (Stimpert et al. 2015). Redfern et al. (2017)

examined the co-occurrence of blue, fin, and humpback whales with sound from commercial shipping off southern California and identified several regions of overlap where the acoustic habitat of these species was degraded by noise. Fin whales may modify their calls in the presence of high noise conditions resulting from ship traffic and airguns (Castellote et al. 2012). The 5-Year review concludes that the possible impacts of the various sources of anthropogenic noise on fin whales requires further study.

Recovery Plan Fin Whale

The 2010 Fin Whale Recovery Plan identifies nine measures in the recovery strategy for this species. Key elements of the recovery program for this species are 1) coordinate state, federal, and international actions to implement recovery efforts; 2) determine population discreteness and stock structure; 3) develop and apply July 2010 vi NMFS methods to estimate population size and monitor trends in abundance; 4) conduct risk analyses; 5) identify and protect habitat essential to fin whale survival and recovery; 6) identify causes of and minimize human-caused injury and mortality; 7) determine and minimize any detrimental effects of anthropogenic noise in the oceans; 8) maximize efforts to acquire scientific information from dead, stranded, and entangled or entrapped fin whales; and 9) develop a post-delisting monitoring plan.

More information on the status of fin whales in the action area is presented in Section 2.3.1 Baseline Conditions of Fin Whales.

2.2.3.5 Rangewide Status of Western North Pacific Gray Whales

The WNP gray whale is listed as a distinct population segment (DPS), separate from other gray whales under the ESA. The DPS encompasses the same population as the stock under MMPA. Off the Oregon and Washington coasts, the occurrence of the non-listed Eastern North Pacific gray whales is much more common, with population estimates of approximately 20,000 animals (Calambokidis *et al.* 1998). The Eastern North Pacific stock was delisted from the ESA in 1993, therefore we are not analyzing the Eastern North Pacific stock in this opinion. The WNP gray whale is listed as endangered under the ESA.

The most recent stock assessment is incorporated here by reference and can be found at:

https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock

Geographic Range and Distribution/Spatial Structure/Diversity –WNP Gray Whale

The primary range of WNP gray whales is along the east coast of the Asia continent in the Western North Pacific Ocean. However, tagging, photo-identification, and genetic studies have identified WNP gray whales in Russian foraging areas along the Aleutian Islands, through the Gulf of Alaska, and south to the Washington State and Oregon coasts (Mate *et al.* 2011), and to the southern tip of Baja California and back to Sakhalin Island (IWC 2012).

Abundance, Productivity, and Trends – WNP Gray Whale

The WNP gray whales are rare, with population estimates of approximately 200 individuals (220 including calves) (Cook 2018; Moore et al. 2018). The 2018 Stock Assessment primarily focuses on technical genetic information being gathered to identify very basic information used to delineate these whales as a distinct population or stock.

The following is taken from the 2018 Stock Assessment summary (NMFS 2018c):

> "STATUS OF STOCK
> The WNP stock is listed as "Endangered" under the U.S. Endangered Species Act of 1973 (ESA) and is therefore also considered "strategic" and "depleted" under the MMPA. At the time the ENP stock was delisted, the WNP stock was thought to be geographically isolated from the ENP stock. Documentation of some whales moving between the WNP and ENP indicates otherwise (Lang 2010; Mate et al. 2011; Weller et al. 2012; Urbán et al. 2013). Other research findings, however, provide continued support for identifying two separate stocks of North Pacific gray whales, including: (1) significant mitochondrial and nuclear genetic differences between whales that feed in the WNP and those that feed in the ENP (LeDuc et al. 2002; Lang et al. 2011), (2) recruitment into the WNP stock is almost exclusively internal (Cooke et al. 2013), (3) a single nucleotide polymorphism (SNP) study that indicates the gray whale gene pool is differentiated into two populations (Brüniche-Olsen et al. 2018) and (4) the abundance of the WNP stock remains low while the abundance of the ENP stock grew steadily following the end of commercial whaling (Cooke et al.2017). As long as the WNP stock remains listed as endangered under the ESA, it will continue to be considered as depleted under the MMPA.
>
> The IWC Scientific Committee has conducted a series of annual (2014-2018) range-wide workshops on the status of North Pacific gray whales. The objective of the workshops has been to develop a series of range-wide stock structure hypotheses, using all available data sources (e.g. photo-id, genetics, tagging), that can be tested within a modelling framework (IWC 2017). Cooke et al. (2017) conducted an updated assessment of gray whales in the WNP using an individually-based stage-structured population model with modified stock definitions that allows for the possibility of multiple feeding/breeding groups. Cooke et al. (2017) noted that "there is preferential, but not exclusive, mating within the Sakhalin feeding aggregation. The hypothesis of mating exclusively within the Sakhalin feeding population is just rejected ($p < 0.05$). We conclude that the Sakhalin feeding aggregation is probably not genetically closed but that the Sakhalin and Kamchatka feeding aggregations, taken together, may be genetically closed. However, genetic data from Kamchatka would be required to confirm this." In this scenario, whales identified feeding off Sakhalin represent about 2/3 of the combined Sakhalin Island-Kamchatka subpopulation. Further substructure within the subpopulation was not excluded by Cooke et al. (2017), including the possibility of less than 50 mature whales that breed only in the WNP. The IWC analysis is ongoing and the results of Cooke et al. (2017) are considered provisional pending further exploration of additional gray whale stock structure hypotheses."

Limiting Factors and Threats – WNP Gray Whale

The WNP gray whales face similar threats to the Eastern North Pacific gray whales of entanglement in fishing gear, vessel strikes, disturbance from whale watching, and ocean noise.

Recovery Plan - WNP Gray Whale

No Recovery Plan for this species has been created. No ESA 5-Year Status Review is available for this species.

More information related to WNP gray rights whales in the action area is presented in Section 2.3.11 Baseline Conditions.

2.2.3.6 Rangewide Status of North Pacific Right Whales

The North Pacific right whale has been listed as endangered under the Endangered Species Act since 1973 when it was listed as the "northern right whale." It was originally listed as endangered under the Endangered Species Conservation Act, the precursor to the ESA, in June 1970. The species is also designated as depleted under the Marine Mammal Protection Act.

In 2005, the Center for Biological Diversity petitioned NOAA Fisheries to list the North Pacific right whale, as endangered, and NOAA Fisheries issued a 90-day finding. In 2006, the Center for Biological Diversity filed its intent to sue after NOAA Fisheries did not make a 12-month finding. In 2008, NOAA Fisheries reclassified the endangered northern right whale as two separate, endangered species: North Pacific right whale (*E. japonica*) and North Atlantic right whale (*E. glacialis*). Critical habitat of North Pacific right whales is designated in the Bering Sea and the Gulf of Alaska, outside of the action area (73 FR 19000-19014).

North Pacific right whales are among the rarest of all marine mammal species. Two other species of right whale exist in the world’s oceans: the North Atlantic right whale, which is found in the North Atlantic Ocean, and the southern right whale, which is found in the southern hemisphere. North Pacific right whales are baleen whales, which feed by straining huge volumes of ocean water through their comb-like baleen plates that trap shrimp-like krill and small fish.

Commercial whaling greatly reduced right whale populations in the Pacific Ocean. Human activity such as entanglement in fishing gear and marine debris, vessel strikes, impacts from climate change, and ocean noise, continue to endanger this species (https://www.fisheries.noaa.gov/species/north-pacific-right-whale). There are no reliable estimates of current abundance or trends for right whales in the North Pacific. The North Pacific right whale population is very small, likely in the low 100s, and most sightings have been of single whales, though small groups have been sighted. The most recent Stock Assessment report (NMFS 2019d), Recovery Plan (NMFS 2013a), and 2017 5-Year Status Review (NMFS 2017a) are incorporated here by reference.

Geographic Range and Distribution/Spatial Structure/Diversity – North Pacific Right Whale

North Pacific Right Whale Recovery Plan contains the following summary on the geographic range and distribution of the North Pacific right whales. Past commercial whaling depleted North Pacific right whales, with the species now likely numbering fewer than 500 individuals. There are two populations within the species of North Pacific right whales. The eastern population is located primarily in the U.S. Exclusive Economic Zone (EEZ), with an estimated historical seasonal migration range extending from the Bering Sea and Gulf of Alaska in the north down the west coast of the United States to Baja California in the south. The eastern population is estimated to consist of approximately 30 individuals. The western population is located primarily in the EEZs of the Russian Federation, Japan, and China. Its estimated historical seasonal migration range extends from north of the Okhotsk Sea to the coasts of China and Vietnam to the south.

Right whale sightings have been very rare (notably for the eastern population) and geographically scattered, leading to persistent uncertainty regarding population size and distribution. Small populations and rarity of sightings make it very difficult to estimate current range, habitat use, and population parameters. Therefore, a primary goal of this Recovery Plan is to gain more data needed for effective management.

Abundance, Productivity, and Trends – North Pacific Right Whale

The following is taken from the 2019 Stock Assessment summary (NMFS 2019d):

> “The right whale is listed as endangered under the Endangered Species Act of 1973, and therefore designated as depleted under the Marine Mammal Protection Act. In 2008, NMFS relisted the North Pacific right whale as endangered as a separate species (*Eubalaena japonica*) from the North Atlantic species, E. glacialis (73 FR 12024, 06 March 2008). As a result, the stock is classified as a strategic stock. The abundance of this stock is considered to represent only a small fraction of its pre-commercial whaling abundance, i.e., the stock is well below its Optimum Sustainable Population (OSP). The minimum estimated mean annual level of human-caused mortality and serious injury is unknown for this stock. The reason(s) for the apparent lack of recovery for this stock is (are) unknown. Brownell et al. (2001) and Ivashchenko and Clapham (2012) noted the devastating impact of extensive illegal Soviet catches in the eastern North Pacific in the 1960s, and both suggested that the prognosis for right whales in this area was poor. Biologists working aboard the Soviet factory ships that killed right whales in the eastern North Pacific in the 1960s considered that the fleets had caught close to 100% of the animals they encountered (Ivashchenko and Clapham 2012); accordingly, it is quite possible that the Soviets killed the great majority of the animals in the population at that time. In its review of the status of right whales worldwide, the IWC expressed “considerable concern” over the status of this population (IWC 2001), which is currently the most endangered stock of large whales in the world for which an abundance estimate is available. A genetic analysis of biopsy samples from North Pacific right whales found an apparent loss of genetic diversity, low frequencies of females and calves, extremely low effective population size, and possible isolation from conspecifics in the western

> Pacific indicating that right whales in the eastern North Pacific are in severe danger of immediate extirpation from the eastern North Pacific (LeDuc et al. 2012).
>
> There are key uncertainties in the assessment of the Eastern North Pacific stock of North Pacific right whales. The abundance of this stock is critically low and migration patterns, calving grounds, and breeding grounds are not well known. There appear to be more males than females in the population and calf production is very low. PBR is designed to allow stocks to recover to, or remain above, the maximum net productivity level (MNPL) (Wade 1998). An underlying assumption in the application of the PBR equation is that marine mammal stocks exhibit certain dynamics. Specifically, it is assumed that a depleted stock will naturally grow toward OSP, and that some surplus growth could be removed while still allowing recovery. However, the Eastern North Pacific right whale population is far below historical levels and at a very small population size, and small populations can have different dynamics than larger populations from Allee effects and stochastic dynamics. Although there is currently no known direct human-caused mortality, given the small number of animals estimated to be in the population, any human-caused mortality or serious injury from ship strikes or commercial fisheries is likely to have a serious population-level impact."

The 2017 5-Year Status Review for North Pacific Right Whales concluded that due to insufficient data, a high demographic risk, and major risks that are not well understood, this species remains endangered (NMFS 2017a). Very little is known of the current size and distribution of right whales in the North Pacific. Only 43 right whales were observed in the 1980s and 1990s in the eastern North Pacific, with five of those occurring off California or Mexico and one off the coast of Washington. The one whale was sighted off Washington in 1992, while none have been sighted off of Oregon as of 2001 (Brownell *et al*. 2001). It is likely that right whales were never common off the coast of Oregon and Washington (Scarff 1986, 1991). Aboriginal and commercial whaling records indicate that right whales were not common off the west coast of North America even during the early stages of whaling (Townsend 1935, Scarff 1986, Mitchell and Reeves 2001). This cannot be said for other areas of the North Pacific, such as the southeastern Bering Sea and Aleutian Islands, where the paucity of contemporary right whale sightings, despite dedicated marine mammal surveys, is more likely attributable to overharvest (Brownell *et al.* 2001). Their migration patterns are unknown, but are believed to include north-south movements between summer and winter feeding areas.

Much of the information in the ESA 5-Year Status review is the same as the information in the Recovery Plan. Given that the North Pacific right whale population is extremely small and little current information is available, recovery is not anticipated in the foreseeable future (e.g., several decades to a century or more). Life history characteristics such as low reproductive rates, delayed sexual maturity, and reliance on high juvenile survivorship make long-lived species such as whales particularly vulnerable to demographic risks posed by anthropogenic-related mortalities. Risks from entanglement and ship strikes may currently pose little direct threat to recovery of North Pacific right whales, although injury or mortality from any of these sources would be noteworthy due to the limited size of the population. Oil and gas development activities, chemical pollution, harmful algal blooms, and climate change could potentially impact critical habitat, foraging success, and reproductive rates in the future.

Many basic life history parameters and census data, including calving and growth rates, age structure, mortality, and distribution remain largely undetermined. These data are necessary to perform quantitative population analyses or develop surrogate models to evaluate the risk of extinction. When such reliable information on the biology and ecology of this population becomes available, managers will be able to make informed decisions by applying specific criteria to address the survival and recovery of this species.

Limiting Factors and Threats – North Pacific Right Whale

The North Pacific Right Whale Recovery Plan identifies the main threats to the species as anthropogenic noise (including ship noise), oil and gas exploration activities (seismic surveys in search of new oil resources below the seafloor), military sonar and explosive, vessel interactions (vessel collisions/ship strikes and vessel sound), predation and natural mortality, disturbance from researchers, direct hunting, competition for resources, and loss of prey base from climate/ecosystem changes. Key elements of the recovery program for this species are: 1) coordinate state, federal, and international actions to maintain whaling prohibitions; 2) estimate population size and monitor trends in abundance; 3) determine North Pacific right whale occurrence, distribution, and range; 4) identify, characterize, protect, and monitor habitat essential to North Pacific right whale recovery; and 5) investigate the impact of human-caused threats on North Pacific right whales.

The following summaries are taken from the Recovery Plan to provide additional information relevant to this opinion for oil spill, vessel collisions, and vessel noise.

Oil Spill and North Pacific Right Whales - Oil spills that occur while North Pacific right whales are present could result in skin contact with the oil, baleen fouling, ingestion of oil, respiratory distress from hydrocarbon vapors, contaminated food sources, and displacement from feeding areas (Geraci 1990). Actual impacts would depend on the extent and duration of contact and the characteristics (e.g., the age) of the oil. Most likely, the effects of oil would include irritation to the respiratory membranes and absorption of hydrocarbons into the bloodstream (Geraci 1990). If a marine mammal was present in an area polluted with fresh oil, it is possible that it could inhale enough vapors to affect its health. Long-term ingestion of pollutants, including oil residues, could affect reproductive success, but data are lacking to determine how oil may fit into this scheme for North Pacific right whales.

If a North Pacific right whale encountered spilled oil, baleen hairs might be fouled, which would reduce a whale's filtration efficiency during feeding. Lambertsen et al. (2005) concluded that because previous "experimental assessment of the effects of baleen function... Thus far has considered exclusively the role of hydraulic pressure in powering baleen function" but "our present results indicate that more subtle hydrodynamic pressure may play a critical role in the function of the baleen in the [balaenids]... The current state of knowledge of how oil would affect the function of the mouth of right whales and bowhead whales can be considered poor, despite considerable past research on the effects of oil on cetaceans."

With the exception of the known ecological impacts from the Exxon Valdez oil spill in coastal Alaska (Wursig 1990), the consequences of the relatively few spills having occurred in the northern North Pacific are not known. Nor is the extent known to which these or future spills may impact right whales. In general, the threat from contaminants and pollutants occurs at an unknown severity and there is a high level of uncertainty regarding the likelihood of a spill occurring and North Pacific right whales being exposed to spilled oil. Thus, the relative impact to recovery of North Pacific right whales due to contaminants and pollution is ranked as unknown. However, this ranking may need to be elevated if future data indicate that reproductive rates are negatively impacted by exposure to contaminants or pollution.

Vessel Collisions and North Pacific Right Whales - The possible impacts of ship strikes on the recovery of North Pacific right whale populations are not well understood. Ship strikes are a well-documented threat to North Atlantic right whales (Kraus et al. 2005) due at least in part to a coastal distribution of that species (Silber et al. 2012). As a result, the potential for increased ship traffic in the North Pacific Ocean may pose a threat to North Pacific right whales. Because many ship strikes go unreported or undetected for various reasons and the offshore distribution of right whales in the North Pacific may make collisions with them less detectable than with other species, any estimates of serious injury or mortality should be considered minimum estimates, thus there is a high level of uncertainty associated with the information presented above. The severity of this threat is unknown but potentially high for the eastern population, with the potential to increase given the possibility for increased ship traffic in the region due to melting sea ice in the Arctic and unknown but potentially low for the western population. The uncertainty of this threat is high for both populations and the relative impact to recovery is ranked as unknown but potentially high for the eastern population.

Vessel Noise and North Pacific Right Whales - The impact of noise exposure on marine mammals can range from little or no effect to severe effects, depending on factors including: noise source level, duration and exposure, the type and characteristics of the noise source, distance between the source and the animal, characteristics of the animal (e.g., hearing sensitivity, behavioral context, age, sex, and previous experience with sound source), and temporal extent of exposure (Richardson et al. 1995; National Research Council 2003; National Research Council 2005; Southall et al. 2007). As one of the potential stressors to marine mammal populations, noise may disrupt marine mammal communication, navigational ability, and social patterns. The effects of anthropogenic noise on marine mammals are often difficult to ascertain, and research on this topic is ongoing (Ketten 2012). The possible impacts of the various sources of anthropogenic noise have not been studied on North Pacific right whales, although some conclusions from studies on baleen whales, and North Atlantic right whales, specifically, could be applied to this species.

There are no direct measurements of the hearing abilities of most baleen whales. Baleen whale calls are predominantly at low frequencies, mainly below 1 kHz and it stands to reason that if a species vocalizes in certain frequency ranges, its hearing acuity is strong in at least those same ranges. Behavioral reactions to noise can vary not only across species and individuals but also for a given individual, depending on previous experience with a sound source, hearing sensitivity, sex, age, reproductive status, geographic location, season, health, social behavior, or context (Richardson et al. 1995). Severity of responses can also vary depending on characteristics associated with the sound source (e.g., its frequency, whether it is moving or stationary) or the potential for the source and individuals co-occurring temporally and spatially (e.g., how close to shore, region where animals may be unable to avoid exposure, propagation characteristics of the area either enhancing or reducing exposure) (Richardson et al. 1995). As one of the potential stressors to marine mammal populations, noise and acoustic influences could disrupt communication, navigational ability, foraging, and social patterns.

Noise may mask an individual’s ability to communicate. Crance et al. (2019) found four song types in North Pacific Right Whales, hypothesizing that the calls are used as reproductive displays similar to other mysticetes. Animals may alter their behavior in response to masking. These behavior changes may include producing more calls, longer calls, or shifting the frequency of the calls. For example, two studies indicate that North Atlantic right whales (Parks et al. 2009) and blue whales (Di Iorio and Clark 2010) alter their vocalizations (call parameters or timing of calls) in response to background noise levels. Clark et al. (2009) developed a model to quantify changes in an animal’s acoustic communication space as a result of spatial, spectral, and temporal changes in background noise. Uncertainties remain regarding how masking affects marine mammals; however, it is increasingly being considered a threat to marine mammals, particularly baleen whales (Clark et al. 2009). The potential impacts that masking may have on individual survival, energetic costs, and behavioral changes are difficult to quantify and are poorly understood.

Sound emitted from large vessels is the principal source of chronic noise in the ocean today (Andrew et al. 2002; McKenna et al. 2012). Ship propulsion and electricity generation engines, engine gearing, compressors, bilge and ballast pumps, as well as hydrodynamic flow surrounding a ship’s hull and any hull protrusions and vessel speed contribute to a large vessel’s noise emission into the marine environment. Prop-driven vessels also generate noise through cavitation, which account for approximately 85 percent or more of the noise emitted by a large vessel (Richardson et al. 1995). Large vessels tend to generate sounds that are louder and at lower frequencies than small vessels (Polefka 2004).

Surface shipping is the most widespread source of anthropogenic, low frequency (0 to 1,000 Hz) noise in the oceans (Simmonds and Hutchinson. 1996). Ross (1976) estimated that between 1950 and 1975, shipping caused a rise in ambient noise levels of 10 decibels (dB) (this scale is logarithmic, so a 6 dB increase is a doubling) worldwide. He predicted that this would increase by another 5 dB by the beginning of the 21st century. The National Research Council (2003) estimated that the background ocean noise level at 100 Hz has been increasing by about 1.5 dB per decade since the advent of propeller-driven ships, while others have estimated that the increase in background ocean noise is as much as 3 dB per decade in the Pacific Ocean (McDonald et al. 2006). Clark et al. (2009) provided information on the effects of sound masking on mysticetes (i.e., fin, North Atlantic right, and humpback whales) exposed to noise from ships and reported that, among other things, whale call rates diminished in the presence of passing vessels. Rolland et al. (2012) found that stress in North Atlantic right whales (as determined by levels of stress-related hormone metabolites) decreased in periods when ship noise diminished.

While certain species of large whales have shown behavioral changes and adaptations to anthropogenic noise in the marine environment (Richardson et al. 1995), there have been few studies on how it might affect right whales, and those studies have focused on North Atlantic right whales, specifically (Clark et al. 2009; Parks et al. 2009; Urazghildiiev et al. 2009; Hatch et al. 2012). However, existing data suggest that the level of sensitivity to noise disturbance and vessel activity appears related to the behaviors in which they are engaged at the time (Watkins 1986; Nowacek et al. 2004; Parks et al. 2011). In particular, feeding or courting right whales may be relatively unresponsive to loud sounds and, therefore, slow to react to approaching vessels. Malme et al. (1983) speculated on the potential detrimental impacts of the noise associated with vessel transits during oil and gas production, but the impact of noise from shipping and industrial activities on the communication, behavior, and distribution of right whales remains unknown (Southall et al. 2007).

At this time, the BRT determined the severity of the threat of ship noise to North Pacific right whales is unknown and uncertainty of the threat is high. Therefore, the BRT concluded the relative impact to recovery is ranked as unknown.

Extinction Risk – North Pacific Right Whale

Based on the limited available new information and existing conservation and management measures, the BRT concluded in the 2017 5-Year Status Review that the North Pacific right whale remains endangered, with the eastern population being critically endangered.

More information on North Pacific right whales in the action area is presented in Section 2.3.12 Baseline Conditions.

2.2.3.7 Rangewide Status of Status of Sperm Whales

Sperm whales, as a species, were listed as endangered worldwide under the precursor to the ESA, the Endangered Species Conservation Act of 1969, and remained on the list of threatened and endangered species after the passage of the ESA in 1973 (35 FR 8491; June 2, 1970). The entire species of sperm whales are currently listed as endangered under the ESA. There is no designated critical habitat for sperm whales. We issued the Final Recovery Plan for the Sperm Whale in December 2010 (NMFS 2010b). The sperm whales most likely to be observed within the action area are identified as the CA/OR/WA stock. The Recovery Plan (NMFS 2010b), the Sperm Whale 5-Year Review (NMFS 2015c), and most recent Stock Assessment (NMFS 2019e) are incorporated here by reference.

The following is taken from the 2019 Stock Assessment for the California/Oregon/Washington Stock (NMFS 2019e):

> “Whaling removed at least 436,000 sperm whales from the North Pacific between 1800 and the end of legal commercial whaling for this species in 1987 (Best 1976; Ohsumi 1980; Brownell 1998; Kasuya 1998). Of this total, an estimated 33,842 were taken by Soviet and Japanese pelagic whaling operations in the eastern North Pacific from the longitude of Hawaii to the U.S. West coast, between 1961 and 1976 (Allen 1980), and approximately 1,000 were reported taken in land-based U.S. West coast whaling operations 157 between 1919 and 1971 (Ohsumi 1980; Clapham et al. 1997). There has been a prohibition ban on taking sperm whales in the North Pacific since 1988, but large-scale pelagic whaling stopped in 1980.

> STATUS OF STOCK
>
> “Sperm whales are listed as "endangered" under the U.S. Endangered Species Act (ESA), and consequently this stock is automatically considered as "depleted" and "strategic" under the MMPA. The status of sperm whales with respect to carrying capacity and optimum sustainable population (OSP) is unknown. The observed annual rate of documented mortality and serious injury (≥ 0.64 per year) is less than the calculated PBR (2.5) for this stock, but anthropogenic mortality and serious injury is likely underestimated due to incomplete detection of carcasses and injured whales. Total human-caused mortality is greater than 10% of the calculated PBR and, therefore, is not insignificant and approaching zero mortality and serious injury rate. Increasing levels of anthropogenic sound in the world’s oceans has been suggested to be a habitat concern for whales, particularly for deep-diving whales like sperm whales that feed in the ocean’s sound channel.”

Geographic Range and Distribution/Spatial Structure/Diversity – Sperm Whale

Sperm whales are currently globally listed as endangered as one species. Sperm whales are the largest of the toothed whales and have one of the widest global distributions of any marine mammal species. They are found in all deep oceans, from the equator to the edge of the pack ice in the Arctic and Antarctic. Sperm whales have a global distribution and can be found in the Atlantic, Pacific, and Indian Oceans. Currently, the population structure of sperm whales has not been adequately defined. Most models have assigned arbitrary boundaries, often based on patterns of historic whaling activity and catch reports, rather than on biological evidence. Populations are often divided on an ocean basin level. Therefore, the 2010 Recovery Plan is organized, for convenience, by ocean basin and discussed in three sections, those sperm whales in the Atlantic Ocean/Mediterranean Sea, including the Caribbean Sea and Gulf of Mexico, those in the Pacific Ocean and its adjoining seas and gulfs, and those in the Indian Ocean. An improved understanding of the genetic differences between populations would allow better estimates of abundance and more effective management of the species. Although there is new information, existing knowledge of population structure for this nearly continually distributed species remains poor.

Abundance, Productivity, and Trends- Sperm Whale

The 2015 5-Year Status Review offers some updated data from that presented in the 2010 Recovery Plan. Whitehead (2002) estimated sperm whale abundance to be approximately 300,000-450,000 worldwide. These estimates are based on extrapolating surveyed areas to unsurveyed areas and thus, are not necessarily accurate; however, without a systematic survey design, these are probably the best available and most current estimates of global sperm whale abundance.

Historical data on the killing of sperm whales are important in understanding the current global population status. From 1900 to 1999, sperm whales were the second most hunted whale species, with 761,523 hunted globally by industrial whaling operations. From 1969 to 1975, sperm whale kills exceeded 10,000 whales each year (Rocha et al. 2014). Unfortunately, whaling data from the Soviet Union have been underreported, and illegal whaling continued in both hemispheres from the 1950s through the 1970s (Rocha et al. 2014). From 1948 to 1979, the total global catch (all species) for the Soviet Union was 534,204 whales, of which 178,811 were not reported (Rocha et al. 2014). During that same period, sperm whale Soviet catch data in the North Pacific, showed 157,680 sperm whales were hunted of which 25,175 were unreported (Ivaschchenko et al. 2014). Areas with high catch levels included the Gulf of Alaska, central Pacific, and southern Kurils/northern Japan. Extensive illegal catches of female sperm whales in higher latitudes likely continues to impact the populations in the North Pacific (Mizroch and Rice 2013; Ivaschchenko et al. 2014). The impact of historical hunting on females is of note. Mizroch and Rice (2013) noted that few matrilineal groups are currently found in Alaskan waters and Ivashchenko et al. (2014) noted that large aggregations of sperm whales are seldom seen during current surveys. Because of the extensive illegal catch of female sperm whales (Berzin 2008; Ivashchenko et al. 2014), Mizroch and Rice (2013) suggested that the effects of the removal of so many females may be disproportionately negative because of the importance of females in sperm whale social interactions (Whitehead et al. 1997; Best et al. 1984).

Sperm Whales in the Pacific Ocean

For the North Pacific Ocean, prior to whaling, abundance was reported to be 1,260,000, which was reduced to 930,000 sperm whales by the late 1970s (Rice 1989). In 1997, based on a combined visual and acoustic line-transect survey, sperm whales were estimated in the northeastern temperate North Pacific to be 26,300 based on visual sightings, and 32,100 based on acoustic detections and visual group size (Barlow and Taylor 2005). The sperm whale population along the U.S. west coast was estimated to be 971 whales based on surveys conducted in 2005 and 2008 (Carretta et al. 2013). Trend model analysis using data collected on sperm whales observed in the California Current off the U.S. coast during surveys conducted from 1991 to 2014 provide a best estimate of abundance of 1,997 whales, with a minimum of 1,270 (Moore and Barlow 2017; Barlow 2015). The number of small groups has increased in the area likely due to an increase in adult males occurring as lone individuals or in pairs in the region (Moore and Barlow 2014). For the North Pacific populations that enter U.S. waters, population trends are unknown (NMFS 2013b; Moore and Barlow 2017).

Limiting Factors and Threats- Sperm Whale

Populations of sperm whales in the Atlantic Ocean/ Mediterranean Sea, Pacific Ocean, and Indian Ocean have been legally protected from commercial whaling for the last twenty or more years, and this protection continues. Although the main direct threat to sperm whales was addressed by the IWC whaling moratorium on commercial whaling, several potential threats remain. Among the current potential threats are collisions with vessels, reduced prey abundance due to climate change, the possibility that illegal whaling or resumed legal whaling will cause removals at biologically unsustainable rates, contaminants and pollutants, and, possibly, the effects of increasing anthropogenic ocean noise.

The Recovery Plan lists the following threats and potential threats to sperm whales: fisheries interactions, ship noise, oil and gas exploration (seismic exploration of ocean bottoms), military sonar and explosives, vessel interactions, ship strikes, whale watching, contaminants, disease, marine debris, research, predation and natural mortality, direct harvest, competition for resources, loss of prey base from climate change/ecosystem shifts, and cable laying. The threats pertinent to this opinion are described in more detail below.

Oil Spill and Sperm Whales - The BRT concluded that the threat level from oil spill is unknown for this species. Oil spills that occur while sperm whales are present could result in skin contact with the oil, ingestion of oil, respiratory distress from hydrocarbon vapors, contaminated food sources, and displacement from feeding areas (Geraci 1990). Actual impacts would depend on the extent and duration of contact, and the characteristics (age) of the oil. Most likely, the effects of oil would be irritation to the respiratory membranes and absorption of hydrocarbons into the bloodstream (Geraci 1990). If a marine mammal was present in the immediate area of fresh oil, it is possible that it could inhale enough vapors to affect its health. Contaminated food sources and displacement from feeding areas also may occur as a result of an oil spill. Long term ingestion of pollutants, including oil residues, could affect reproductive success, but data is lacking to determine how oil may fit into this scheme for sperm whales. Little is known about the possible long-term and trans-generational effects of exposure of sperm whales to pollutants. It is not known if high levels of heavy metals, persistent organic pollutants such as PCBs, and organochlorines found in prey species accumulate with age and are transferred through nursing, as demonstrated in other marine mammals, such as killer whales. It is also not known if exposure to oil from an oil spill will have a detrimental effect on sperm whales.

In general, the threat from contaminants and pollutants occurs at an unknown severity and there is a high level of uncertainty. Thus, the relative impact to recovery of sperm whales due to contaminants and pollution is ranked as unknown. However, the BRT notes that this ranking may need to be revised if future data indicate reproductive rates are indeed impacted by exposure to contaminants or pollution. For instance, the BRT notes that they may obtain new information based on the 2010 Gulf of Mexico oil spill that leads them to reevaluate threats from contaminants in general.

The 2015 Status Review for Sperm Whales Oil contains information on sperm whale impacts from the 2010 Deepwater Horizon oil spill in the Gulf of Mexico. After the spill, over 8 million liters of chemical dispersants were applied at the surface and at the source of the leak without knowledge of the potential short and long-term toxicological impact these dispersants may have on marine organisms (Wise et al. 2014). To combat the oil spill, two dispersants were applied, Corexit 9500 and Corexit 9527. Wise et al. (2014) examined the cytotoxicity and genotoxicity of the dispersants at different concentration levels on sperm whale skin cells. Both compounds were cytotoxic to the sperm whale skin cells with possible effects of fibrosis and impaired organ function. Corexit 9527 was also genotoxic to the sperm whale skin cells. Sperm whales occur in the Gulf of Mexico and depending on their proximity to the application of the dispersants, their exposure could have been less than 1 percent and up to 100 percent (Wise et al. 2014). If genotoxicity occurred during essential stages of reproduction or embryogenesis, mortality or developmental abnormalities in the offspring would increase.

In addition to dispersants, gentoxic metals such as chromium and nickel were present in the oil spilled during the Deepwater Horizon event (Wise et al. 2014). Chromium and nickel are known carcinogens in humans and damage DNA and bioaccumulate in organisms, resulting in persistent exposures. Sperm whales in the Gulf of Mexico had significantly higher concentrations of nickel and chromium than the global mean average from the global surveys conducted in 1999 through 2005 (discussed above; Wise et al. 2009). The mean global nickel concentration was 2.4 ppm (n = 298; measured as μg g-1 wet weight and expressed as ppm). Whereas, in this study the average nickel concentration in the Gulf of Mexico sperm whales after the Deepwater Horizon was 15.9 ppm, which is 6.6 times higher than the global average (Wise et al. 2014a). Also, resident females and immature males had higher nickel concentrations than the global mean, yet mature males that migrate beyond the Gulf of Mexico to forage in higher latitudes had similar values to the global mean. Chromium levels were also significantly higher in the Gulf of Mexico study compared to the global mean (12.8 ppm versus 9.3 ppm, respectively). Sampling protocols were similar in the global surveys and this study; thus, it is reasonable not to rule out the oil spill as a reason for the higher concentrations in these gentoxic metals in the Gulf of Mexico sperm whales (Wise et al. 2014a).

After the Deepwater Horizon oil spill in the Gulf of Mexico, there was a low number of observed sperm whale mortalities, leading media to report only a “modest” environmental impact (Williams et al. 2011). However, Williams et al. (2011) estimated that the carcass recovery rate for sperm whales was, on average, only 3.4 percent of the actual mortalities. Assuming only one sperm whale carcass was found and the cause of death was determined to be oil, it could be hypothesized that the best estimate of total mortality (using the 3.4 percent) was actually 29 sperm whales (Williams et al. 2011). Ackleh et al. (2012) used passive acoustic recordings collected in the Gulf of Mexico in 2007 and compared them to data collected in 2010 after the oil spill to examine the possible impacts the spill may have on sperm whales. Sperm whale abundance and vocalization was higher by a factor of two at a site 25 miles from the spill compared to a site located 9 miles from the spill. Sperm whales likely moved away from the oil spill due to a shortage of non-contaminated food in the area and/or an increase in vessel traffic and anthropogenic noise in response to the spill (Ackleh et al. 2012).). Farmer et al. (2018) developed a model to analyze how the Deepwater Horizon oil spill may impact the northern Gulf of Mexico (NGM) stock and projected a 26 percent mean stock decline by 2025 as a result of the oil exposure. The model projected reduced survival and reproductive success based on direct exposure to oil and impacts on reduced prey availability due to oil. The actual number of sperm whales that may have been impacted by the Deepwater Horizon oil spill is unknown, but it can be assumed that the impact was greater than observed.

Vessel Collisions and Sperm Whales – From a worldwide compilation of 292 recorded strikes contained in the Jensen and Silber (2003), 17 were of sperm whales. Sperm whales spend long periods (typically up to 10 minutes) “rafting” and socializing at the surface between deep dives (Jaquet *et al.* 1998; Whitehead 2003). This could make them vulnerable to vessel strikes. There were also instances in which sperm whales approached vessels too closely and were cut by the propellers. Reports of ships colliding with sperm whales are said to be “frequent” in the Canary Islands, where ship traffic is heavy and the local density of sperm whales relatively high (André *et al.* 1997). André *et al.* (1997) in Laist *et al.* (2001), reports a case in the Canary Islands in which a high speed ferry collided with and killed a sperm whale while traveling at 45 knots. Fais et al. (2016) found that the vessel strike mortality rate likely exceeds the population growth rate of 2.5 whales per year in the Canary Islands.

One of nine sperm whales found stranded on the north coast of the Gulf of Mexico between 1987 and 1994 had "deep, parallel cuts posterior to the dorsal ridge that were believed to be caused by the propeller of a large vessel" (Waring *et al.* 1997). In May 1994, a ship-struck sperm whale was observed south of Nova Scotia (Reeves and Whitehead 1997) and in May 2000, a merchant shop reported a strike in Block Canyon (off the central east coast of the U.S.) (Waring *et al.* 2009). In the spring, Block Canyon is a major pathway for sperm whales entering southern New England continental shelf waters in pursuit of squid (CETAP 1982; Scott and Sadove 1997). From 2001–2003 one stranded sperm whale was reported struck by a naval vessel, and another whale was reported struck by a merchant vessel near Rhode Island (Waring *et al.* 2005). During 2001–2005, mortality from ship strikes off the east coast of the U.S. was estimated at 0.2 sperm whales per year (Waring *et al.* 2005). Due to the sperm whale's offshore distribution, it is likely that mortality and injury from ship strikes off the east coast of North America are documented less often than they occur (*i.e.,* they are less likely to drift to shore and strand than some other species).

More than 6 percent (7) of 111 sperm whales stranded in Italy (1986–1999) and Greece (1982–2001) had died after being struck by a vessel, and 6 percent of 51 photo-identified individuals (39 in Greece and 22 in Italy) bore wounds or scars that were clearly caused by a collision (Pesante *et al.* 2002). DiMeglio et al. (2018) found that 9 percent of photo-identified sperm whales in the Mediterranean Sea had scars from vessel strikes.

Two whales described as "possibly sperm whales" are known to have died in U.S. waters in 1990 after being struck by vessels (Barlow *et al.* 1997). In 2005, two sperm whales were struck by a ship, but it is not known if these ship strikes resulted in a mortality or injury. In 2007 a sperm whale calf was struck and killed off of Florence, Oregon. There were 14 unidentified whales struck by ships in California from 1982–2008 (California Marine Mammal Stranding Network Database). While there have been some reports of sperm whales struck by ships, it does not appear that ship strikes are a significant threat to sperm whales (Whitehead 2003). However, the BRT concluded that quantifying the effects of ship strikes in the U.S. is not possible, at this time.

The possible impact of ship strikes on recovery of sperm whale populations is not well understood. Carcasses that do not drift ashore may go unreported, and those that do strand may show no obvious signs of having been struck by a ship. Because many ship strikes go unreported or undetected for various reasons and the offshore distribution of sperm whales may make ship strikes less detectable than for other species, the estimates of serious injury or mortality should be considered minimum estimates. The BRT concluded that threat occurs at a medium severity and there is a medium level of uncertainty associated with the evidence above. While the number of sperm whale ship strikes is likely greater than those reported, the relative impact of this threat to recovery of the population is not considered significant. Thus, the relative impact to recovery of sperm whales due to ship strikes is ranked by the BRT as unknown but potentially low.

The 2019 Stock Report for the CA/OR/WA Stock reports that one sperm whale died as the result of a ship strike in Oregon in 2007 (NMFS Northwest Regional Stranding data, unpublished). Another sperm whale was struck by a 58-foot sablefish longline vessel in 2007 while at idle speed (Jannot et al. 2011). The observer noted no apparent injuries to the whale. Based on the size and speed of the vessel relative to the size of a sperm whale, this incident was categorized as a non-serious injury (Carretta et al. 2013). For the most recent 5-year period of

2013 to 2017, no ship strike deaths or serious injuries were observed. Due to the low probability of a sperm whale carcass washing ashore, estimated ship strike deaths are likely underestimated. Ship strikes are assessed over the most recent 5-year period to reflect the degree of shipping risk to large whales since ship traffic routes changed in response to new ship pollution rules implemented in 2009 (McKenna et al. 2012, Redfern et al. 2013).

Vessel Noise and Sperm Whales – The severity of the threat of ship noise to sperm whales is unknown and uncertainty of the threat is high. Therefore, the BRT concluded that relative impact to recovery of sperm whales due to this threat is ranked as unknown. The effects of anthropogenic noise are difficult to ascertain and research on this topic is ongoing. The possible impacts of the various sources of anthropogenic noise have not all been well studied on sperm whales. The BRT concluded that the relative impact of anthropogenic noise to the recovery of sperm whales is ranked as unknown. Similar to other whale species, one concern is masking.

An animal's detection threshold may be masked by noise that is at frequencies similar to those of biologically important signals, such as mating calls. The size of this "zone of masking" of a marine mammal is highly variable, and depends on many factors that affect the received levels of the background noise and the sound signal (Richardson *et al.* 1995; Foote *et al*. 2004). Masking is influenced by the amount of time that the noise is present, as well as the spectral characteristics of the noise source (*i.e.*, overlap in time, space, and frequency characteristics between noise and receiver). There are still many uncertainties regarding how masking affects marine mammals. For example, it is not known how loud signals must be for animals to recognize or respond to another animal's vocalizations (NRC 2003). It is also unknown if animals listen/respond to all the sounds they can hear or can be selective about what they will listen to. Richardson *et al*. (1995) argued that the maximum radius of influence of an industrial noise (including broadband low frequency sound transmission) on a marine mammal, is the distance from the source to the point at which the noise can barely be heard. This range is determined by either the hearing sensitivity of the animal or the background noise level present.

The echolocation calls of toothed whales are subject to masking by high frequency sound. Human data indicate low frequency sound can mask high frequency sounds (*i.e.*, upward masking). Studies on captive odontocetes (not sperm whales) (Au *et al.* 1974, 1985; Au 1993) indicate that some species may use various processes to reduce masking effects (*e.g.*, adjustments in echolocation call intensity or frequency as a function of background noise conditions). There is also evidence that the directional hearing abilities of odontocetes are useful in reducing masking at the high frequencies used for echolocation, but not at the low-moderate frequencies used for communication (Zaitseva *et al.* 1980).

There are still many uncertainties regarding how masking affects marine mammals, including sperm whales. The potential impacts that masking may have on individual survival, the behaviors marine mammals may exhibit to avoid masking, and the energetic costs of changing behavior to reduce masking, are poorly understood.

Sperm Whale Recovery Plan

The 2010 Sperm Whale Recovery Plan states that its primary purpose is to identify and take actions that will minimize or eliminate effects of human activities that are detrimental to the recovery of sperm whale populations. Immediate objectives are to identify factors that may be limiting abundance/recovery/ productivity, and cite actions necessary to allow the populations to increase. The main threats to sperm whale populations include collisions with vessels, direct harvest, and possibly competition for resources, loss of prey base due to climate change, and disturbance from anthropogenic noise. Another important component of the recovery program is to determine population structure of the species and population discreteness. This would be a first step in estimating population size, monitoring trends in abundance, and enabling an assessment of the species throughout its range. Because sperm whales move freely across international borders, the Plan Recovery stresses the importance of a multinational approach to management. Ideally, both research and conservation should be undertaken at oceanic rather than national levels.

Extinction Risk- Sperm Whale

The sperm whale 2015 5-Year Status Review concludes with the following discussion. While it is often assumed that the worldwide population of sperm whales has increased since the implementation of the IWC moratorium against whaling in 1988, there are insufficient data on population structure and abundance of inhabited ocean basins to determine population trends accurately. Regional estimates of abundance are fragmented and incomplete, and the best worldwide estimate of 300,000-450,000 (Whitehead 2002) is imprecise. In addition, historical catch records are sparse or nonexistent in some areas of the world and over long periods of time. Also under-reporting or misreporting of modern catch data has taken place on a large scale. The wide-ranging, generally offshore distribution of sperm whales and their long submergence times, complicate efforts to estimate abundance. Further, the removal of adults during historical hunting may still be impacting some populations. Mizroch and Rice (2013) noted that few matrilineal groups are currently found in Alaskan waters and Ivashchenko et al. (2014) noted that large aggregations of sperm whales are seldom seen during current surveys. Because of the extensive illegal catch of female sperm whales (Berzin 2008; Ivashchenko et al. 2014), Mizroch and Rice (2013) suggested that the effects of the removal of so many females may be disproportionately negative because of the importance of females in sperm whale social interactions (Whitehead et al. 1997; Best et al. 1984). Thus, the extent of depletion and degree of recovery of populations are uncertain.

Although the historical threat of whaling to the worldwide population is no longer a primary threat, sperm whales continue to face several other threats. Although data are lacking on the severity of multiple potential threats, the available evidence indicates that threats are affecting the recovery of sperm whale populations. Thus the BRT concluded that the status of the sperm whale should remain as “endangered.”

More information on sperm whales is in Section 2.3.9 Baseline Conditions.

2.2.3.8 Rangewide Status of Leatherback Sea Turtles

NMFS listed leatherback turtles as endangered under the ESA in June, 1970 (35 FR 8491). In 1979, NMFS designated critical habitat for leatherback turtles to include coastal waters adjacent to Sandy Point, St. Croix, U.S. Virgin Island (44 Fed. Reg. 17710) (March 23, 1979). We designated additional critical habitat along the U.S. West Coast in January, 2012 (77 Fed. Reg. 4170) (January 26, 2012). We issued the final Recovery Plan for leatherback turtles in January 1998 (NMFS and USFWS 1998) and it is incorporated here by reference. The most recent status review for this species was completed in 2020 (NMFS and USFWS 2020). In the 2020 Status Review, the globally listed population was assessed for discreteness and significance of geographic populations. The Status Review concluded with a proposal to delineate seven DPSs of leatherback turtles worldwide. These proposed or potential DPSs are not yet formally recognized as DPSs under the ESA. However, for this opinion, we focus our analysis on the West Pacific DPS because it is the population that occurs within the action area. Note that the ESA listing is still for the global population as a whole. Within the opinion, we refer to this population as the West Pacific population.

Geographic Range and Distribution/Spatial Structure/Diversity – Leatherback Turtle

Leatherback turtles are widely distributed throughout the oceans of the world. The West Pacific population is comprised of leatherback turtles originating from the West Pacific Ocean, with the following boundaries: south of 71° N, north of 47° S, east of 120° E, and west of 117.124° W (this includes the entire West Coast of the U.S. stopping at the Mexico border; the East Pacific potential DPS occurs along the border of Mexico and south along Central and South America). The range of the population (i.e., all areas of occurrence) extends throughout the Pacific Ocean, with specific coastal and pelagic areas in the Indo-Pacific basin providing important foraging and migratory habitats. Leatherback turtles of the West Pacific population migrate through the EEZs of at least 32 nations, spending between 45 and 78 percent of the year on the high seas including in the U.S. EEZs of California and Hawaii (Harrison et al. 2018). Foraging occurs in seven ecoregions: South China/Sulu and Sulawesi Seas, Indonesian Seas, East Australian Current Extension, Tasman Front, Kuroshio Extension of the Central North Pacific, equatorial Eastern Pacific, and California Current Extension (Benson et al. 2011). Leatherback turtles of the West Pacific population nest in tropical and subtropical latitudes primarily in Indonesia, Papua New Guinea, and Solomon Islands, and to a lesser extent in Vanuatu (Dutton et al. 2007; Benson et al. 2007a; Benson et al. 2007b; Benson et al. 2011).

Leatherback turtles are generally considered a pelagic species but they also aggregate in productive coastal areas (NMFS 2012a), foraging widely in temperate and tropical waters except during the nesting season, when gravid females return to tropical beaches to lay eggs. Leatherbacks are highly migratory, exploiting convergence zones and upwelling areas for foraging in the open ocean, along continental margins, and in archipelagic waters. Aerial surveys of coastal California, Oregon, and Washington indicate leatherbacks are most likely to occur along the continental slope as opposed to the continental shelf (NMFS and USFWS 1998). Recent work by NMFS have tracked leatherbacks across the Pacific and confirmed that leatherbacks utilize zones of upwelling relaxation with central California and the waters off the Columbia River being two primary feeding areas (Benson *et al* 2007b, 2011, and 77 FR 4169).

Abundance, Productivity, and Trends – Leatherback Turtle

The 2020 Status Review estimated the total index of nesting female abundance of the West Pacific population to be 1,277 females. This number represents an index of nesting female abundance for this DPS because it only includes available data from recently (as of 2014) and consistently monitored (over the remigration interval) nesting beaches: Jamursba-Medi and Wermon, Indonesia. It does not include nesting females from other beaches of Indonesia, Papua New Guinea, Solomon Islands or Vanuatu because these areas have not been consistently monitored for nesting in recent years. However, these locations may host 25 to 50 percent of the nests. Therefore, actual nesting female abundance could be higher, given the potential for unidentified or unmonitored nesting beaches.

The West Pacific population exhibits a declining nest trend. The DPS exhibits low hatching success, and the overall nest trend is declining, likely due to anthropogenic and environmental impacts at nesting beaches and in foraging habitats (Tiwari et al. 2013a). Overall, there is moderate confidence in productivity and trend for this DPS: while multiple sources identify long-term or historic declines, inconsistent data collection prevents high confidence of current levels of decline at all nesting beaches. However, the 2020 Status Reviews states that the bulk of information points to substantial declines across the West Pacific population over the long term. The decline may reflect past and current threats that exceed the population's productivity metrics. A population growth rate below replacement levels would further reduce nesting female abundance, even if the threats remained constant; increasing or additional threats would further worsen this scenario. The 2020 Status Review concludes that the declining nest trend and low reproductive output place the West Pacific population at elevated extinction risk.

The West Pacific population nests throughout four countries with a broad, diverse foraging range. It exhibits metapopulation dynamics and fine-scale population structure.
Aerial surveys conducted between 2004 and 2007 identified Indonesia, Papua New Guinea and Solomon Islands as the core nesting areas for the DPS (Benson et al. 2007a; Benson et al. 2007b; Benson et al. 2011; Benson et al. 2018b). During the nesting season, nesting females generally stayed within 300 km or less of these nesting beaches (Benson et al. 2011), although a few females were documented visiting multiple beaches during a nesting season (Benson et al. 2007b). Distributing nesting activity among various habitats may help to buffer some of the population from impacts at a single nesting area, but the majority of females utilize one nesting area during a nesting season (Benson et al. 2011).

Migration and foraging strategies vary based on nesting season, likely due to prevailing offshore currents and seasonal monsoon-related effects experienced as hatchlings (Gaspar et al. 2012). Oceanic currents help to structure the spatial and temporal distribution of juveniles which lead them to foraging and developmental habitats (e.g., the North Pacific Transition Zone); they undertake seasonal migrations seeking favorable oceanic habitats/temperatures and abundant foraging resources, such as the central California ecoregion (Gaspar and Lalire 2017). Inter-annual or long-term variability in dispersal patterns can influence population impacts or resilience to regional or Pacific Ocean perturbations (e.g., exposure to fisheries, ENSO events, etc.). Summer nesting females forage in Northern Hemisphere foraging habitats in Asia and the Central North Pacific Ocean, while winter nesting females migrate to tropical waters of the

Southern Hemisphere in the South Pacific Ocean (Benson et al. 2011; Harrison et al. 2018). This variance in foraging strategy results in a foraging range that covers much of the Pacific Ocean The wide distribution and variance in foraging strategies likely buffers this population against local catastrophes or environmental changes that would limit prey availability. The distribution of nesting beaches throughout four countries, although primarily concentrated in three, helps to buffer the entire West Pacific population from major environmental catastrophes because disturbances are not likely to similarly affect all countries during the same seasons. Additionally, the fine-scale genetic structure among nesting aggregations is indicative of metapopulation dynamics.

The West Pacific population exhibits genetic diversity, with six haplotypes identified in 106 samples from Solomon Islands, Papua Barat Indonesia, and Papua New Guinea (Dutton 2006; Dutton et al. 2007; Dutton and Squires 2008). This provides the population with the raw material necessary for adapting to long-term environmental changes, such as cyclic or directional changes in ocean environments due to natural and human causes (McElhany et al. 2000; NMFS 2017b). The population also exhibits temporal nesting diversity, with various proportions of the population nesting during different times of the year (summer versus winter) which helps to increase resilience to environmental impacts. The foraging strategies are also diverse, with turtles using seven ecoregions of the Pacific Ocean. Diverse foraging strategies likely provide some resilience against local reductions in prey availability or catastrophic events, such as oil spills or typhoons, by limiting exposure to only a portion of the West Pacific population. The 2020 Status Review concludes that diversity within the West Pacific population provides it with some resilience to threats.

The 2020 Status Review concludes that current threats contribute to the high risk of extinction of the West Pacific population. The overutilization of turtles and eggs, as a result of legal and illegal harvest, is the primary threat to this population, reducing abundance and productivity. Abundance and productivity are further reduced by fisheries bycatch. Juvenile and adult turtles are taken by numerous international, coastal, and pelagic fisheries throughout the extensive, pan-Pacific foraging range of the population. Predation (especially by dogs and pigs) reduces productivity at high rates at nesting beaches. Erosion and inundation result in habitat loss and modification that reduce productivity and contribute to low hatching success. Additional threats include: pollution and marine debris, vessel interactions, and natural disasters. Climate change is an increasing threat that results in reduced productivity; high (lethal) beach incubation temperatures have already resulted in nest failure, which contributes to low hatching success and perhaps has already skewed sex ratios. Though many regulatory mechanisms exist, they are inadequate to sufficiently reduce the threats.

Abundance estimates of foraging leatherbacks off the US West Coast are discussed in Section 2.3.13 Baseline.

Limiting Factors and Threats – Leatherback Turtle

Threats to leatherbacks are detailed in the most recent 5-year status reviews (NMFS and USFWS 2013 and 2020). The 2020 Status Review concludes that current threats contribute to the high risk of extinction of the West Pacific population. The overutilization of turtles and eggs, as a result of legal and illegal harvest, is the primary threat to this population, reducing abundance and productivity. Abundance and productivity are further reduced by fisheries bycatch. Juvenile and adult turtles are taken by numerous international, coastal, and pelagic fisheries throughout the extensive, pan-Pacific foraging range of the population. Predation (especially by dogs and pigs) reduces productivity at high rates at nesting beaches. Erosion and inundation result in habitat loss and modification that reduce productivity and contribute to low hatching success. Additional threats include: pollution and marine debris, vessel interactions, and natural disasters. Climate change is an increasing threat that results in reduced productivity; high (lethal) beach incubation temperatures have already resulted in nest failure, which contributes to low hatching success and perhaps has already skewed sex ratios. Though many regulatory mechanisms exist, they are inadequate to sufficiently reduce the threats.

Oil Spill and Leatherback Turtle - The 1998 Recovery Plan for US Pacific population of leatherbacks ranks oil exploration and development on the US West Coast unknown for threat level (NMFS and USFWS 1998). The Recovery Plan summarizes the threat as follows:

> "Oil exploration and development pose direct and indirect threats to sea turtles. A rise in transport traffic increases the amount of oil in the water from bilge pumping and disastrous oil spills. Oil spills resulting from blow-outs, ruptured pipelines, or tanker accidents, can result in death to sea turtles. Indirect consequences include destruction of foraging habitat by drilling, anchoring, and pollution. While oil exploration is currently limited by regulation in U.S. waters, recent proposals to allow drilling on the California coast are cause for concern. Any such exploration should be carefully evaluated for impact to leatherback populations before such explorations are undertaken."

The Leatherback 2013 5-Year Status Review (NMFS and USFWS 2013) does not contain much discussion on oil spills. The following is the extent of the discussion:

> "As leatherbacks forage widely in the oceanic habitat, modifications to foraging areas are more difficult to monitor. For example, their marine (and nesting) environment is impacted by the petroleum industry. Numerous oil platforms operate off Gabon. Billes and Fretey (2004) found debris and tar balls that likely came from these operations. Oil spills are a concern. In 2010, a major oil spill occurred in the north central U.S. Gulf of Mexico, affecting important foraging habitat used by leatherbacks (Evans et al. 2012; Witherington et al. 2012). Assessment of the harm is ongoing as part of the Natural Resources Damage Assessment."

The Leatherback Status Review Report (2020) similarly provides limited information on oil spill risk and impacts, but does distinguish the risk by populations. It does state that "leatherback turtles of all life stages are vulnerable to oil spills, on land and at sea, where exposure to oil and dispersants occurs via contact (i.e., physical fouling), inhalation, or ingestion (reviewed by Wallace et al. 2020)." For the West Pacific population, the 2020 Status Review states that, "diverse foraging strategies likely provide some resilience against local reductions in prey availability or catastrophic events, such as oil spills or typhoons, by limiting exposure to only a portion of the DPS. We conclude that diversity within the DPS provides it with some resilience to threats."

The Recovery Plan listed environmental contaminants as an unknown threat.

Vessel Collision and Leatherback Turtle - The Recovery Plan for leatherback turtles identified collisions with vessels as "not current problem." The 2013 5-Year Status Review does not contain much information on vessel strikes of leatherbacks. The review simply identifies vessel strikes as an anthropogenic threat. The 2020 Status Review acknowledges that vessel strikes pose a threat to the West Pacific population. Of leatherback strandings documented in central California between 1981 and 2016, 11 were determined to be the result of vessel strikes (7.3 percent of total; NMFS unpublished data). The range of the population overlaps with many high-density vessel traffic areas and it is possible that the vast majority of vessel strikes are undocumented. The 2020 Status Review concludes that boat/ship strikes pose a threat to individuals of the population, although the impact to the West Pacific population as a whole is currently unknown. More information on vessel collisions on the West Coast is presented in Section 2.3.14 Baseline.

2.2.3.9 Rangewide Status of the Species- Puget Sound Chinook Salmon

This ESU was listed as a threatened species in 1999; its threatened status was reaffirmed June 28, 2005 (70 FR 37160). The NMFS issued results of a five-year status review of all ESA-listed salmon and steelhead species on the West Coast, on May 26, 2016 (81 FR 33469), and concluded that this species (the Puget Sound Chinook ESU) should remain listed as threatened. As part of the review, NOAA's Northwest Fisheries Science Center evaluated the viability of the listed species undergoing 5-year reviews and issued a review providing updated information and analysis of the biological status of the listed species (NWFSC 2015). The NMFS' 2016 Status Review incorporated the findings of the Science Center's report, summarized new information concerning the delineation of the ESU and inclusion of closely related salmonid hatchery programs, and included an evaluation of the listing factors (NMFS 2017c). Where possible, particularly as new material becomes available, the status review information is supplemented with more recent information and other population specific data that may not have been considered during the status review so that NMFS is assured of using the best available information within its biological opinions. On October 4, 2019 NMFS published 84 FR 53117, requesting updated information on all listed Puget Sound populations to inform the most recent five-year status review anticipated for completion in 2021.

Geographic Range and Distribution/Spatial Structure/Diversity – PS Chinook Salmon

The PSTRT determined that 22 historical populations currently contain Chinook salmon and grouped them into five major geographic regions, based on consideration of historical distribution, geographic isolation, dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity (Table 6). Based on genetic and historical evidence reported in the literature, the PSTRT also determined that there were 16 additional spawning aggregations or populations in the Puget Sound Chinook Salmon ESU that are now putatively extinct[11] (Ruckelshaus et al. 2006). This ESU includes all naturally spawned Chinook salmon originating from rivers flowing into Puget Sound from the Elwha River

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[11] It was not possible in most cases to determine whether these Chinook salmon spawning groups historically represented independent populations or were distinct spawning aggregations within larger populations.

(inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound and the Strait of Georgia. Also, the ESU includes Chinook salmon from 26 artificial propagation programs: the Kendall Creek Hatchery Program; Marblemount Hatchery Program (spring subyearlings and summer-run); Harvey Creek Hatchery Program (summer-run and fall-run); Whitehorse Springs Pond Program; Wallace River Hatchery Program (yearlings and subyearlings); Tulalip Bay Program; Issaquah Hatchery Program; Soos Creek Hatchery Program; Icy Creek Hatchery Program; Keta Creek Hatchery Program; White River Hatchery Program; White Acclimation Pond Program; Hupp Springs Hatchery Program; Voights Creek Hatchery Program; Diru Creek Program; Clear Creek Program; Kalama Creek Program; George Adams Hatchery Program; Rick’s Pond Hatchery Program; Hamma Hatchery Program; Dungeness/Hurd Creek Hatchery Program; Elwha Channel Hatchery Program; and the Skookum Creek Hatchery Spring-run Program (70 FR 37160). NMFS proposed a rule to revise the Code of Federal Regulations to update the list of hatchery programs that are included as part of Pacific salmon and steelhead species listed under the Endangered species Act (81 FR 72759).

Table 6. Extant PS Chinook salmon populations in each geographic region (Ruckelshaus et al. 2006).

Geographic Region	**Population (Watershed)**
Strait of Georgia	**North Fork Nooksack River**
	South Fork Nooksack River
Strait of Juan de Fuca	**Elwha River**
	Dungeness River
Hood Canal	**Skokomish River**
	Mid Hood Canal River
Whidbey Basin	Skykomish River (late)
	Snoqualmie River (late)
	North Fork Stillaguamish River (early)
	South Fork Stillaguamish River (moderately early)
	Upper Skagit River (moderately early)
	Lower Skagit River (late)
	Upper Sauk River (early)
	Lower Sauk River (moderately early)
	Suiattle River (very early)
	Cascade River (moderately early)
Central/South Puget Sound Basin	Cedar River
	North Lake Washington/ Sammamish River
	Green/Duwamish River
	Puyallup River
	White River
	Nisqually River

NOTE: NMFS has determined that the bolded populations, in particular, are essential to recovery of the Puget Sound ESU. In addition, at least one other population within the Whidbey Basin and Central/South Puget Sound Basin regions would need to be viable for recovery of the ESU. The PSTRT noted that the Nisqually watershed is in comparatively good condition, and thus the certainty that the population could be recovered is among the highest in the Central/South Region. NMFS concluded in its supplement to the Puget Sound Salmon Recovery Plan that protecting the existing habitat and working toward a viable population in the Nisqually watershed would help to buffer the entire region against further risk (NMFS 2006a).

Three of the five regions (Strait of Juan de Fuca, Georgia Basin, and Hood Canal) contain only two populations, both of which must be recovered to viability to recover the ESU (NMFS 2006a). Under the Puget Sound Salmon Recovery Plan, the Suiattle and one each of the early, moderately early, and late run-timing populations in the Whidbey Basin Region, as well as the

White and Nisqually (or other late-timed) populations in the Central/South Sound Region must also achieve viability (NMFS 2006a).

The Technical Recovery Team (TRT) did not define the relative roles of the remaining populations in the Whidbey and Central/South Sound Basins for ESU viability. Therefore, NMFS developed additional guidance which considers distinctions in genetic legacy and watershed condition among other factors in assessing the risks to survival and recovery of the listed species by the proposed actions across all populations within the Puget Sound Chinook ESU. In doing so it is important to take into account whether the genetic legacy of the population is intact or if it is no longer distinct. Populations are defined by their relative isolation from each other, and by the unique genetic characteristics that evolve as a result of that isolation, and adaptation to their specific habitats. If these are populations that still retain their historic genetic legacy, then the appropriate course, to ensure their survival and recovery, is to preserve that genetic legacy and rebuild those populations. Preserving that legacy requires both a sense of urgency and the actions necessary and appropriate to preserve the legacy that remains. However, if the genetic legacy is gone, then the appropriate course is to recover the populations using the individuals that best approximate the genetic legacy of the original population, reduce the effects of the factors that have limited their production, and provide the opportunity for them to readapt to the existing conditions.

In keeping with this approach, NMFS further classified Puget Sound Chinook populations into three tiers based on a systematic framework that considers the population’s life history and production and watershed characteristics (NMFS 2010c) (Figure 16). This framework, termed the *Population Recovery Approach*, carries forward the biological viability and delisting criteria described in the Supplement to the Puget Sound Salmon Recovery Plan (Ruckelshaus et al. 2002; NMFS 2006a). The assigned tier indicates the relative role of each of the 22 populations comprising the ESU to the viability of the ESU and its recovery. Tier 1 populations are most important for preservation, restoration, and ESU recovery. Tier 2 populations play a less important role in recovery of the ESU. Tier 3 populations play the least important role. When we analyze proposed actions, we evaluate impacts at the individual population scale for their effects on the viability of the ESU. We expect that impacts to Tier 1 populations would be more likely to affect the viability of the ESU as a whole than similar impacts to Tier 2 or 3 populations, because of the relatively greater importance of Tier 1 populations to overall ESU viability. NMFS has incorporated this and similar approaches in previous ESA section 4(d) determinations and opinions on Puget Sound salmon fisheries and regional recovery planning (example- NMFS 2005a).

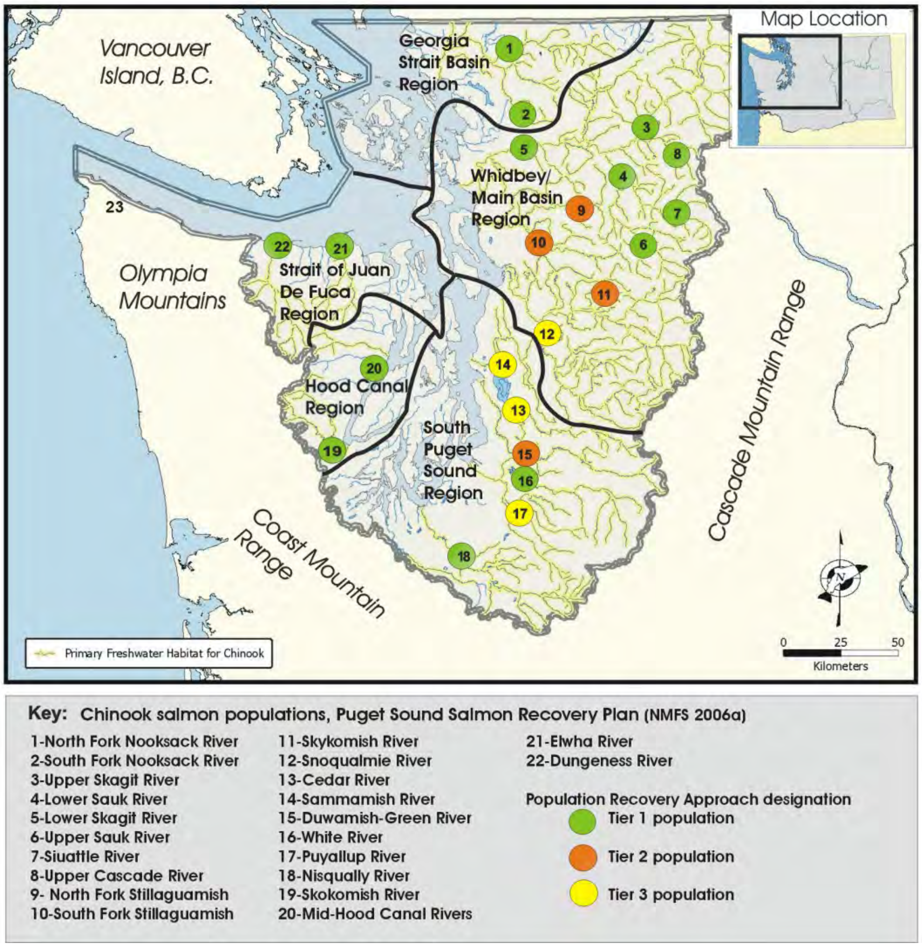

Figure 16. Puget Sound Chinook Populations.

Indices of spatial distribution and diversity have not been developed at the population level, though diversity at the ESU level is declining. Abundance is becoming more concentrated in fewer populations and regions within the ESU. The Whidbey Basin Region is the only region with consistently high fractions of natural-origin spawner abundance, in six of the 10 populations within the Region. All other regions have moderate to high proportions of hatchery-origin spawners (Table 3).

In general, the Strait of Juan de Fuca, Georgia Basin, and Hood Canal regions are at greater risk than the other regions due to critically low natural abundance and/or declining growth rates of the populations in these regions. In addition, spatial structure, or geographic distribution, of the White, Skagit, Elwha,[12] and Skokomish populations have been substantially reduced or impeded by the loss of access to the upper portions of those tributary basins due to flood control activities and hydropower development. Habitat conditions conducive to salmon survival in most other watersheds have been reduced significantly by the effects of land use, including urbanization, forestry, agriculture, and development (NMFS 2005b; SSPS 2005; NMFS 2008b; 2008). It is

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[12] Removal of the two Elwha River dams and restoration of the natural habitat in the watershed began in 2011. Dam removal was completed in 2014.

likely that genetic and life history diversity has been significantly adversely affected by this habitat loss.

Abundance, Productivity, and Trends – PS Chinook Salmon

Most Puget Sound Chinook populations are well below escapement levels identified as required for recovery to low extinction risk (Table 7). All populations are consistently below productivity goals identified in the Recovery Plan (Table 8). Although trends vary for individual populations across the ESU, currently 20 populations exhibit a stable or increasing trend in natural escapement (Table 7). Fourteen of 22 populations show a growth rate in the 18-year geometric mean natural-origin spawner escapement that is greater or equal to 1.00. Both the previous status review in 2015 (NWFSC 2015), and the 2016 Pacific Salmon Commission Chinook Technical Committee's Evaluation Report (CTC 2018) had similarly concluded there was a widespread negative trend for the total ESU. Both reports were based on data through 2013 or 2014 and were the best available information at the time of the completion of previous opinions (NMFS 2016c; 2017d; CTC 2018). For this review, the results incorporate an updated long-term data series, and for most populations, four additional years of escapement data (2015-2018) (Table 8). Incorporation of this information indicates more positive trends in natural-origin Chinook salmon spawner population across the ESU.[13] For populations which did experience increased escapements over the updated long term data series, when the average natural-origin escapements for 2010-2014 are compared to the average natural-origin escapements reported in 2015-2018, these recent average escapements represent an 11-126 percent increase in natural-origin escapement. These populations represent all five of the five recovery regions in Puget Sound.

Natural-origin escapements for seven populations are at or below their critical thresholds[14]. These seven populations occur in three of the five biogeographical regions: Georgia Strait, Hood Canal and Strait of Juan de Fuca (Table 7). When hatchery spawners are included, aggregate average escapement is over 1,000 for one of the two populations in each of these three regions; reducing the demographic risk to the populations in these regions. Ten populations are above their rebuilding thresholds[15]; seven of them in the Whidbey/Main Basin Region. This appears to reflect modest improvements in the status of most Puget Sound populations, relative to abundance estimates in these previous opinions (NMFS 2016c; 2017d; 2018d; 2019f) for the Puget Sound salmon fisheries were completed. There are exceptions to the general increases as well, with eight populations' average abundance being lower. In 2018 NMFS and the Northwest

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[13] This is a synopsis of information provided in the recent five-year status review and supplemental data and complementary analysis from other sources, including the NWFSC Abundance and Productivity Tables. Differences in results reported in Tables 7 and 8 from those in the status review are related to the data source, method, and time period analyzed (e.g., 15 vs 25 years).

[14] After taking into account uncertainty, the critical threshold is defined as a point below which: (1) depensatory processes are likely to reduce the population below replacement; (2) the population is at risk from inbreeding depression or fixation of deleterious mutations; or (3) productivity variation due to demographic stochasticity becomes a substantial source of risk (NMFS 2000).

[15] The rebuilding threshold is defined as the escapement that will achieve Maximum Sustainable Yield (MSY) under current environmental and habitat conditions (NMFS 2000), and is based on an updated spawner-recruit assessment in the Puget Sound Chinook Harvest Management Plan, December 1, 2018. Thresholds were based on population-specific data, where available.

Fishery Science Center (NWFSC) updated the rebuilding thresholds for several key Puget Sound populations. These thresholds represent the Maximum Sustained Yield estimate of spawners based on available habitat. The new spawner-recruit analyses for several populations indicated a significant reduction in the number of spawners that can be supported by the available habitat when compared to analyses conducted 10-15 years ago. This may be due to further habitat degradation or improved productivity assessment or, more likely, a combination of the two. For example, the updated rebuilding escapement threshold for the Green River is 1,700 spawners compared to the previous rebuilding escapement threshold of 5,523 spawners. So, although several populations are above the updated rebuilding thresholds, indicating that escapement is sufficient for the available habitat in many cases, the overall abundance has declined.

Trends in growth rate of natural-origin escapement are generally higher than growth rate of natural-origin recruitment (i.e., abundance prior to fishing) indicating some stabilizing influence on escapement, possibly from past reductions in fishing-related mortality (Table 8). Since 1990, 14 populations show productivity that is at or above replacement for natural-origin escapement including populations in all regions. Eight populations in four of the five regions demonstrate positive growth rates in natural-origin recruitment (Table 8). Survival and recovery of the Puget Sound Chinook Salmon ESU will depend, over the long term, on remedial actions related to all harvest, hatchery, and habitat related activities. Many of the habitat and hatchery actions identified in the Puget Sound Salmon Recovery Plan are likely to take years or decades to be implemented and to produce significant improvements in natural population attributes, and current trends are consistent with these expectations (NWFSC 2015).

Life history traits such as size at age can affect growth rate of recruitment. Studies examining those variables responsible for influencing the fecundity of female salmonids indicate that as the average body size at maturation is reduced, the productivity of the population also exhibits a reduction. This reduction is related to the production of fewer and smaller eggs, and the reduced ability to dig redds deep enough to withstand scouring (Healey and Heard 1984; Healey 1991; Hixon et al. 2014). For Puget Sound Chinook salmon (primarily hatchery origin), there were few 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). Perhaps because Puget Sound Chinook salmon populations are not exhibiting a reduction in body size at age of maturation, the productivity estimates reported (Table 8) for many of the populations continue to demonstrate stable levels of recruitment.

Table 7. Estimates of escapement and productivity (recruits/spawner) for Puget Sound Chinook populations. Natural origin escapement information is provided where available. Populations at or below their critical escapement threshold are bolded. For several populations, hatchery contributions to natural spawning data are limited or unavailable.

Region	Population	1999 to 2018 Run Year Geometric mean Escapement (Spawners)		NMFS Escapement Thresholds		Recovery Planning Abundance Target in Spawners (productivity)[2]	Average % hatchery fish in escapement 1999-2018 (min-max)[5]
		Natural [1] 1999-2018	Natural-Origin (Productivity[2])	Critical[3]	Rebuilding[4]		
Georgia Basin	Nooksack MU	1,787	281[9]	400	500		
	NF Nooksack	1,494	202[9] (0.4)	*200*[6]	-	3,800 (3.4)	85 (63-94)
	SF Nooksack	246	**57**[9] (1.8)	*200*[6]	-	2,000 (3.6)	51 (19-81)
Whidbey/Main Basin	Skagit Summer/Fall MU						
	Upper Skagit River	9,349	8,422 (2.8)	738	5,836	5,380 (3.8)	9 (0-36)
	Lower Sauk River	560	533 (3.2)	*200*[6]	371	1,400 (3.0)	4 (0-33)
	Lower Skagit River	2,089	1, 916 (2.8)	281	2,475	3,900 (3.0)	8 (0-23)
	Skagit Spring MU						
	Upper Sauk River	633	624 (3.2)	170	484	750 (3.0)	1 (0-4)
	Suiattle River	379	373 (2.0)	170	250	160 (2.8)	2 (0-7)
	Upper Cascade River	284	256 (1.4)	130	196	290 (3.0)	9 (0-50)
	Stillaguamish MU						
	NF Stillaguamish R.	1,052	499 (0.88)	300	550	4,000 (3.4)	50 (25-81)
	SF Stillaguamish R.	133	**69** (0.64)	*200*[6]	300	3,600 (3.3)	48 (9-100)
	Snohomish MU						
	Skykomish River	3,390	2,273 (1.5)	400	1,500	8,700 (3.4)	31 (10-62)
	Snoqualmie River	1,505	1, 216 (1.4)	400	900	5,500 (3.6)	19 (8-35)
Central/South Sound	Cedar River	927	661 (2.9)	*200*[6]	*282*[7]	2,000 (3.1)	28 (10-50)
	Sammamish River	1,132	**164** (0.5)	*200*[6]	*1,250*[6]	1,000 (3.0)	80 (36-89)
	Duwamish-Green R.	4,075	1,534 (1.5)	400	1,700	-	60 (27-79)
	White River[10]	1,817	643 (0.9)	*200*[6]	488[7]	-	57 (19-90)
	Puyallup River[11]	1,645	826 (1.3)	*200*[6]	797[7]	5,300 (2.3)	45 (19-79)
	Nisqually River	1,659	612 (1.4)	*200*[6]	1,200[8]	3,400 (3.0)	57 (17-87)
Hood Canal	Skokomish River	1,398	**282** (0.8)	452	1,160	-	71 (7-96)
	Mid-Hood Canal Rivers[12]	**187**		*200*[6]	*1,250*[6]	1,300 (3.0)	36[12] (2-87)
Strait of Juan de Fuca	Dungeness River	458	**178**(1.4)	*200*[6]	925[8]	1,200 (3.0)	59 (24-96)
	Elwha River[13]	1,653	**76**[9]	*200*[6]	*1,250*[6]	6,900 (4.6)	95 91-98)

[1] Includes naturally spawning hatchery fish (Nooksack Major Unit (MU)=1999-2016, North Fork (NF) population=1999-2016, and South Fork (SF) populations=1999-2017 geomean).

[2] Source productivity is Abundance and Productivity Tables from NWFSC database; measured as the mean of observed recruits/observed spawners through brood year 2015. Sammamish productivity estimate has not been revised to include Issaquah Creek. Source for Recovery Planning productivity target is the final supplement to the Puget Sound Salmon Recovery Plan (NMFS 2006a); measured as recruits/spawner associated with the number of spawners at Maximum Sustained Yield under recovered conditions.

[3] Critical natural-origin escapement thresholds under current habitat and environmental conditions (McElhany et al. 2000; NMFS 2000; NMFS and NWFSC 2018).

[4] Rebuilding natural-origin escapement thresholds under current habitat and environmental conditions (McElhany et al. 2000; NMFS 2000; NMFS and NWFSC 2018).

[5] Estimates of the fraction of hatchery fish in natural spawning escapements are from the Abundance and Productivity Tables from NWFSC database; measured as mean and range for 1999-2018.

[6] Based on generic VSP guidance (McElhany et al. 2000; NMFS 2000).

[7] Based on spawner-recruit assessment (Puget Sound Chinook Harvest Management Plan, December 1, 2018).

[8] Based on alternative habitat assessment.

[9] Estimates of natural-origin escapement for NF Nooksack available only for 1999-2016; SF Nooksack only for 1999-2017; Elwha for 2009-2017

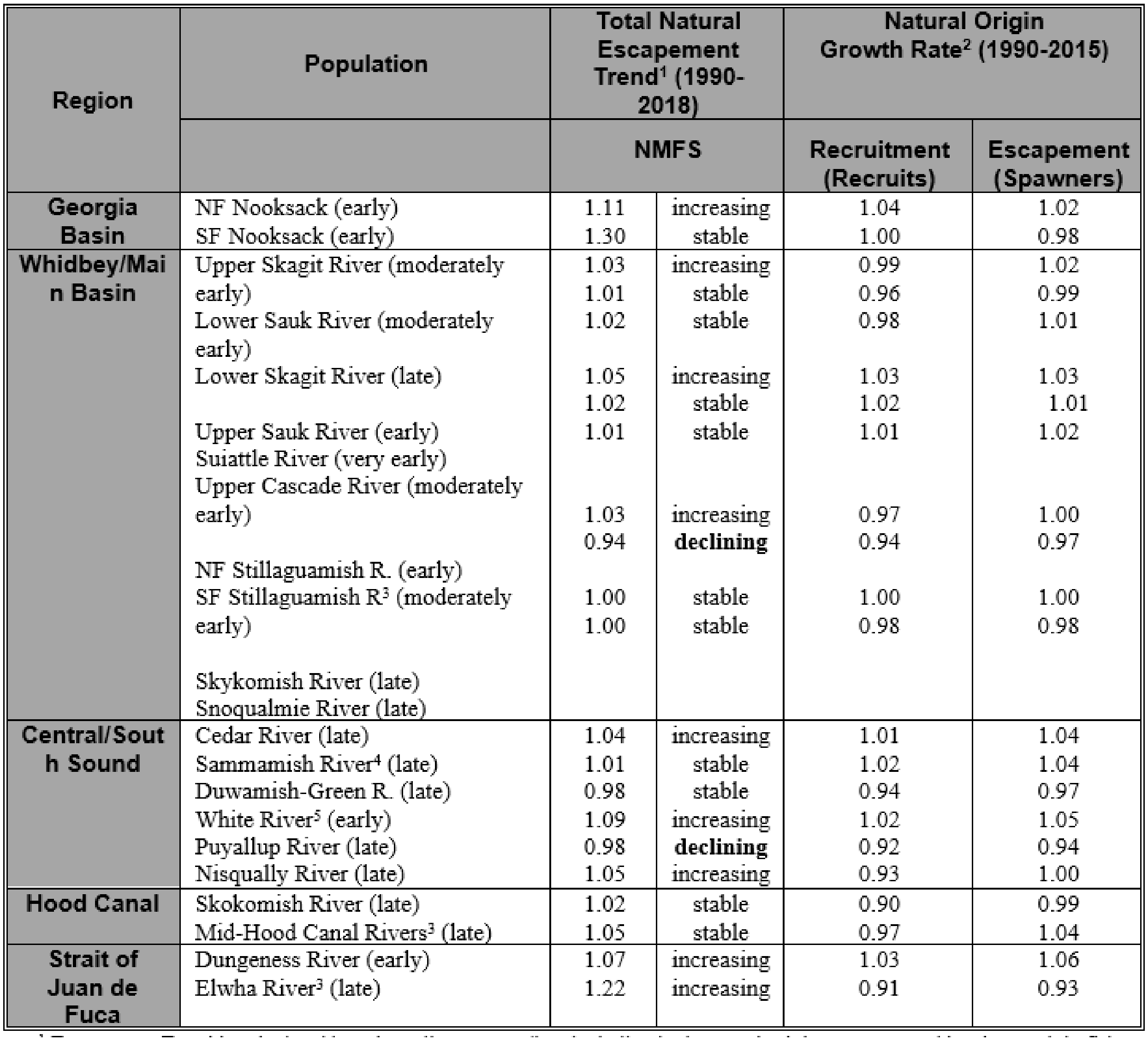
[10] Captive broodstock program for early run Chinook salmon ended in 2000; estimates of natural spawning escapement include an unknown fraction of naturally spawning hatchery-origin fish from late- and early run hatchery programs in the White and Puyallup River basins.

[11] South Prairie index area provides a more accurate trend in the escapement for the Puyallup River because it is the only area in the Puyallup River for which spawners or redds can be consistently counted (PSIT and WDFW 2010a).

[12] The PSTRT considers Chinook salmon spawning in the Dosewallips, Duckabush, and Hamma Hamma rivers to be subpopulations of the same historically independent population; annual counts in those three streams are variable due to inconsistent visibility during spawning ground surveys. Data on the contribution of hatchery fish is very limited; primarily based on returns to the Hamma Hamma River.

[13] Estimates of natural escapement do not include volitional returns to the hatchery or those hatchery or natural-origin fish gaffed or seined from spawning grounds for supplementation program broodstock collection.

Table 8. Long-term trends in abundance and productivity for Puget Sound Chinook populations. Long-term, reliable data series for natural-origin contribution to escapement are limited in many areas.



Region	Population	Total Natural Escapement Trend[1] (1990-2018)		Natural Origin Growth Rate[2] (1990-2015)	
		NMFS		Recruitment (Recruits)	Escapement (Spawners)
Georgia Basin	NF Nooksack (early)	1.11	increasing	1.04	1.02
	SF Nooksack (early)	1.30	stable	1.00	0.98
Whidbey/Main Basin	Upper Skagit River (moderately	1.03	increasing	0.99	1.02
	early)	1.01	stable	0.96	0.99
	Lower Sauk River (moderately	1.02	stable	0.98	1.01
	early)				
	Lower Skagit River (late)	1.05	increasing	1.03	1.03
		1.02	stable	1.02	1.01
	Upper Sauk River (early)	1.01	stable	1.01	1.02
	Suiattle River (very early)				
	Upper Cascade River (moderately				
	early)	1.03	increasing	0.97	1.00
		0.94	**declining**	0.94	0.97
	NF Stillaguamish R. (early)				
	SF Stillaguamish R[3] (moderately	1.00	stable	1.00	1.00
	early)	1.00	stable	0.98	0.98
	Skykomish River (late)				
	Snoqualmie River (late)				
Central/South Sound	Cedar River (late)	1.04	increasing	1.01	1.04
	Sammamish River[4] (late)	1.01	stable	1.02	1.04
	Duwamish-Green R. (late)	0.98	stable	0.94	0.97
	White River[5] (early)	1.09	increasing	1.02	1.05
	Puyallup River (late)	0.98	**declining**	0.92	0.94
	Nisqually River (late)	1.05	increasing	0.93	1.00
Hood Canal	Skokomish River (late)	1.02	stable	0.90	0.99
	Mid-Hood Canal Rivers[3] (late)	1.05	stable	0.97	1.04
Strait of Juan de Fuca	Dungeness River (early)	1.07	increasing	1.03	1.06
	Elwha River[3] (late)	1.22	increasing	0.91	0.93

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[2] Median growth rate (λ) is calculated based on natural-origin production. It is calculated assuming the reproductive success of naturally spawning hatchery fish is equivalent to that of natural-origin fish (for those populations where information on the fraction of hatchery fish in natural spawning abundance is available). Source: Abundance and Productivity Tables from NWFSC database.

[3] Estimate of the fraction of hatchery fish in time series is not available for use in λ calculation, so trend represents that in hatchery-origin + natural-origin spawners.

[4] Median growth rate estimates for Sammamish has not been revised to include escapement in Issaquah Creek.

[5] Natural spawning escapement includes an unknown % of naturally spawning hatchery-origin fish from late- and early run hatchery programs in the White/Puyallup River basin.

Limiting Factors and Threats – PS Chinook Salmon

Limiting factors described in SSPS (2005) and reiterated in NMFS (2017c) include:

- Degraded nearshore and estuarine habitat: Residential and commercial development has reduced the amount of functioning nearshore and estuarine habitat available for salmon rearing and migration. The loss of mudflats, eelgrass meadows, and macroalgae further limits salmon foraging and rearing opportunities in nearshore and estuarine areas.
- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and large wood supply, stream substrate, impaired passage conditions and water quality have been degraded for adult spawning, embryo incubation, and rearing as a result of cumulative impacts of agriculture, forestry, and development. Some improvements have occurred over the last decade for water quality and removal of forest road barriers.
- Anadromous salmonid hatchery programs: Salmon and steelhead released from Puget Sound hatcheries operated for harvest augmentation purposes pose ecological, genetic, and demographic risks to natural-origin Chinook salmon populations. The risk to the species' persistence that may be attributable to hatchery-related effects has decreased since the last Status Review, based on hatchery risk reduction measures that have been implemented, and new scientific information regarding genetic effects noted above (NWFSC 2015). Improvements in hatchery operations associated with on-going ESA review and determination processes are expected to further reduce hatchery-related risks.
- Salmon harvest management: Total fishery exploitation rates on most Puget Sound Chinook populations have decreased substantially since the late 1990s when compared to years prior to listing (average reduction = -18 percent, range = -52 to +41 percent), (October. 2018 Fishery Regulation Assessment Model (FRAM) base period validation results, version 6.2) but weak natural-origin Chinook salmon populations in Puget Sound still require enhanced protective measures to reduce the risk of overharvest. The risk to the species' persistence because of harvest remains the same since the last status review. Further, there is greater uncertainty associated with this threat due to shorter term harvest plans and exceedance of rebuilding exploitation rates (RER) for many Chinook salmon populations essential to recovery.
- Concerns regarding existing regulatory mechanisms, including: lack of documentation or analysis of the effectiveness of land-use regulatory mechanisms and land-use management plans, lack of reporting and enforcement for some regulatory programs, certain Federal, state, and local land and water use decisions continue to occur without the benefit of ESA review. State and local decisions have no Federal nexus to trigger the ESA Section 7 consultation requirement, and thus certain permitting actions allow direct and indirect species take and/or adverse habitat effects.

Recovery Plan – Puget Sound Chinook Salmon

The NMFS adopted the Recovery Plan for Puget Sound Chinook on January 19, 2007 (72 FR 2493). The Recovery Plan consists of two documents: the Puget Sound Salmon Recovery Plan prepared by the Shared Strategy for Puget Sound (Puget Sound Salmon Recovery Plan) (SSPS 2005) and Final Supplement to the Shared Strategy's Puget Sound Salmon Recovery Plan (NMFS 2006a). The Recovery Plan adopts ESU and population level viability criteria recommended by the Puget Sound Technical Recovery Team (PSTRT) (Ruckelshaus et al. 2002; Ruckelshaus et al. 2006). The PSTRT's Biological Recovery Criteria will be met when the following conditions are achieved:

1. All watersheds improve from current conditions, resulting in improved status for the species;
2. At least two to four Chinook salmon populations in each of the five biogeographical regions of Puget Sound attain a low risk status over the long-term[16];
3. At least one or more populations from major diversity groups historically present in each of the five Puget Sound regions attain a low risk status;
4. Tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations are functioning in a manner that is sufficient to support an ESU-wide recovery scenario;
5. Production of Chinook salmon from tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations occurs in a manner consistent with ESU recovery.

More information related to Puget Sound Chinook salmon in the action area is presented under **Section 2.3.15 Baseline**

2.2.3.10 Rangewide Status of the Species- Puget Sound Steelhead

The Puget Sound steelhead DPS was listed as threatened on May 11, 2007 (72 FR 26722). NOAA's Northwest Fisheries Science Center evaluated the viability of steelhead within the Puget Sound DPS (Hard et al. 2015), and issued a status review update providing new information and analysis on the biological status of the listed species (NWFSC 2015). In 2016 NMFS completed a five-year status review of the Puget Sound Steelhead DPS (NMFS 2017c). Using key findings in NWFSC (2015), the status review concluded there were no major changes in the status or composition of the Puget Sound Steelhead DPS. The status review incorporated the findings of the Science Center's report, summarized new information concerning the delineation of the DPS and inclusion of closely related salmonid hatchery programs, and included an evaluation of the listing factors (NMFS 2017c). Based on this review, NMFS concluded that the species should remain listed as threatened. On October 4, 2019 NMFS published 84 FR 53117, requesting updated information on all listed Puget Sound populations to inform the most recent five-year status review anticipated for completion in 2021. In this

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[16] The number of populations required depends on the number of diversity groups in the region. For example, three of the regions only have two populations generally of one diversity type; the Central Sound Region has two major diversity groups; the Whidbey/Main Region has four major diversity groups.

opinion, where possible, the status review information is supplemented with more recent information and other population specific data that may not have been available for consideration during the NWFSC (2015) status review.

As part of the early recovery planning process, NMFS convened a technical recovery team to identify historic populations and develop viability criteria for the Recovery Plan. The Puget Sound Steelhead Technical Recovery Team (PSSTRT) delineated populations and completed a set of population viability analyses (PVAs) for these Demographically Independent Populations (DIPs) and Major Population Groups (MPGs) within the DPS that are summarized in the 5-year status review and the final draft viability criteria reports (Puget Sound Steelhead Technical Recovery Team 2011; PSSTRT 2013; NWFSC 2015). These documents present the biological viability criteria recommended by the PSSTRT. The framework and the analysis it supports do not set targets for delisting or recovery, nor do they explicitly identify specific populations or groups of populations for recovery priority. Rather, the framework and associated analysis are meant to provide a technical foundation for those charged with recovery of listed steelhead in Puget Sound from which they can develop effective recovery plans at the watershed scale, and higher, that are based on biologically meaningful criteria (PSSTRT 2011).

Geographic Range and Distribution/Spatial Structure/Diversity – PS Steelhead

The populations within the Puget Sound steelhead DPS are aggregated into three extant MPGs containing a total of 32 DIPs based on genetic, environmental, and life history characteristics (PSSTRT 2011). Populations can include summer steelhead only, winter steelhead only, or a combination of summer and winter run timing (e.g., winter run, summer run or summer/winter run). Figure 17 illustrates the DPS, MPGs, and DIPs for Puget Sound steelhead.

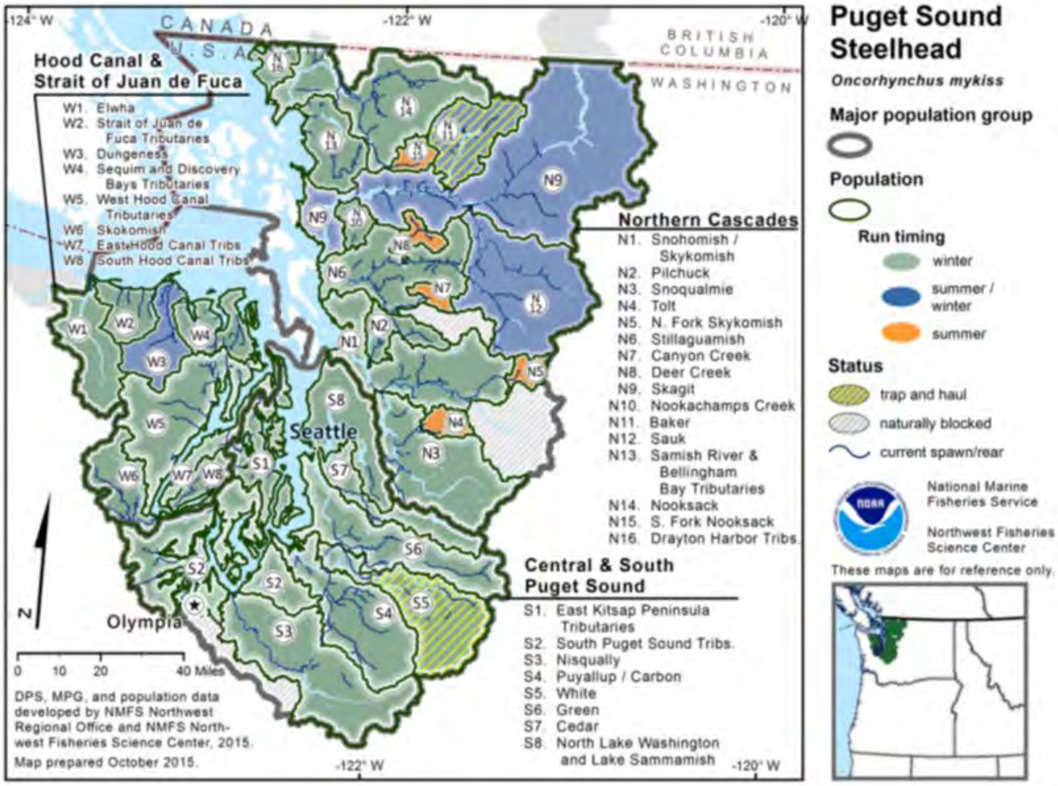

Figure 17. The Puget Sound Steelhead DPS showing MPGs and DIPs. The steelhead MPGs include the Northern Cascades, Central & Sound Puget Sound, and the Hood Canal & Strait of Juan de Fuca

The Puget Sound Steelhead DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) populations originating below natural and manmade impassable barriers from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound and the Strait of Georgia. Also, steelhead from six artificial propagation programs: the Green River Natural Program; White River Winter Steelhead Supplementation Program; Hood Canal Steelhead Supplementation Off-station Projects in the Dewatto, Skokomish, and Duckabush Rivers; and the Lower Elwha Fish Hatchery Wild Steelhead Recovery Program. (79 FR 20802, April 14, 2014). Steelhead included in the listing are the anadromous form of *O. mykiss* that occur in rivers, below natural and man-made impassable barriers to migration, in northwestern Washington State. Non-anadromous ‘‘resident’’ *O. mykiss* occur within the range of Puget Sound steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral characteristics (Hard et al. 2007).

When NMFS initiated an ESA-listing status review for Puget Sound steelhead, a Biological Review Team (BRT) was formed to review the available information and assess the extinction risk of the DPS. The BRT considered the major risk factors associated with spatial structure and diversity of Puget Sound steelhead to be: (1) the low abundance of several summer run populations; (2) the sharply diminishing abundance of some winter steelhead populations, especially in south Puget Sound, Hood Canal, and the Strait of Juan de Fuca; and (3) continued releases of out-of-ESU hatchery fish from Skamania-derived summer run and Chambers Creek-derived winter run stocks (Discussed further in section 2.4.1; Hard et al. 2007; Hard et al. 2015). Loss of diversity and spatial structure were judged to be "moderate" risk factors (Hard et al. 2007).

In 2013, the PSSTRT completed its evaluation of factors that influence the diversity and spatial structure VSP criteria for steelhead in the DPS. For spatial structure, this included the fraction of available intrinsic potential rearing and spawning habitat that is occupied compared to what is needed for viability.[17] For diversity, these factors included hatchery fish production, contribution of resident fish to anadromous fish production, and run timing of adult steelhead. Quantitative information on spatial structure and connectivity was not available for most Puget Sound steelhead populations, so a Bayesian Network framework was used to assess the influence of these factors on steelhead viability at the population, MPG, and DPS scales. The PSSTRT concluded that low population viability was widespread throughout the DPS and populations showed evidence of diminished spatial structure and diversity. Specifically, population viability associated with spatial structure and diversity was highest in the Northern Cascades MPG and lowest in the Central and South Puget Sound MPG (Figure 18). Diversity was generally higher for populations within the Northern Cascades MPG, where more variability in viability was expressed and diversity generally higher, compared to populations in both the Central and South Puget Sound and Hood Canal and Strait of Juan de Fuca MPG, where diversity was depressed and viabilities were generally lower (NWFSC 2015). Most Puget Sound steelhead populations were given intermediate scores for spatial structure and low scores for diversity because of extensive hatchery influence, low breeding population sizes, and freshwater habitat fragmentation or loss (NWFSC 2015).

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[17] Where intrinsic potential is the area of habitat suitable for steelhead rearing and spawning, at least under historical conditions (Puget Sound Steelhead Technical Recovery Team 2011; PSSTRT 2013).

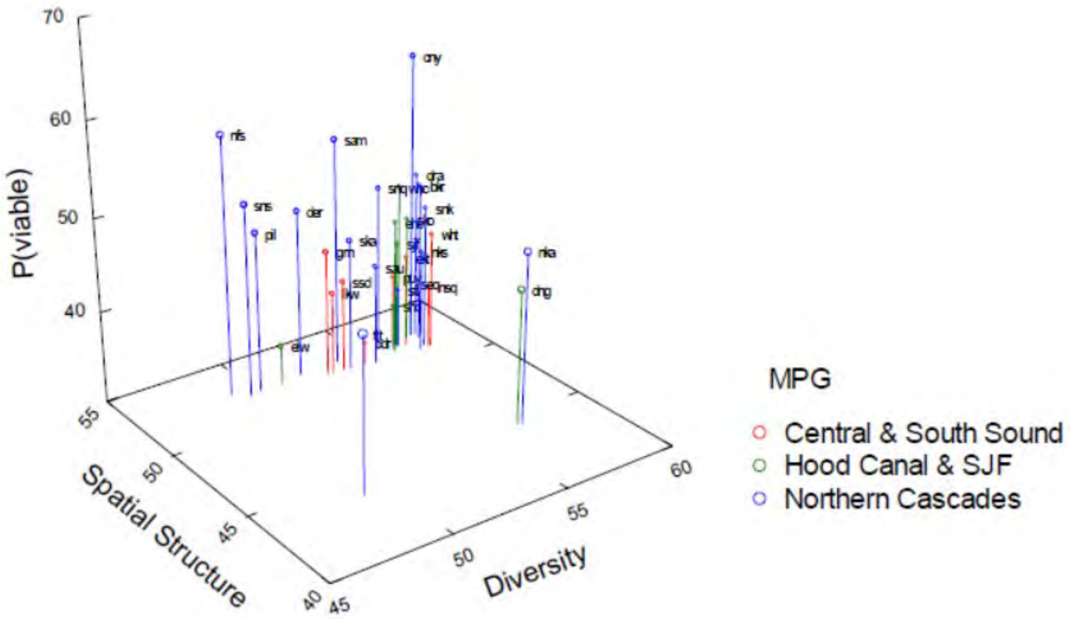
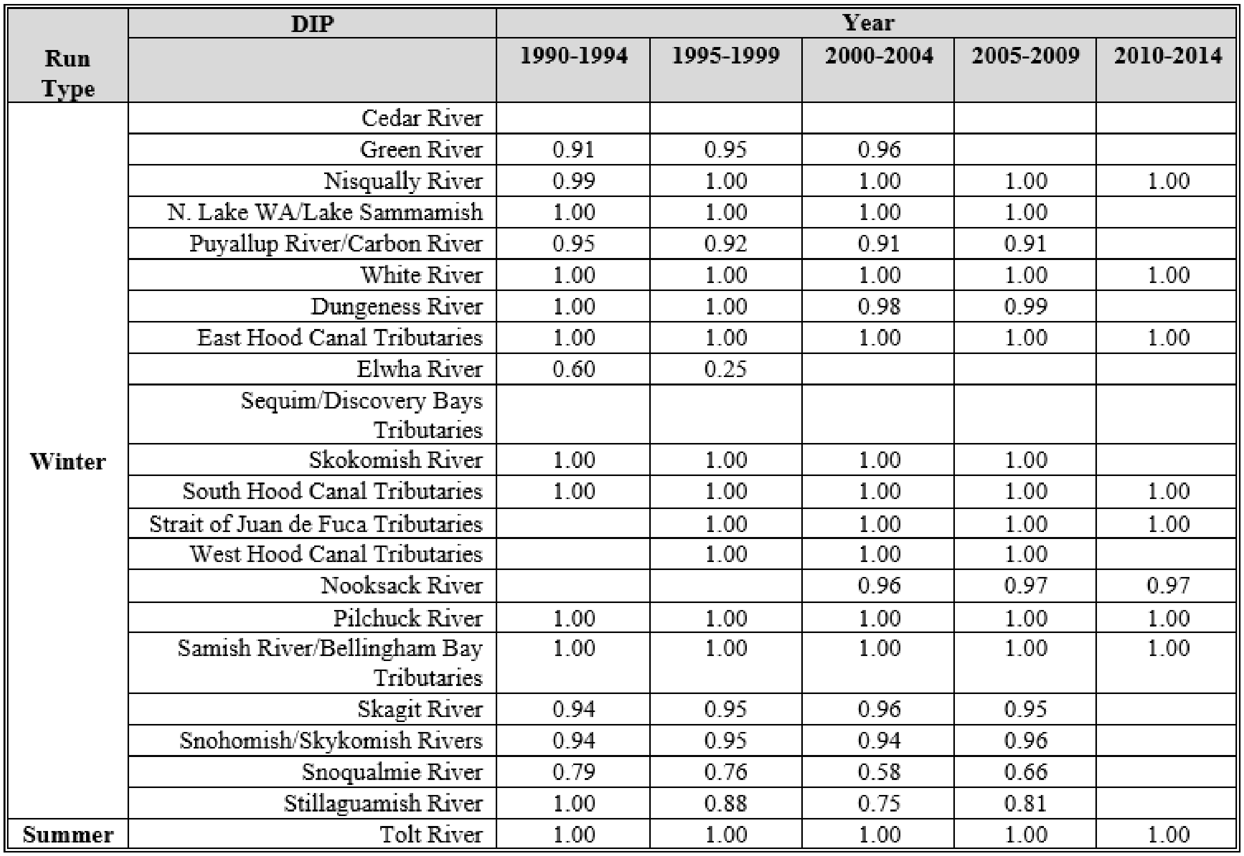


Figure 18. Scatter plot of the probabilities of viability for each of the 32 steelhead populations in the Puget Sound DPS as a function of VSP parameter estimates of influence of diversity and spatial structure on viability (PSSTRT 2011).

Since the Technical Recovery Team completed its review of Puget Sound steelhead, the only spatial structure and diversity data that have become available have been estimates of the fraction of hatchery fish on the spawning grounds (NWFSC 2015). Hatchery production and release of hatchery smolts of both summer-run and winter-run steelhead have declined in recent years for most geographic areas within the DPS (NWFSC 2015). Since publication of the NWFSC report in 2015 even further reductions in hatchery production have occurred and will be discussed in detail in section 2.4.1. In addition, the fraction of hatchery steelhead spawning naturally is low for many rivers (NWFSC 2015). Steelhead hatchery programs are discussed in further detail in the Environmental Baseline section (2.4.1). For 17 DIPs across the DPS, the five-year average for the fraction of natural-origin steelhead spawners exceeded 0.75 from 2005 to 2009; this average was near 1.0 for 8 populations, where data were available, from 2010 to 2014 (NWFSC 2015). In some river systems, these estimates are higher than some guidelines recommend (e.g., no more than 5 percent hatchery-origin spawners on spawning grounds for isolated hatchery programs. Overall, the fraction of natural-origin steelhead spawners is 0.9 or greater for the most recent two time periods (i.e., 2005-2009 and 2010-2014) but this fraction could also not be estimated for a substantial number of DIPs especially during the 2010 to 2014 period (Table 9) (NWFSC 2015).

Table 9. Puget Sound steelhead 5-year mean fraction of natural-origin spawners1 for 22 of the 32 DIPs in the DPS for which data are available (NWFSC 2015).



Run Type	DIP	Year				
		1990-1994	1995-1999	2000-2004	2005-2009	2010-2014
Winter	Cedar River					
	Green River	0.91	0.95	0.96		
	Nisqually River	0.99	1.00	1.00	1.00	1.00
	N. Lake WA/Lake Sammamish	1.00	1.00	1.00	1.00	
	Puyallup River/Carbon River	0.95	0.92	0.91	0.91	
	White River	1.00	1.00	1.00	1.00	1.00
	Dungeness River	1.00	1.00	0.98	0.99	
	East Hood Canal Tributaries	1.00	1.00	1.00	1.00	1.00
	Elwha River	0.60	0.25			
	Sequim/Discovery Bays Tributaries					
	Skokomish River	1.00	1.00	1.00	1.00	
	South Hood Canal Tributaries	1.00	1.00	1.00	1.00	1.00
	Strait of Juan de Fuca Tributaries		1.00	1.00	1.00	1.00
	West Hood Canal Tributaries		1.00	1.00	1.00	
	Nooksack River			0.96	0.97	0.97
	Pilchuck River	1.00	1.00	1.00	1.00	1.00
	Samish River/Bellingham Bay Tributaries	1.00	1.00	1.00	1.00	1.00
	Skagit River	0.94	0.95	0.96	0.95	
	Snohomish/Skykomish Rivers	0.94	0.95	0.94	0.96	
	Snoqualmie River	0.79	0.76	0.58	0.66	
	Stillaguamish River	1.00	0.88	0.75	0.81	
Summer	Tolt River	1.00	1.00	1.00	1.00	1.00

Early winter-run fish produced in isolated hatchery programs are derived from Chambers Creek stock in southern Puget Sound, which has been selected for early spawn timing, a trait known to be inheritable in salmonids.[18] Summer-run fish produced in isolated hatchery programs are derived from the Skamania River summer stock in the lower Columbia River Basin (i.e., from outside the DPS). The production and release of hatchery fish of both run types (winter and summer) may continue to pose risk to diversity in natural-origin steelhead in the DPS, as described in Hard et al. (2007) and Hard et al. (2015).

More information on Puget Sound steelhead spatial structure and diversity can be found in NMFS's PSSTRT viability report and NMFS's status review update on salmon and steelhead (NWFSC 2015).

Abundance, Productivity, and Trends – PS Steelhead

As stated previously, the 2007 BRT considered the major risk factors associated with abundance and productivity to be: (1) widespread declines in abundance and productivity for most natural

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[18] The natural Chambers Creek steelhead stock is now extinct.

steelhead populations in the ESU, including those in Skagit and Snohomish rivers (previously considered to be strongholds); (2) the low abundance of several summer run populations; and (3) the sharply diminishing abundance of some steelhead populations, especially in south Puget Sound, Hood Canal, and the Strait of Juan de Fuca (Hard et al. 2007).

Abundance and productivity estimates have been made available in the NWFSC status review update (NWFSC 2015). Steelhead abundance estimates are available for 7 of the 11 winter-run DIPs and 1 of the 5 summer-run DIPs in the Northern Cascades MPG,[19] 6 of the 8 winter-run DIPs in the Central and South Puget Sound MPG,[20] and 8 of the 8 winter-run DIPs in the Hood Canal and Strait of Juan de Fuca MPG.[21] Little or no data is available on summer run populations to evaluate extinction risk or abundance trends. Because of their small population size and the complexity of monitoring fish in headwater holding areas, summer steelhead have not been broadly monitored. Data were available for only one summer-run DIP, the Tolt River steelhead population in the Northern Cascades MPG. Total abundance of steelhead in these populations (Figure 19) has shown a generally declining trend over much of the DPS.

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[19] Nooksack River, Samish River/Bellingham Bay Tributaries, Skagit River, Pilchuck River, Snohomish/Skykomish River, Snoqualmie River, and Stillaguamish River winter-run DIPs as well as the Tolt River summer-run DIP.

[20] Cedar River, Green River, Nisqually River, North Lake Washington/Lake Sammamish, Puyallup River/Carbon River, and White River winter-run DIPs.

[21] Dungeness River, East Hood Canal Tributaries, Elwha River, Sequim/Discovery Bays Tributaries, Skokomish River, South Hood Canal Tributaries, Strait of Juan de Fuca Tributaries, and West Hood Canal Tributaries winter-run DIPs.

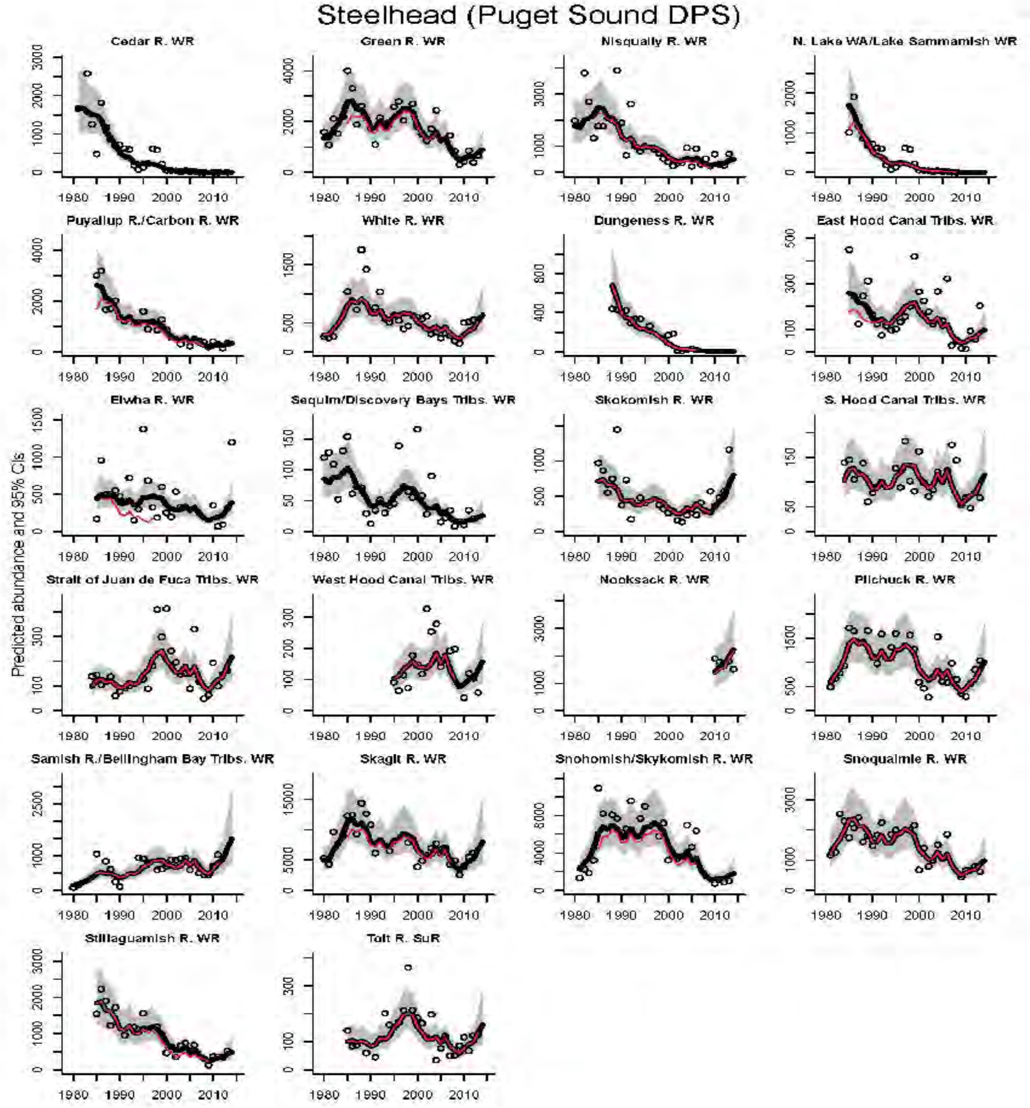

Figure 19. Trends in estimated total (black line) and natural (red line) population spawning abundance of Puget Sound steelhead. The circles represent annual raw spawning abundance data and the gray bands represent the 95% confidence intervals around the estimate (NWFSC 2015).

Since 2009, nine of the 22 populations indicate small to modest increases in abundance.[22] Most steelhead populations remain small. From 2010 to 2014, 8 of the 22 steelhead populations had fewer than 250 natural spawners annually, and 11 of the 22 steelhead populations had fewer than 500 natural spawners (Table 10).

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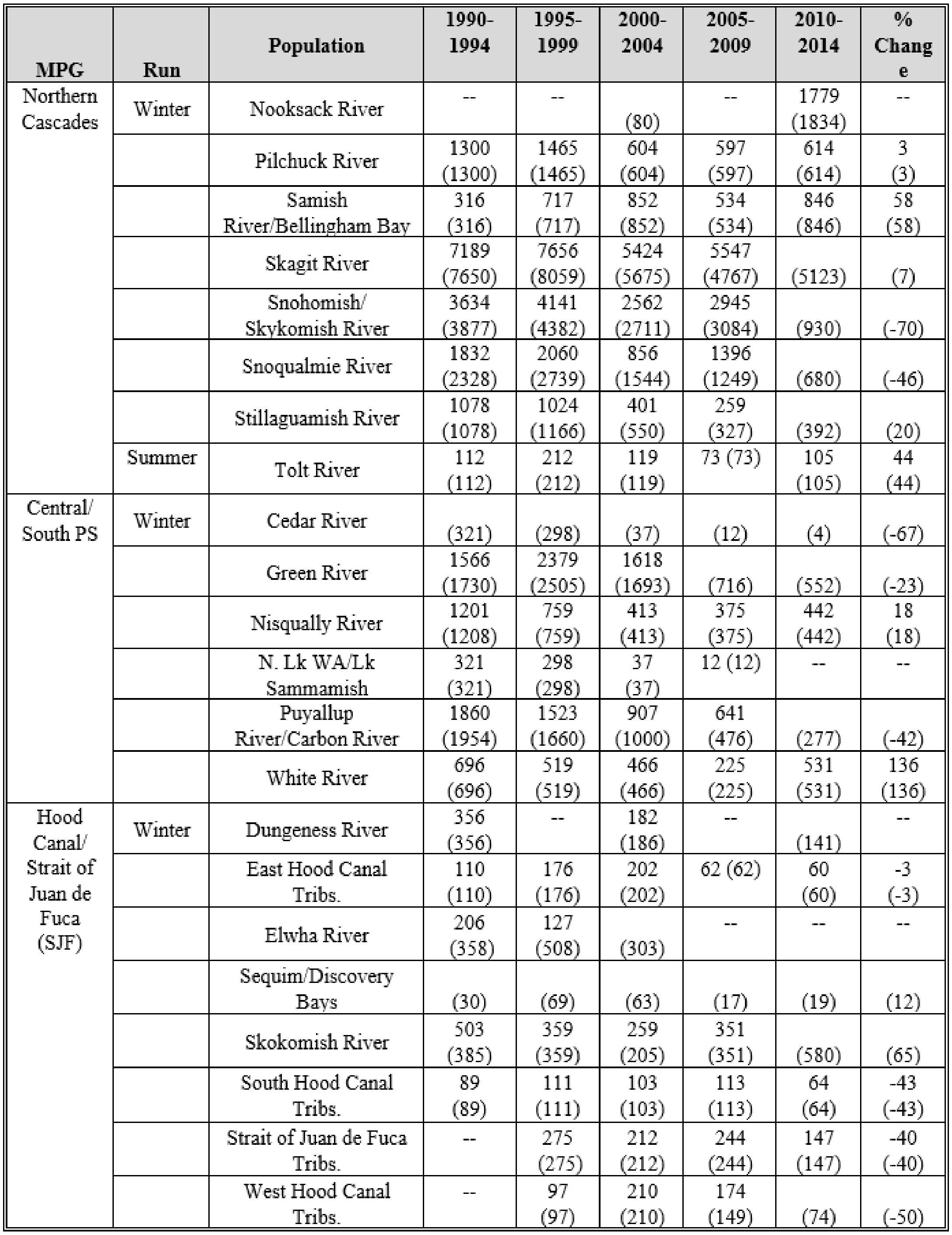
[22] Pilchuck River, Samish River/Bellingham Bays Tributaries, Nisqually River, White River, Sequim/Discovery Bay Tributaries, Skokomish River winter-run populations. The Tolt River, Skagit River and Stillaguamish River summer-run steelhead populations are also showing early signs of upward trends.

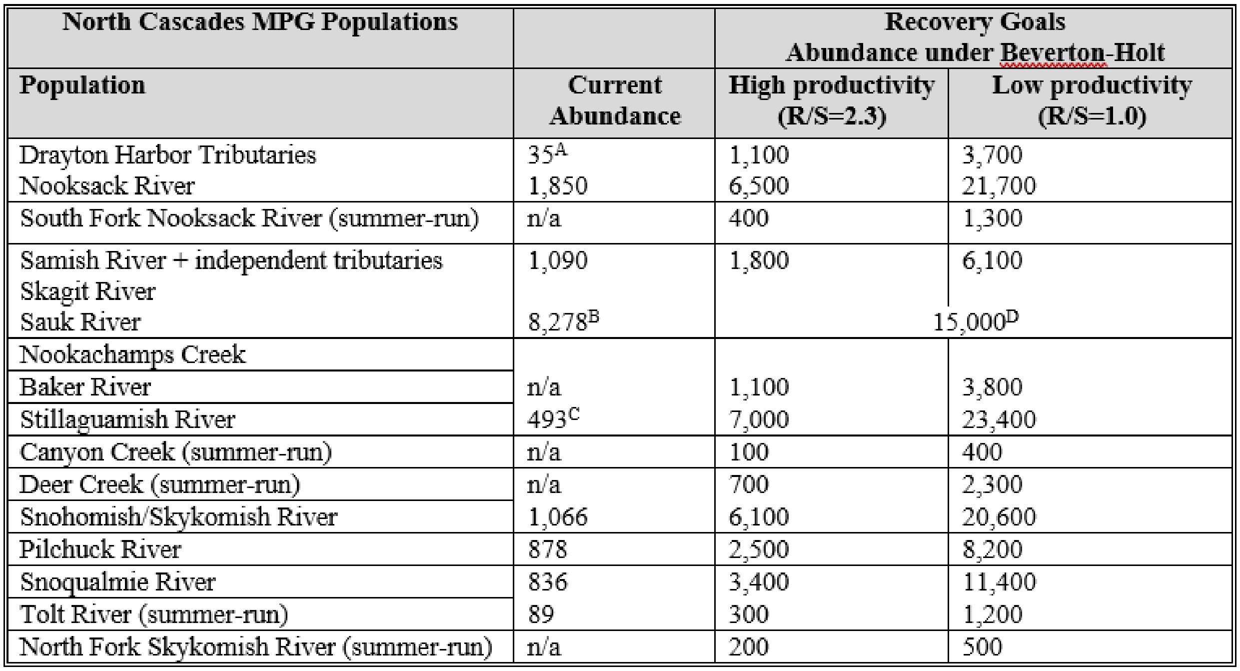
Table 10. 5-year geometric mean of raw natural spawner counts for Puget Sound steelhead (total spawner H and W counts). A value only in parentheses means that a total spawner count was available but no, or only one estimate (within the 5-year (yr) period) of natural-origin spawners was available. Values not in parentheses, where available, represent the 5-year geometric mean of natural-origin spawners for each period. Percent change between the most recent two 5-year periods is shown on the far right (NWFSC 2015).



MPG	Run	Population	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	% Change
Northern Cascades	Winter	Nooksack River	--	--	(80)	--	1779 (1834)	--
		Pilchuck River	1300 (1300)	1465 (1465)	604 (604)	597 (597)	614 (614)	3 (3)
		Samish River/Bellingham Bay	316 (316)	717 (717)	852 (852)	534 (534)	846 (846)	58 (58)
		Skagit River	7189 (7650)	7656 (8059)	5424 (5675)	5547 (4767)	(5123)	(7)
		Snohomish/ Skykomish River	3634 (3877)	4141 (4382)	2562 (2711)	2945 (3084)	(930)	(-70)
		Snoqualmie River	1832 (2328)	2060 (2739)	856 (1544)	1396 (1249)	(680)	(-46)
		Stillaguamish River	1078 (1078)	1024 (1166)	401 (550)	259 (327)	(392)	(20)
	Summer	Tolt River	112 (112)	212 (212)	119 (119)	73 (73)	105 (105)	44 (44)
Central/ South PS	Winter	Cedar River	(321)	(298)	(37)	(12)	(4)	(-67)
		Green River	1566 (1730)	2379 (2505)	1618 (1693)	(716)	(552)	(-23)
		Nisqually River	1201 (1208)	759 (759)	413 (413)	375 (375)	442 (442)	18 (18)
		N. Lk WA/Lk Sammamish	321 (321)	298 (298)	37 (37)	12 (12)	--	--
		Puyallup River/Carbon River	1860 (1954)	1523 (1660)	907 (1000)	641 (476)	(277)	(-42)
		White River	696 (696)	519 (519)	466 (466)	225 (225)	531 (531)	136 (136)
Hood Canal/ Strait of Juan de Fuca (SJF)	Winter	Dungeness River	356 (356)	--	182 (186)	--	(141)	--
		East Hood Canal Tribs.	110 (110)	176 (176)	202 (202)	62 (62)	60 (60)	-3 (-3)
		Elwha River	206 (358)	127 (508)	(303)	--	--	--
		Sequim/Discovery Bays	(30)	(69)	(63)	(17)	(19)	(12)
		Skokomish River	503 (385)	359 (359)	259 (205)	351 (351)	(580)	(65)
		South Hood Canal Tribs.	89 (89)	111 (111)	103 (103)	113 (113)	64 (64)	-43 (-43)
		Strait of Juan de Fuca Tribs.	--	275 (275)	212 (212)	244 (244)	147 (147)	-40 (-40)
		West Hood Canal Tribs.	--	97 (97)	210 (210)	174 (149)	(74)	(-50)

The Recovery Plan (NMFS 2019g) provided updated current abundance by MPG and population, as a five-year average terminal run size (escapement + harvest) for return years 2012 – 2016 (Tables 11 and 12).

Table 11. Current abundance and recovery goals for Puget Sound steelhead in the North Cascades MPG based on recruits/spawner (R/S) in years of high productivity and low productivity. Current abundance is the five-year average terminal run size (escapement + harvest) for return years 2012 – 2016, unless otherwise noted or not available (n/a). We suspect that our methods overestimated the historical steelhead abundance of populations composed of many small independent streams relative to those in larger rivers (NMFS 2019g).



North Cascades MPG Populations		Recovery Goals Abundance under Beverton-Holt	
Population	**Current Abundance**	**High productivity (R/S=2.3)**	**Low productivity (R/S=1.0)**
Drayton Harbor Tributaries	35[A]	1,100	3,700
Nooksack River	1,850	6,500	21,700
South Fork Nooksack River (summer-run)	n/a	400	1,300
Samish River + independent tributaries	1,090	1,800	6,100
Skagit River			
Sauk River	8,278[B]	15,000[D]	
Nookachamps Creek			
Baker River	n/a	1,100	3,800
Stillaguamish River	493[C]	7,000	23,400
Canyon Creek (summer-run)	n/a	100	400
Deer Creek (summer-run)	n/a	700	2,300
Snohomish/Skykomish River	1,066	6,100	20,600
Pilchuck River	878	2,500	8,200
Snoqualmie River	836	3,400	11,400
Tolt River (summer-run)	89	300	1,200
North Fork Skykomish River (summer-run)	n/a	200	500

[B] Combined abundance estimates for Skagit River, Sauk River, and Nookachamps Creek populations.

[C] Index of escapement for North Fork Stillaguamish River and tributaries upstream of Deer Creek, does not include entire watershed or population.

[D] Interim target for the Skagit River of an average total run abundance of 15,000 and with an intrinsic productivity at least equal to what was observed from 1978 through 2017.

Table 12. Current abundance and recovery goals for Puget Sound steelhead in the Central and South Sound and Hood Canal and Strait of Juan de Fuca MPGs based on R/S in years of high productivity and low productivity. Current abundance is the five-year average terminal run size (escapement + harvest) for return years 2012 – 2016, unless otherwise noted or not available (n/a). We suspect that our methods overestimated the historical steelhead abundance of populations composed of many small independent streams relative to those in larger rivers (NMFS 2019g).

Population	**Current Abundance**	**Recovery Goals Abundance under Beverton-Holt**	
		High productivity (R/S=2.3)	**Low productivity (R/S=1.0)**
Central and South Sound MPG Populations			
Cedar River	5	1,200	4,000
North Lake WA Tributaries	n/a	4,800	16,000
Green River	1,166	5,600	18,700
Puyallup/Carbon	740	4,500	15,100
White River	635	3,600	12,000
Nisqually River	951	6,100	20,500
East Kitsap tributaries	n/a	2,600	8,700
South Sound Tributaries	n/a	6,300	21,200
Strait of Juan de Fuca MPG Populations			
Elwha River	1168[A]	2,619[B]	
Dungeness River	626[C]	1,200	4,100
Strait Juan de Fuca Independent Tributaries	216[D]	1,000	3,300
Sequim and Discovery Bay Tributaries	27	500	1,700
Skokomish River	921	2,200	7,300
West Hood Canal tributaries	109	2,500	8,400
East Hood Canal tributaries	89	1,800	6,200
South Hood Canal tributaries	61	2,100	7,100

[B] Peters et al. (2014) identified 2,619 adult steelhead as the goal to reach the Viable Population Phase, the last four sequential recovery phases following removal of two dams on the Elwha River. In contrast to other recovery goals presented here, the Elwha River goal is not in the context of a stock-recruit productivity curve.
[C] Restricted to return years 2013-2015 and 2017.
[D] Estimate restricted to return years 2015 and 2016 within Morse Creek plus McDonald Creek, two of several streams in this population.

Steelhead productivity has been variable for most populations since the mid-1980s. In the NWFSC status review update, natural productivity was measured as the intrinsic rate of natural increase (r), which has been well below replacement for the Stillaguamish River and Snohomish/Skykomish River winter-run populations in the Northern Cascade MPG, the North Lake Washington and Lake Sammamish, Puyallup River/Carbon River and Nisqually winter-run populations in the Central and South Puget Sound MPG, and the Dungeness and Elwha winter-run populations in the Hood Canal and Strait of Juan de Fuca MPG. Productivity has fluctuated around replacement for the remainder of Puget Sound steelhead populations, but the majority have predominantly been below replacement since around 2000 (NWFSC 2015). Some steelhead populations are also showing signs of productivity that has been above replacement in the last two or three years (Figure 20). Steelhead populations with productivity estimates above replacement include the Tolt River summer-run, Pilchuck River winter-run, and Nooksack River winter-run in the Northern Cascades MPG, the White River winter-run in the Central and South Puget Sound MPG, and the East and South Hood Canal Tributaries and Strait of Juan de Fuca Tributaries winter-run steelhead populations in the Hood Canal and Strait of Juan de Fuca MPG.

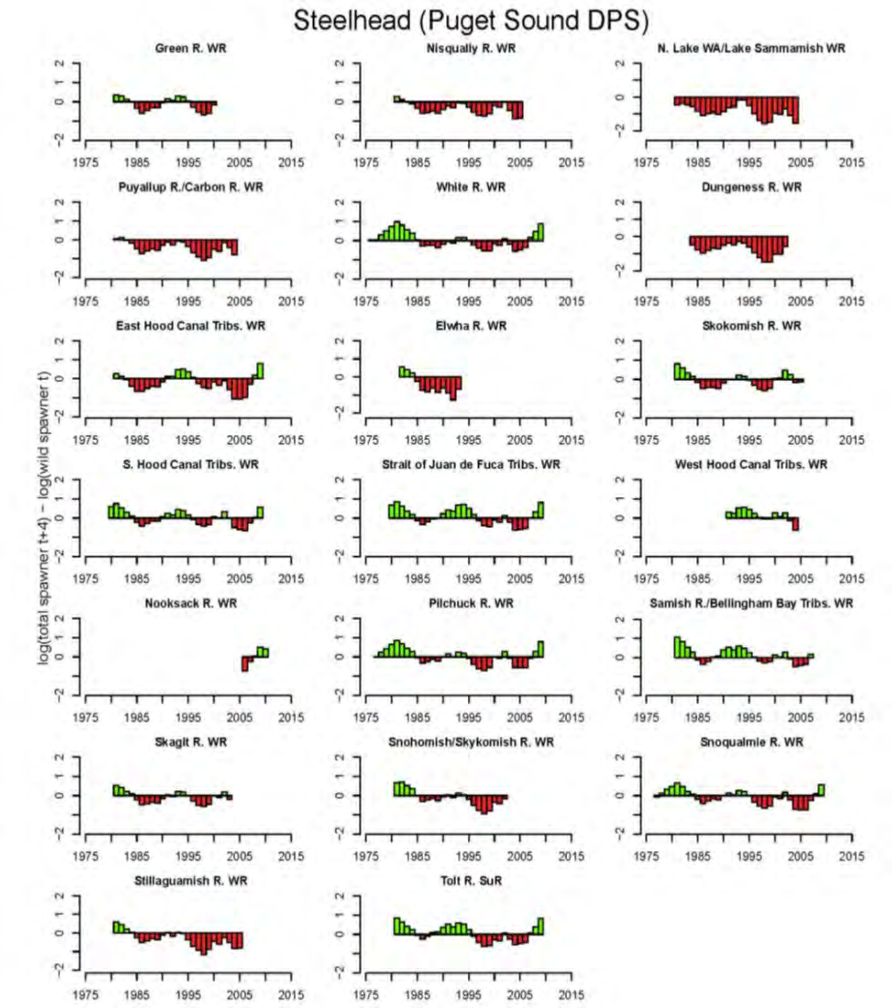


Figure 20. Trends in population productivity of Puget Sound steelhead (NWFSC 2015).

Harvest can affect the abundance and overall productivity of Puget Sound steelhead. Since the 1970s and 1980s, harvest rates have differed greatly among various watersheds, but all harvest rates on Puget Sound steelhead in the DPS have declined (NWFSC 2015). From the late 1970s to early 1990s, harvest rates on natural-origin steelhead averaged between 10 percent and 40 percent, with some populations in central and south Puget Sound[23] at over 60 percent (Figure 21). Harvest rates on natural-origin steelhead vary widely among watersheds, but have declined since the 1970s and 1980s and are now stable and generally less than 5 percent (NWFSC 2015).

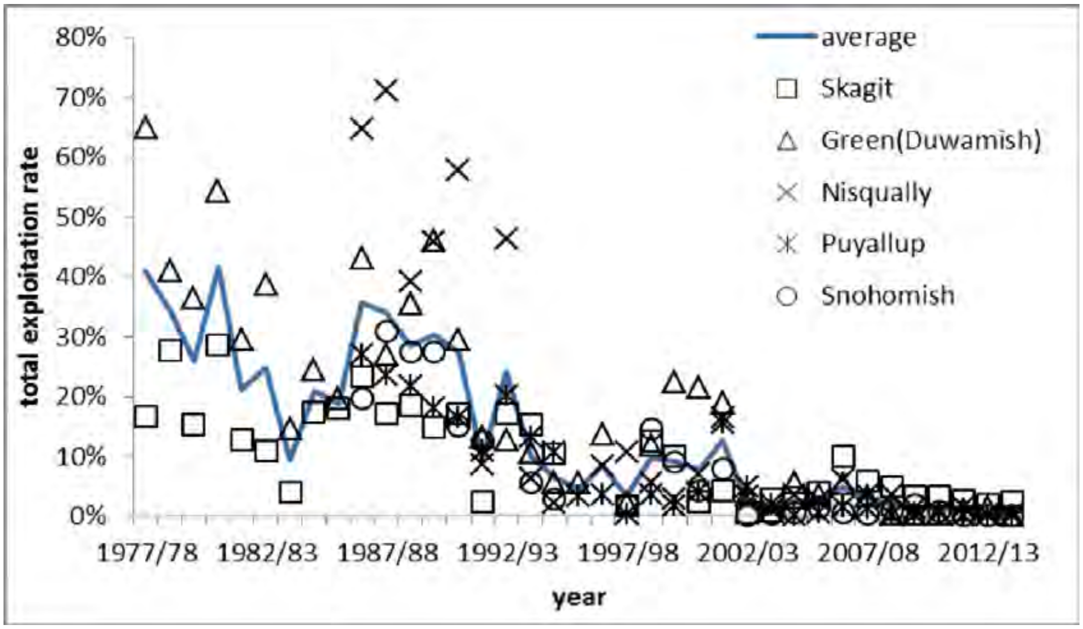


Figure 21. Total harvest rates on natural steelhead in Puget Sound Rivers (WDFW (2010) in NWFSC (2015).

Overall, the status of steelhead based on the best available data on spatial structure, diversity, abundance, and productivity has not changed since the last status review (NWFSC 2015). Recent increases in abundance observed for a few steelhead DIPs have been modest and within the range of variability observed in the past several years and trends in abundance remain negative or flat for just over one half of the DIPs in the DPS over the time series examined in the recent status review update (NWFSC 2015). The production of hatchery fish of both run types (winter and summer) continues to pose risk to diversity in natural-origin steelhead in the DPS (Hard et al. 2007; Hard et al. 2015) although hatchery production has declined in recent years across the DPS and the fraction of hatchery spawners are low for many rivers. Recent increasing estimates of productivity for a few steelhead populations are encouraging but include only one to a few years, thus, the patterns of improvement in productivity are not widespread or considered certain to continue at this time. Total harvest rates are low and are unlikely to increase substantially in the foreseeable future and are low enough that they are unlikely to substantially reduce spawner abundance for most Puget Sound steelhead populations (NWFSC 2015; NMFS 2019g).

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[23] Green River and Nisqually River populations.

Limiting Factors and Threats – PS Steelhead

NMFS, in its listing document and designation of critical habitat (77 FR 26722, May 11, 2007; 76 FR 1392, January 10, 2011), noted that the factors for decline for Puget Sound steelhead also persist as limiting factors. Information reviewed by NWFSC (2015) and NMFS (2019g) did not identify any new key emergent habitat concerns for the Puget Sound steelhead DPS since the 2011 status review.

- In addition to being a factor that contributed to the present decline of Puget Sound steelhead populations, the continued destruction and modification of steelhead habitat is the principal factor limiting the viability of the Puget Sound steelhead DPS into the foreseeable future.
- Reduced spatial structure for steelhead in the DPS.
- Reduced habitat quality through changes in river hydrology, temperature profile, downstream gravel recruitment, and reduced movement of large woody debris.
- In the lower reaches of many rivers and their tributaries in Puget Sound, urbanization has caused increased flood frequency and peak flows during storms, and reduced groundwater-driven summer flows. Altered stream hydrology has resulted in gravel scour, bank erosion, and sediment deposition.
- Dikes, hardening of banks with riprap, and channelization, which have reduced river braiding and sinuosity, have increased the likelihood of gravel scour and dislocation of rearing juveniles.
- Widespread declines in adult abundance (total run size), despite significant reductions in harvest over the last 25 years. Harvest is not considered a significant limiting factor for PS steelhead due to their more limited fisheries.
- Threats to diversity posed by use of two hatchery steelhead stocks (Chambers Creek and Skamania) inconsistent with wild stock diversity throughout the DPS. However, the risk to the species' persistence that may be attributable to hatchery-related effects has decreased since the last Status Review, based on hatchery risk reduction measures that have been implemented. Improvements in hatchery operations associated with on-going ESA review and determination processes are expected to further reduce hatchery-related risks. Further, hatchery releases of PS steelhead have declined.
- Declining diversity in the DPS, including the uncertain, but likely weak, status of summer run fish in the DPS.
- Concerns regarding existing regulatory mechanisms, including: lack of documentation or analysis of the effectiveness of land-use regulatory mechanisms and land-use management plans, lack of reporting and enforcement for some regulatory programs, certain Federal, state, and local land and water use decisions continue to occur without the benefit of ESA review. State and local decisions have no Federal nexus to trigger the ESA Section 7 consultation requirement, and thus certain permitting actions allow direct and indirect species take and/or adverse habitat effects.

Recovery Plan Puget Sound Steelhead

NMFS adopted a Recovery Plan for Puget Sound Steelhead on December 20, 2019 (https://www.fisheries.noaa.gov/resource/document/esa-recovery-plan-puget-sound-steelhead-distinct-population-segment-oncorhynchus). The Puget Sound Steelhead Recovery Plan (Plan) (NMFS 2019g) provides guidance to recover the species to the point that it can be naturally self-sustaining over the long term. To achieve full recovery, steelhead populations in Puget Sound need to be robust enough to withstand natural environmental variation and some catastrophic events, and they should be resilient enough to support harvest and habitat loss due to human population growth. The Plan aims to improve steelhead viability by addressing the pressures that contribute to the current condition: habitat loss/ degradation, water withdrawals, declining water quality, fish passage barriers, dam operations, harvest, hatcheries, climate change effects, and reduced early marine survival. NMFS will use the Recovery Plan to organize and coordinate recovery of the species in partnership with state, local, tribal, and federal resource managers, and the many watershed restoration partners in the Puget Sound. Federal and State steelhead recovery and management efforts will provide new tools and data and technical analyses to further refine Puget Sound steelhead population structure and viability, if needed, and better define the role of individual populations at the watershed level and in the DPS. Future consultations will incorporate information from the Plan (NMFS 2019g).

More information related to Puget Sound steelhead in the action area is presented in Section 2.3.16 Baseline.

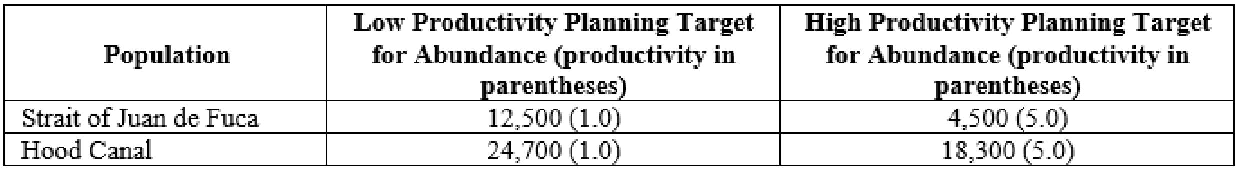
2.2.3.11 Rangewide Status of the Species - Hood Canal Summer Chum

The Hood Canal Summer Chum ESU was listed as threatened on March 25, 1999 (64 FR 14508) and June 28, 2005 (70 FR 37159); updated April 14, 2014 (79 FR 20802). This ESU includes naturally spawned summer-run chum salmon originating from Hood Canal and its tributaries, as well as from Olympic Peninsula rivers between Hood Canal and Dungeness Bay (inclusive). This ESU also includes summer-run chum salmon from four hatchery, or artificial propagation, programs.

Geographic Range and Distribution/Spatial Structure/Diversity

The Puget Sound Technical Recovery Team identified two independent populations for the Hood Canal summer chum, one which includes the spawning aggregations from rivers and creeks draining into the Strait of Juan de Fuca, and one which includes spawning aggregations within Hood Canal proper (Sands et al. 2009).

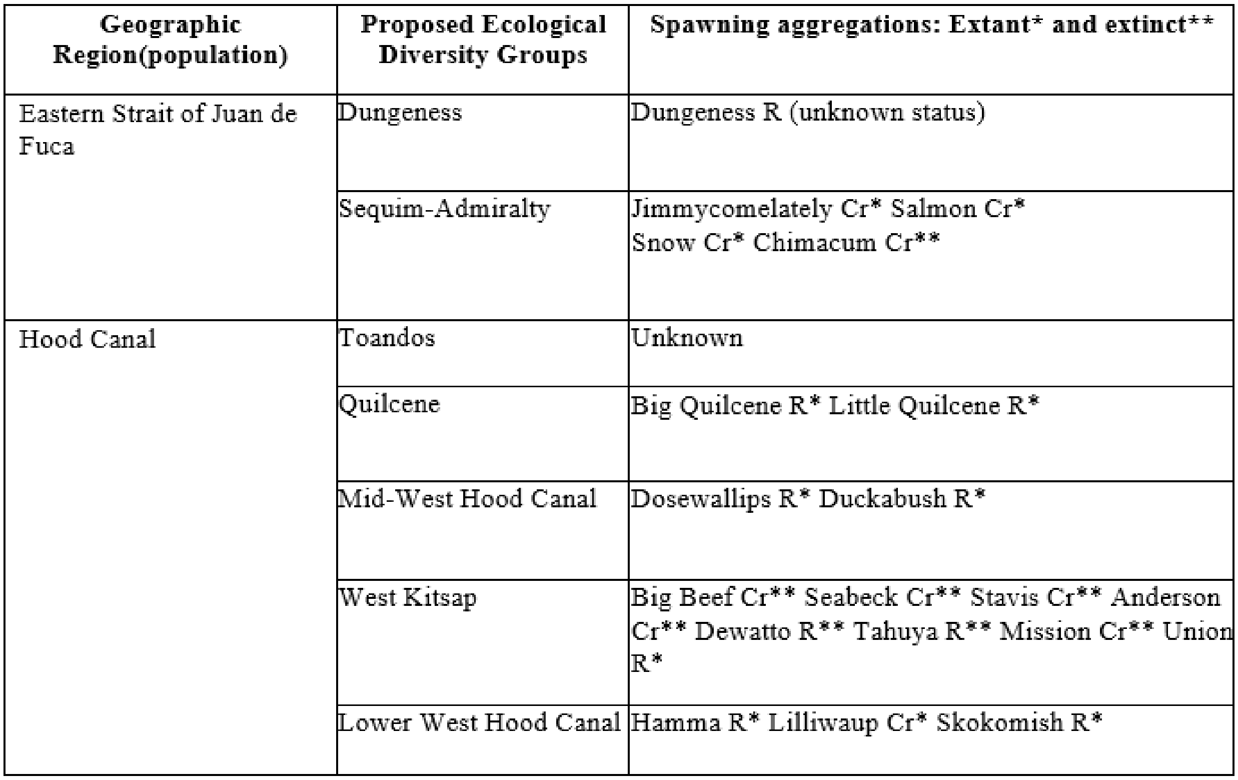
Table 13. Hood Canal summer-run chum ESU abundance and productivity recovery goals (Sands et al. 2007)



Population	Low Productivity Planning Target for Abundance (productivity in parentheses)	High Productivity Planning Target for Abundance (productivity in parentheses)
Strait of Juan de Fuca	12,500 (1.0)	4,500 (5.0)
Hood Canal	24,700 (1.0)	18,300 (5.0)

Spatial structure and diversity measures for the Hood Canal summer chum recovery program have included the reintroduction and sustaining of natural-origin spawning in multiple small streams where summer chum spawning aggregates had been extirpated. Supplementation programs have been very successful in both increasing natural spawning abundance in 6 of 8 extant streams (Salmon, Big Quilcene, Lilliwaup, Hamma, Jimmycomelately, and Union) and increasing spatial structure due to reintroducing spawning aggregations to three streams (Big Beef, Tahuya, and Chimacum). Spawning aggregations are present and persistent within five of the six major ecological diversity groups identified by the PS TRT (Table 14). As supplementation program goals have been met in most locations, they have been terminated except in Lilliwaup/Tahuya, where supplementation is ongoing (NWFSC 2015). Spatial structure and diversity viability parameters for each population have increased and nearly meet the viability criteria.

Table 14. Seven ecological diversity groups as proposed by the PSTRT for the Hood Canal Summer Chum ESU by geographic region and associated spawning aggregation.



Geographic Region(population)	Proposed Ecological Diversity Groups	Spawning aggregations: Extant* and extinct**
Eastern Strait of Juan de Fuca	Dungeness	Dungeness R (unknown status)
	Sequim-Admiralty	Jimmycomelately Cr* Salmon Cr* Snow Cr* Chimacum Cr**
Hood Canal	Toandos	Unknown
	Quilcene	Big Quilcene R* Little Quilcene R*
	Mid-West Hood Canal	Dosewallips R* Duckabush R*
	West Kitsap	Big Beef Cr** Seabeck Cr** Stavis Cr** Anderson Cr** Dewatto R** Tahuya R** Mission Cr** Union R*
	Lower West Hood Canal	Hamma R* Lilliwaup Cr* Skokomish R*

Abundance, Productivity, and Trends – Hood Canal Summer Chum

Smoothed trends in estimated total and natural population spawning abundances for both Hood Canal and Strait of Juan de Fuca populations have generally increased over the 1980 to 2014 time period. The Hood Canal population has had a 25 percent increase in abundance of natural-origin spawners in the most recent 5-year time period over the 2005-2009 time period. The Strait of Juan de Fuca has had a 53 percent increase in abundance of natural-origin spawners in the most recent 5-year time period.

Trends in population productivity, estimated as the log of the smoothed natural spawning abundance in year t minus the smoothed natural spawning abundance in year (t-4), have increased over the past five years, and were above replacement rates in 2012 and 2013. However, productivity rates have varied above and below replacement rates over the entire time period up to 2014. PNPTT and WDFW (2014) provide a detailed analysis of productivity for the ESU, each population, and by individual spawning aggregation, and report that 3 of the 11 stocks exceeded the comanager's interim productivity goal of an average of 1.6 Recruit/Spawner over 8 years. They also report that natural-origin Recruit/Spawner rates have been highly variable in recent brood years, particularly in the Strait of Juan de Fuca population. Only one spawning aggregation (Chimacum) meets the comanager's interim recovery goal of 1.2 recruits per spawner in 6 of the most recent 8 years. Productivity of individual spawning aggregates shows only two of eight aggregates have viable performance. (NWFSC 2015).

Limiting Factors and Threats – Hood Canal Summer Chum

Limiting factors for this species include (Hood Canal Coordinating Council 2005):

- Reduced floodplain connectivity and function
- Poor riparian condition
- Loss of channel complexity (reduced large wood and channel condition, loss of side channels, channel instability)
- Sediment accumulation
- Altered flows and water quality

Recovery Plan Hood Canal Summer Chum

We adopted a Recovery Plan for HC summer-run chum salmon in May of 2007 (NMFS 2007). The Recovery Plan consists of two documents: the Hood Canal and Eastern Strait of Juan de Fuca Summer Chum Salmon Recovery Plan (Hood Canal Coordinating Council 2005) and a supplemental plan by NMFS (2007). The Recovery Plan adopts ESU and population level viability criteria recommended by the Puget Sound Technical Recovery Team (PS-TRT) (Sands *et al.* 2007).

Despite substantive gains towards meeting viability criteria in the Hood Canal and Strait of Juan de Fuca summer chum salmon populations, the ESU did not meet all of the recovery criteria for population viability at this time at the last 5-Year Status Review. (NWFSC 2015).

2.2.3.12 Rangewide Status of the Species- Southern DPS Eulachon

Eulachon were listed as a threatened species on March 18, 2010 (75 FR 13012). On October 20, 2016, NMFS released a final Recovery Plan for eulachon on September 6, 2017 (NMFS 2017e). On April 1, 2016, we announced the results of our 5-year review of eulachon status (Gustafson et al., 2016). After completing the review, we recommended the southern DPS of eulachon remain classified as a threatened species.

Geographic Range and Distribution/Spatial Structure/Diversity – Southern DPS Eulachon

Eulachon are endemic to the northeastern Pacific Ocean, ranging from northern California to southwest and south-central Alaska and into the southeastern Bering Sea. The southern DPS of eulachon includes all naturally-spawned populations that occur in rivers south of the Nass River in British Columbia to the Mad River in California. Core populations for this species include the Fraser River, Columbia River and (historically) the Klamath River. Eulachon leave saltwater to spawn in their natal streams late winter through early summer, and typically spawn at night in the lower reaches of larger rivers fed by snowmelt. After hatching, larvae are carried downstream and widely dispersed by estuarine and ocean currents. Eulachon movements in the ocean are poorly known, although the amount of eulachon bycatch in the pink shrimp fishery seems to indicate that the distribution of these organisms overlap in the ocean. The southern DPS includes four major subpopulations: Columbia, Klamath, Frazier, and British Columbia. However, these subpopulations do not include all spawning aggregations within the DPS. For instance, spawning runs of eulachon have been noted in Redwood Creek and the Mad River in California, the Umpqua River and Tenmile Creek in Oregon, and the Naselle and Quinault rivers in Washington (NMFS 2017e).

Abundance, Productivity, and Trends – Southern DPS Eulachon

Eulachon were historically an important food source for many Native American tribes and Canadian First Nations from northern California to Alaska. In the early 1990s, there was an abrupt decline in the abundance of eulachon returning to the Columbia River with no evidence of returning to their former population levels since then (Drake *et al.* 2008). Persistent low returns and landings of eulachon in the Columbia River from 1993-2000 prompted the states of Oregon and Washington to adopt a Joint State Eulachon Management Plan in 2001 that provides for restricted harvest management when parental run strength, juvenile production, and ocean productivity forecast a poor return (WDFW and ODFW 2001). Despite a brief period of improved returns in 2001-2003, the returns and associated commercial landings have again declined to the very low levels observed in the mid-1990s (Joint Columbia River Management Staff 2009). Starting in 2005, the fishery has operated at the most conservative level allowed in the management plan. Montgomery (2020) found a relationship between ocean conditions and abundance estimates two to three years following, such as cooler conditions in 2011. Although eulachon abundance in monitored rivers has generally improved, especially in the 2013-2015 return years, recent poor ocean conditions and the likelihood that these conditions will persist into the near future suggest that population declines may be widespread in the upcoming return years. Therefore, it is too early to tell whether recent improvements in the southern DPS of eulachon will persist or whether a return to the severely depressed abundance years of the mid-late 1990s and late 2000s will recur (NMFS 2017e).

Limiting Factors and Threats – Southern DPS Eulachon

Limiting factors for this species include (NMFS 2017e):

- Changes in ocean conditions due to climate change, particularly in the southern portion of the species' range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success.
- Climate-induced change to freshwater habitats
- Bycatch of eulachon in commercial fisheries
- Adverse effects related to dams and water diversions
- water quality
- Shoreline construction and dredging
- Over harvest
- Predation

Recovery Plan – Southern DPS Eulachon

A Recovery Plan for the Southern DPS Eulachon was finalized September 2017. The Recovery Plan lists the following priority action to support recovery of the species:

Priority Actions

- Establish a eulachon technical recovery and implementation team to develop an overall framework for funding, prioritization, implementation, and reporting of recovery actions.
- Develop outreach and education strategies regarding the ecological, economic, and cultural values of eulachon; foster stewardship of the marine ecosystem; expand funding and research partnerships; and increase involvement of existing regional and international organizations.
- Continue to work with the ocean shrimp trawl fisheries and the states of California, Oregon, and Washington to implement actions, e.g., fleet-wide implementation of light emitting diode lights, rigid grate bycatch reduction devices, and additional gear-type or operational modifications, to further reduce bycatch of eulachon in the ocean shrimp trawl fisheries.
- Continue to work with the states to implement a limited-opportunity eulachon fishery to: (1) provide essential context for interpreting historical harvest data to better understand trends and variability in eulachon abundance; (2) filling critical information gaps such as the length and age structure of spawning eulachon, as well as the temporal and spatial distribution of the run; (3) supporting the cultural traditions of Northwest tribes who rely on eulachon as a seasonally important food source; and (4) providing a limited public and commercial opportunity for eulachon harvest to maintain a connection between people and the eulachon resource. This connection is important to sustaining public engagement in eulachon conservation and recovery.
- Continue to work with Federal and non-Federal entities that maintain and operate dams and channel-spanning water control structures to develop and implement actions to reduce the ecological effects caused by water management operations on riverine and estuarine habitats to support the full-range of biological requirements for eulachon.

- Continue to work with the U.S. Army Corps of Engineers to develop and implement actions to reduce impacts from dredging, e.g., entrainment, on eulachon.
- Continue to work with the states of California, Oregon, and Washington to implement programs that improve water quality for temperature.
- Continue to work with Federal agencies and the states of California, Oregon, and Washington to implement programs, e.g., revetment breaching and removal, to reduce the impacts of shoreline construction on eulachon and their habitats.

2.2.2.13 Rangewide Status of the Species- Southern DPS Green Sturgeon

The southern DPS of green sturgeon was listed as threatened on April 7, 2006 (71 FR 17757). We completed a 5-year review for this DPS in 2015 and recommended the DPS retain its threatened classification.

Geographic Range and Distribution/Spatial Structure/Diversity – Southern DPS Green Sturgeon

Two DPSs have been defined for green sturgeon, a Northern DPS (spawning populations in the Klamath and Rogue rivers) and a Southern DPS (spawning population in the Sacramento River system). Southern DPS green sturgeon includes all naturally-spawned populations of green sturgeon originating from south of the Eel River in Humboldt County, California. Telemetry data and genetic analyses suggest that Southern DPS green sturgeon generally occur from Graves Harbor, Alaska to Monterey Bay, California (Moser and Lindley 2007; Lindley et al. 2008, 2011) and, within this range, most frequently occur in coastal waters of Washington, Oregon, and Vancouver Island as well as in the San Francisco Bay-Delta and Monterey Bay (Huff et al. 2012). Within the nearshore marine environment, tagging and fisheries data indicate that Northern and Southern DPS green sturgeon most frequently occur in marine waters of less than a depth of 110 m (Erickson and Hightower 2007). Only the Southern DPS is listed under the ESA.

Abundance Productivity and Trends –Southern DPS Green Sturgeon

Recent studies are providing preliminary information on the population abundance of Southern DPS green sturgeon. The current estimate of spawning adult abundance is between 824-1,872 individuals (NMFS 2015d). The spawning population of the Southern DPS in the Sacramento River congregates in a limited area of the river compared to potentially available habitat. The reason for this is unknown. This is concerning given that a catastrophic or targeted poaching event impacting just a few holding areas could affect a significant portion of the adult population. No comparable data on holding area occupancy within the Sacramento River were available at the time of the last status review making it difficult to assess whether the current observations reflect an improvement or decline in the species status (NMFS 2015d).

Limiting Factors and Threats – Southern DPS Green Sturgeon

The principal factor for the decline of Southern DPS green sturgeon is the reduction of its spawning area to a single known population limited to a small portion of the Sacramento River. Threats contributing to the species’ risk of extinction primarily include elimination of freshwater spawning habitat, degradation of freshwater and estuarine habitat quality, water diversions, fishing, and other causes (USDC 2010). Adequate water flow and temperature are issues of concern. Water diversions pose an unknown but potentially serious threat within the Sacramento and Feather Rivers and the Sacramento River Delta. Poaching also poses an unknown but potentially serious threat because of high demand for sturgeon caviar. The effects of contaminants and nonnative species are also unknown but potentially serious. As mentioned above, retention of green sturgeon in both recreational and commercial fisheries is now prohibited within the western states, but the effect of capture/release in these fisheries is unknown. There is evidence of fish being retained illegally, although the magnitude of this activity likely is small (NOAA Fisheries 2011).

Recovery Plan – Southern DPS Green Sturgeon

The Recovery Plan for this DPS was finalized in August, 2018 (NMFS 2018e). A key recovery strategy is to reestablish additional spawning areas in currently occupied rivers in California (https://repository.library.noaa.gov/view/noaa/18695).

2.2.3.14 Rangewide Status of the Species – Bocaccio and Yelloweye Rockfish

Detailed assessments of yelloweye rockfish and bocaccio can be found in the Recovery Plan (NMFS 2017f) and the 5-year status review (NMFS 2016d), and are summarized here. We describe the status of yelloweye rockfish and bocaccio with nomenclature referring to specific areas of Puget Sound. Puget Sound is the second largest estuary in the United States, located in northwest Washington State and covering an area of about 900 square miles (2,330 square km), including 2,500 miles (4,000 kilometers(km)) of shoreline. Puget Sound is part of a larger inland waterway, the Georgia Basin, situated between southern Vancouver Island, British Columbia, Canada, and the mainland coast of Washington State. We subdivide the Puget Sound into five interconnected basins because of the presence of shallow areas called sills: (1) the San Juan/Strait of Juan de Fuca Basin (also referred to as “North Sound”), (2) Main Basin, (3) Whidbey Basin, (4) South Sound, and (5) Hood Canal. We use the term “Puget Sound proper” to refer to all of these basins except the San Juan/Strait of Juan de Fuca Basin.

The Puget Sound/Georgia Basin DPS of yelloweye rockfish is listed under the ESA as threatened, and bocaccio are listed as endangered (75 FR 22276, April 28, 2010). On January 23, 2017, we issued a final rule to remove the Puget Sound/Georgia Basin canary rockfish (*Sebastes pinniger*) DPS from the Federal List of Threatened and Endangered Species and remove its critical habitat designation. We proposed these actions based on newly obtained samples and genetic analysis that demonstrates that the Puget Sound/Georgia Basin canary rockfish population does not meet the DPS criteria and therefore does not qualify for listing under the Endangered Species Act. Within the same rule, we extended the yelloweye rockfish DPS area further north in the Johnstone Strait area of Canada, as reflected in Figure 22. This extension was also the result of new genetic analysis of yelloweye rockfish. The final rule was effective March 24, 2017.

Geographic Range and Distribution/Spatial Structure/Diversity - Rockfish

The DPSs include all yelloweye rockfish and bocaccio found in waters of Puget Sound, the Strait of Georgia, and the Strait of Juan de Fuca east of Victoria Sill (Figure 22 and Figure 23). Yelloweye rockfish and bocaccio are 2 of 28 species of rockfish in Puget Sound (Palsson et al. 2009).

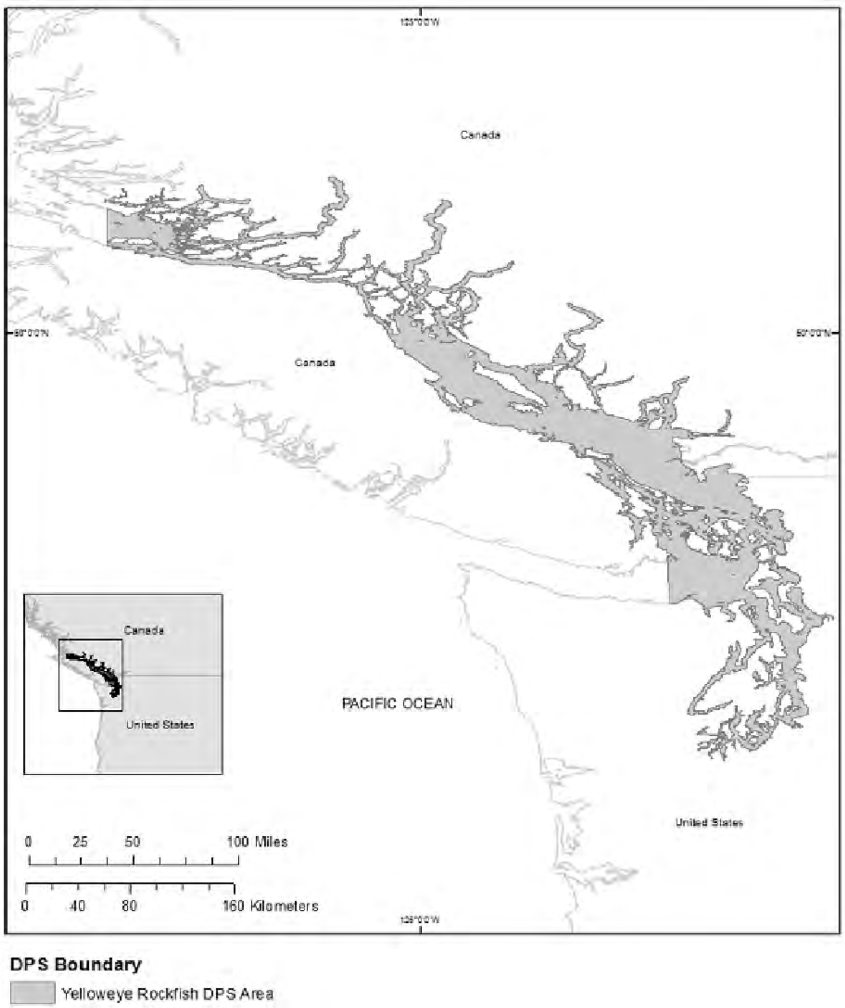


Figure 22. Yelloweye rockfish DPS Range.

Figure 23. Bocaccio DPS Range.

The life histories of yelloweye rockfish and bocaccio include a larval/pelagic juvenile stage followed by a juvenile stage, and subadult and adult stages. Much of the life history and habitat use for these two species is similar, with important differences noted below. Rockfish fertilize their eggs internally and the young are extruded as larvae. Individual mature female yelloweye rockfish and bocaccio produce from several thousand to over a million eggs each breeding cycle (Love et al. 2002). Larvae can make small local movements to pursue food immediately after birth (Tagal et al. 2002), but are likely initially passively distributed with prevailing currents until they are large enough to progress toward preferred habitats. Larvae are observed under free-floating algae, seagrass, and detached kelp (Shaffer et al. 1995; Love et al. 2002), but are also distributed throughout the water column (Weis 2004). Unique oceanographic conditions within Puget Sound proper likely result in most larvae staying within the basin where they are released (e.g., the South Sound) rather than being broadly dispersed (Drake et al. 2010).

When bocaccio reach sizes of 1 to 3.5 inches (3 to 9 centimeters (cm)) (approximately 3 to 6 months old), they settle onto shallow nearshore waters in rocky or cobble substrates with or without kelp (Love et al. 1991; Love et al. 2002). These habitat features offer a beneficial mix of warmer temperatures, food, and refuge from predators (Love et al. 1991). Areas with floating and submerged kelp species support the highest densities of most juvenile rockfish (Carr 1983; Halderson and Richards 1987; Matthews 1989; Hayden-Spear 2006). Unlike bocaccio, juvenile yelloweye rockfish do not typically occupy intertidal waters (Love et al. 1991; Studebaker et al.

2009), but settle in 98 to 131 feet (30 to 40 m) of water near the upper depth range of adults (Yamanaka and Lacko 2001).

Subadult and adult yelloweye rockfish and bocaccio typically utilize habitats with moderate to extreme steepness, complex bathymetry, and rock and boulder-cobble complexes (Love et al. 2002). Within Puget Sound proper, each species has been documented in areas of high relief rocky and non-rocky substrates such as sand, mud, and other unconsolidated sediments (Washington 1977; Miller and Borton 1980). Yelloweye rockfish remain near the bottom and have small home ranges, while bocaccio have larger home ranges, move long distances, and spend time suspended in the water column (Love et al. 2002). Adults of each species are most commonly found between 131 to 820 feet (40 to 250 m) (Orr et al. 2000; Love et al. 2002).

Yelloweye rockfish are one of the longest-lived of the rockfishes, with some individuals reaching more than 100 years of age. They reach 50 percent maturity at sizes around 16 to 20 inches (40 to 50 cm) and ages of 15 to 20 years (Rosenthal et al. 1982; Yamanaka and Kronlund 1997). The maximum age of bocaccio is unknown, but may exceed 50 years, and they reach reproductive maturity near age 6.[24]

In the following section, we summarize the condition of yelloweye rockfish and bocaccio at the DPS level according to the following demographic viability criteria: abundance and productivity, spatial structure/connectivity, and diversity. These viability criteria are outlined in McElhany et al. (2000) and reflect concepts that are well founded in conservation biology and are generally applicable to a wide variety of species. These criteria describe demographic risks that individually and collectively provide strong indicators of extinction risk (Drake et al. 2010). There are several common risk factors detailed below at the introduction of each of the viability criteria for each listed rockfish species. Habitat and species limiting factors can affect abundance, spatial structure and diversity parameters, and are described.

Spatial structure consists of a population's geographic distribution and the processes that generate that distribution (McElhany et al. 2000). A population's spatial structure depends on habitat quality, spatial configuration, and dynamics as well as dispersal characteristics of individuals within the population (McElhany et al. 2000). Prior to contemporary fishery removals, each of the major basins in the range of the DPSs likely hosted relatively large populations of yelloweye rockfish and bocaccio (Washington 1977; Washington et al. 1978; Moulton and Miller 1987). This distribution allowed each species to utilize the full suite of available habitats to maximize their abundance and demographic characteristics, thereby enhancing their resilience (Hamilton 2008). This distribution also enabled each species to potentially exploit ephemerally good habitat conditions, or in turn receive protection from smaller-scale and negative environmental fluctuations. These types of fluctuations may change prey abundance for various life stages and/or may change environmental characteristics that influence the number of annual recruits. Spatial distribution also provides a measure of protection from larger scale anthropogenic changes that damage habitat suitability, such as oil spills or hypoxia that can occur within one basin but not necessarily the other basins. Rockfish population resilience is sensitive to changes in connectivity among various groups of fish

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[24] Life History of Bocaccio: www.fishbase.org

(Hamilton 2008). Hydrologic connectivity of the basins of Puget Sound is naturally restricted by relatively shallow sills located at Deception Pass, Admiralty Inlet, the Tacoma Narrows, and in Hood Canal (Burns 1985). The Victoria Sill bisects the Strait of Juan de Fuca and runs from east of Port Angeles north to Victoria, and regulates water exchange (Drake et al. 2010). These sills regulate water exchange from one basin to the next, and thus likely moderate the movement of rockfish larvae (Drake et al. 2010). When localized depletion of rockfish occurs, it can reduce stock resiliency (Hilborn et al. 2003; Hamilton 2008). The effects of localized depletions of rockfish are likely exacerbated by the natural hydrologic constrictions within Puget Sound.

Yelloweye rockfish spatial structure and connectivity is threatened by the reduction of fish within each basin. This reduction is likely most acute within the basins of Puget Sound proper. Yelloweye rockfish are probably most abundant within the San Juan Basin, but the likelihood of juvenile recruitment from this basin to the adjacent basins of Puget Sound proper is naturally low because of the generally retentive circulation patterns that occur within each of the major basins of Puget Sound proper.

Most bocaccio may have been historically spatially limited to several basins. They were historically most abundant in the Main Basin and South Sound (Drake et al. 2010) with no documented occurrences in the San Juan Basin until 2008[25]. Positive signs for spatial structure and connectivity come from the propensity of some adults and pelagic juveniles to migrate long distances, which could re-establish aggregations of fish in formerly occupied habitat (Drake et al. 2010). The apparent reduction of populations of bocaccio in the Main Basin and South Sound represents a further impairment in the historically spatially limited distribution of bocaccio, and adds risk to the viability of the DPS.

In summary, spatial structure and connectivity for each species have been adversely impacted, mostly by fishery removals. These impacts on species viability are likely most acute for yelloweye rockfish because of their sedentary nature as adults.

Characteristics of diversity for rockfish include fecundity, timing of the release of larvae and their condition, morphology, age at reproductive maturity, physiology, and molecular genetic characteristics. In spatially and temporally varying environments, there are three general reasons why diversity is important for species and population viability: (1) diversity allows a species to use a wider array of environments, (2) diversity protects a species against short-term spatial and temporal changes in the environment, and (3) genetic diversity provides the raw material for surviving long-term environmental changes.

Yelloweye rockfish size and age distributions have been truncated (Figure 24). Recreationally caught yelloweye rockfish in the 1970s spanned a broad range of sizes. By the 2000s, there was some evidence of fewer older fish in the population (Drake et al. 2010). No adult yelloweye rockfish have been observed within the WDFW ROV surveys and all observed fish in 2008 in the San Juan Basin were less than 8 inches long (20 centimeters(cm)) (Pacunski et al. 2013). Since these fish were observed several years ago, they are likely bigger. However, Pacunski et al. (2013) did not report a precise size for these fish; thus, we are unable to provide a precise

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[25] WDFW 2011: Unpublished catch data 3003-2009

estimate of their likely size now. As a result, the reproductive burden may be shifted to younger and smaller fish. This shift could alter the timing and condition of larval release, which may be mismatched with habitat conditions within the range of the DPS, potentially reducing the viability of offspring (Drake et al. 2010). Recent genetic information for yelloweye rockfish further confirmed the existence of fish genetically differentiated within the Puget Sound/Georgia Basin compared to the outer coast (NMFS 2017f) and that yelloweye rockfish in Hood Canal are genetically divergent from the rest of the DPS. Yelloweye rockfish in Hood Canal are addressed as a separate population in the Recovery Plan (NMFS 2017f).

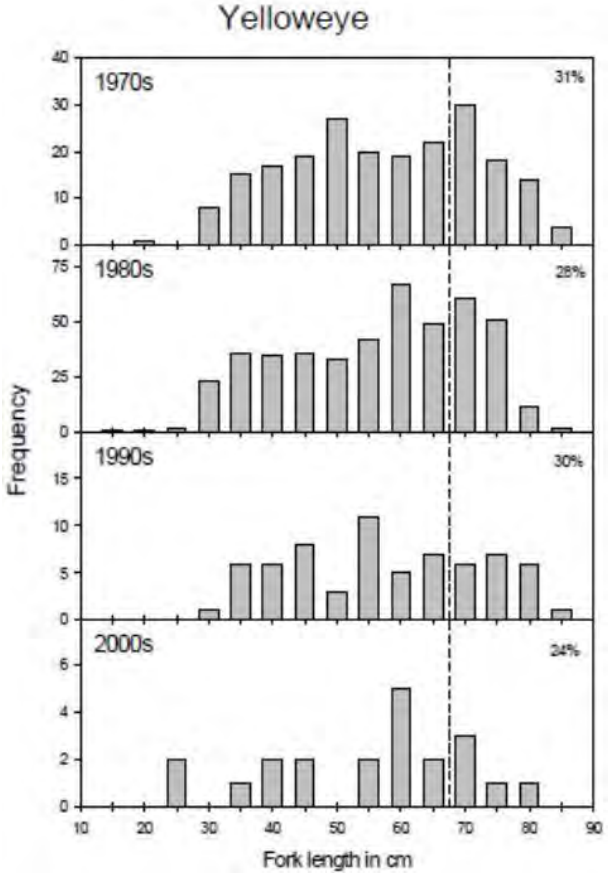


Figure 24. Yelloweye rockfish length frequency distributions (cm) binned within four decades.

Size-frequency distributions for bocaccio in the 1970s indicate a wide range of sizes, with recreationally caught individuals from 9.8 to 33.5 inches (25 to 85 cm) (Figure 25). This broad size distribution suggests a spread of ages, with some successful recruitment over many years. A similar range of sizes is also evident in the 1980s' catch data. The temporal trend in size distributions for bocaccio also suggests size truncation of the population, with larger fish becoming less common over time. By the decade of the 2000s, no size distribution data for bocaccio were available. Bocaccio in the Puget Sound/Georgia Basin may have physiological or behavioral adaptations because of the unique habitat conditions in the range of the DPS. The potential loss of diversity in the bocaccio DPS, in combination with their relatively low productivity, may result in a mismatch with habitat conditions and further reduce population viability (Drake et al. 2010).

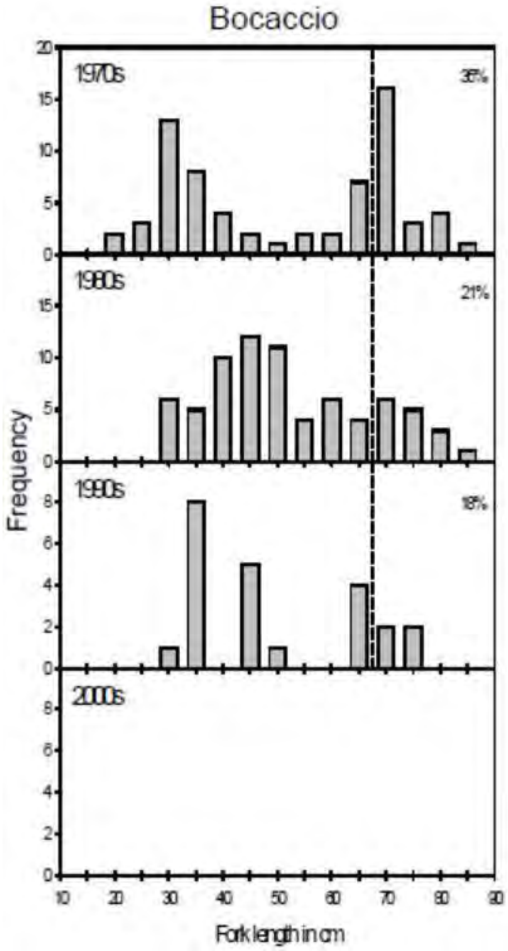


Figure 25. Bocaccio length frequency distributions (cm) within four decades. The vertical line depicts the size at which about 30 percent of the population comprised fish larger than the rest of the population in the 1970s, as a reference point for a later decade

In summary, diversity for each species has likely been adversely impacted by fishery removals. In turn, the ability of each fish to utilize habitats within the action area may be compromised.

Abundance, Productivity, and Trends – Bocaccio and Yelloweye Rockfish

There is no single reliable historical or contemporary population estimate for the yelloweye rockfish or bocaccio within the full range of the Puget Sound/Georgia Basin DPSs (Drake et al. 2010). Despite this limitation, there is clear evidence each species' abundance has declined dramatically, largely due to recreational and commercial fisheries that peaked in the early 1980's (Drake et al. 2010; Williams et al. 2010a). Analysis of SCUBA surveys, recreational catch, and WDFW trawl surveys indicated total rockfish populations in the Puget Sound region are estimated to have declined between 3.1 and 3.8 percent per year for the past several decades, which corresponds to a 69 to 76 percent decline from 1977 to 2014 (NMFS 2017f).

Catches of yelloweye rockfish and bocaccio have declined as a proportion of the overall rockfish catch (Palsson et al. 2009; Drake et al. 2010). Yelloweye rockfish were 2.4 percent of the harvest in North Sound during the 1960s, occurred in 2.1 percent of the harvest during the 1980s, but then decreased to an average of 1 percent from 1996 to 2002 (Palsson et al. 2009). In Puget Sound proper, yelloweye rockfish were 4.4 percent of the harvest during the 1960s, only 0.4 percent during the 1980s, and 1.4 percent from 1996 to 2002 (Palsson et al. 2009).

Bocaccio consisted of 8 to 9 percent of the overall rockfish catch in the late 1970s and declined in frequency, relative to other species of rockfish, from the 1970s to the 1990s (Drake et al. 2010). From 1975 to 1979, bocaccio averaged 4.6 percent of the catch. From 1980 to 1989, they were 0.2 percent of the 8,430 rockfish identified (Palsson et al. 2009). In the 1990s and early 2000s, bocaccio were not observed by WDFW in the dockside surveys of the recreational catches (Drake et al. 2010), but a few have been observed in recent remotely operated vehicle (ROV) surveys and other research activities.

Productivity is the measurement of a population’s growth rate through all or a portion of its life cycle. Life history traits of yelloweye rockfish and bocaccio suggest generally low levels of inherent productivity because they are long-lived, mature slowly, and have sporadic episodes of successful reproduction (Tolimieri and Levin 2005; Drake et al. 2010). Overfishing can have dramatic impacts on the size or age structure of the population, with effects that can influence ongoing productivity. When the size and age of females decline, there are negative impacts on reproductive success. These impacts, termed maternal effects, are evident in a number of traits. Larger and older females of various rockfish species have a higher weight-specific fecundity (number of larvae per unit of female weight) (Boehlert et al. 1982; Bobko and Berkeley 2004; Sogard et al. 2008). A consistent maternal effect in rockfishes relates to the timing of parturition. The timing of larval birth can be crucial in terms of corresponding with favorable oceanographic conditions because most larvae are released typically once annually, with a few exceptions in southern coastal populations and in yelloweye rockfish in Puget Sound (Washington et al. 1978). Several studies of rockfish species have shown that larger or older females release larvae earlier in the season compared to smaller or younger females (Nichol and Pikitch 1994; Sogard et al. 2008). Larger or older females provide more nutrients to larvae by developing a larger oil globule released at parturition, which provides energy to the developing larvae (Berkeley et al. 2004; Fisher et al. 2007), and in black rockfish enhances early growth rates (Berkeley et al. 2004).

Contaminants such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and chlorinated pesticides appear in rockfish collected in urban areas (Palsson et al. 2009). While the highest levels of contamination occur in urban areas, toxins can be found in the tissues of fish throughout Puget Sound (West et al. 2001). Although few studies have investigated the effects of toxins on rockfish ecology or physiology, other fish in the Puget Sound region that have been studied do show a substantial impact, including reproductive dysfunction of some sole species (Landahl et al. 1997). Reproductive function of rockfish is also likely affected by contaminants (Palsson et al. 2009) and other life history stages may be affected as well (Drake et al. 2010).

Future climate-induced changes to rockfish habitat could alter their productivity (Drake et al. 2010). Harvey (2005) created a generic bioenergetic model for rockfish, showing that their productivity is highly influenced by climate conditions. For instance, El Niño-like conditions generally lowered growth rates and increased generation time. The negative effect of the warm water conditions associated with El Niño appear to be common across rockfishes (Moser et al. 2000). Recruitment of all species of rockfish appears to be correlated at large scales. Field and Ralston (2005) hypothesized that such synchrony was the result of large-scale climate forcing. Exactly how climate influences rockfish in Puget Sound is unknown; however, given the general importance of climate to rockfish recruitment, it is likely that climate strongly influences the dynamics of listed rockfish population viability (Drake et al. 2010), although the consequences of climate change to rockfish productivity during the course of the Proposed action will likely be small.

Yelloweye rockfish within the Puget Sound/Georgia Basin (in U.S. waters) are very likely the most abundant within the San Juan Basin. The San Juan Basin has the most suitable rocky benthic habitat (Palsson et al. 2009) and historically was the area of greatest numbers of angler catches (Moulton and Miller 1987; Olander 1991).

Productivity for yelloweye rockfish is influenced by long generation times that reflect intrinsically low annual reproductive success. Natural mortality rates have been estimated from 2 to 4.6 percent (Yamanaka and Kronlund 1997; Wallace 2007). Productivity may also be particularly impacted by Allee effects, which occur as adults are removed from the population and the density and proximity of mature fish decreases. Adult yelloweye rockfish typically occupy relatively small ranges (Love et al. 2002) and it is unknown the extent they may move to find suitable mates.

In Canada, yelloweye rockfish biomass is estimated to be 12 percent of the unfished stock size on the inside waters of Vancouver Island (DFO 2011). There are no analogous biomass estimates in the U.S. portion of the yelloweye rockfish DPS. However, WDFW has generated several population estimates of yelloweye rockfish in recent years. ROV surveys in the San Juan Island region in 2008 (focused on rocky substrate) and 2010 (across all habitat types) estimated a population of 47,407±11,761 and 114,494±31,036 individuals, respectively. A 2015 ROV survey of that portion of the DPSs south of the entrance to Admiralty Inlet encountered 35 yelloweye rockfish, producing a preliminary population estimate of 66,998±7,370 individuals (video review is still under way) (WDFW 2017). For the purposes of this analysis we use an abundance scenario derived from the combined WDFW ROV survey in the San Juan Islands in 2010, and the 2015 ROV survey in Puget Sound proper. We chose the 2010 survey in the San Juan Islands because it occurred over a wider range of habitat-types than the 2008 survey. We use the lower confidence intervals for each survey to form a precautionary analysis and total yelloweye population estimate of 143,086 fish within the U.S. portion of the DPS.

Bocaccio in the Puget Sound/Georgia Basin were historically most common within the South Sound and Main Basin (Drake et al. 2010). Though bocaccio were never a predominant segment of the multi-species rockfish abundance within the Puget Sound/Georgia Basin (Drake et al. 2010), their present-day abundance is likely a fraction of their pre-contemporary fishery abundance. Bocaccio abundance may be very low in large segments of the Puget Sound/Georgia Basin. Productivity is driven by high fecundity and episodic recruitment events, largely correlated with environmental conditions. Thus, bocaccio populations do not follow consistent growth trajectories and sporadic recruitment drives population structure (Drake et al. 2010).

Natural annual mortality is approximately 8 percent (Palsson et al. 2009). Tolimieri and Levin (2005) found that the bocaccio population growth rate is around 1.01, indicating a very low intrinsic growth rate for this species. Demographically, this species demonstrates some of the highest recruitment variability among rockfish species, with many years of failed recruitment being the norm (Tolimieri and Levin 2005). Given their severely reduced abundance, Allee effects may be particularly acute for bocaccio, even considering the propensity of some individuals to move long distances and potentially find mates.

In Canada, the median estimate of bocaccio biomass is 3.5 percent of its unfished stock size (though this included Canadian waters outside of the DPS's area) (Stanley et al. 2012). There are no analogous biomass estimates in the U.S. portion of the bocaccio DPS. However, The ROV survey of the San Juan Islands in 2008 estimated a population of 4,606±4,606 (based on four fish observed along a single transect), but no estimate could be obtained in the 2010 ROV survey because this species was not encountered. A single bocaccio encountered in the 2015 ROV survey produced a statistically invalid population estimate for that portion of the DPS lying south of the entrance to Admiralty Inlet and east of Deception Pass. Several bocaccio have been caught in genetic surveys and by recreational anglers in Puget Sound proper in the past several years.

In summary, though abundance and productivity data for yelloweye rockfish and bocaccio is relatively imprecise, both abundance and productivity have been reduced largely by fishery removals within the range of each Puget Sound/Georgia Basin DPSs.

Limiting Factors and Threats – Bocaccio and Yelloweye Rockfish

Climate Change and Other Ecosystem Effects - As reviewed in ISAB (2007), average annual Northwest air temperatures have increased by approximately 1.8°F (1°C) since 1900, which is nearly twice that for the previous 100 years, indicating an increasing rate of change. Summer temperatures, under the A1B emissions scenario (a "medium" warming scenario), are expected to increase 3°F (1.7°C) by the 2020s and 8.5°F (4.7°C) by 2080 relative to the 1980s in the Pacific Northwest (Mantua et al. 2010). This change in surface temperature has already modified, and is likely to continue to modify, marine habitats of listed rockfish. There is still a great deal of uncertainty associated with predicting specific changes in timing, location, and magnitude of future climate change.

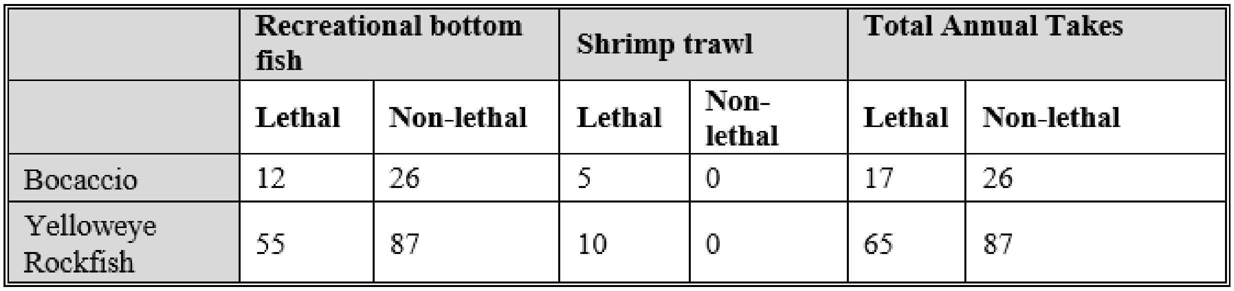
As described in ISAB (2007), climate change effects that have, and will continue to, influence the habitat, include increased ocean temperature, increased stratification of the water column, and intensity and timing changes of coastal upwelling. These continuing changes will alter primary and secondary productivity, marine community structures, and in turn may alter listed rockfish growth, productivity, survival, and habitat usage. Increased concentration of carbon dioxide (CO_2) (termed Ocean Acidification, or OA) reduces carbonate availability for shell-forming invertebrates. Ocean acidification will adversely affect calcification, or the precipitation of dissolved ions into solid calcium carbonate structures, for a number of marine organisms, which could alter trophic functions and the availability of prey (Feely et al. 2010). Further research is needed to understand the possible implications of OA on trophic functions in Puget Sound to understand how they may affect rockfish. Thus far, studies conducted in other areas have shown that the effects of OA will be variable (Ries et al. 2009) and species-specific (Miller et al. 2009).

There have been very few studies to date on the direct effect OA may have on rockfish. In a laboratory setting OA has been documented to affect rockfish behavior (Hamilton et al. 2014). Fish behavior changed markedly after juvenile California rockfish (*Sebastes diploproa*) spent one week in seawater with the OA conditions that are projected for the next century in the California shore. Researchers characterized the behavior as “anxiety” as the fish spent more time in unlighted environments compared to the control group. Research conducted to understand adaptive responses to OA on other marine organisms has shown that although some organisms may be able to adjust to OA to some extent, these adaptations may reduce the organism’s overall fitness or survival (Wood et al. 2008). More research is needed to further understand rockfish-specific responses and possible adaptations to OA.

There are natural biological and physical functions in regions of Puget Sound, especially in Hood Canal and South Sound, that cause the water to be corrosive and hypoxic, such as restricted circulation and mixing, respiration, and strong stratification (Newton and Voorhis 2002; Feely et al. 2010). However, these natural conditions, typically driven by climate forcing, are exacerbated by anthropogenic sources such as OA, nutrient enrichment, and land-use changes (Feely et al. 2010). By the next century, OA will increasingly reduce pH and saturation states in Puget Sound (Feely et al. 2010). Areas in Puget Sound susceptible to naturally occurring hypoxic and corrosive conditions are also the same areas where low seawater pH occurs, compounding the conditions of these areas (Feely et al. 2010).

Commercial and Recreational Bycatch - Listed rockfish are caught in some recreational and commercial fisheries in Puget Sound. Recreational fishermen targeting bottom fish in shrimp trawl fishery in Puget Sound can incidentally catch listed rockfish. In 2012, we issued an incidental take permit (ITP) to the WDFW for listed rockfish in these fisheries (Table 15) and the WDFW is working on a new ITP application (WDFW 2017). If issued, the new permit would be in effect for up to 15 years.

Table 15. Anticipated Maximum Annual Takes for Bocaccio, Yelloweye Rockfish by the fisheries within the WDFW ITP (2012 – 2017) (WDFW 2012).



	Recreational bottom fish		**Shrimp trawl**		**Total Annual Takes**	
	Lethal	**Non-lethal**	**Lethal**	**Non-lethal**	**Lethal**	**Non-lethal**
Bocaccio	12	26	5	0	17	26
Yelloweye Rockfish	55	87	10	0	65	87

In addition, NMFS permits limited take of listed rockfish for scientific research purposes (Section 2.4.5). Listed rockfish can be caught in the recreational and commercial halibut fishery. In 2018 we estimated that these halibut fisheries would result in up to 270 lethal takes in addition, NMFS permits limited take of listed rockfish for scientific research purposes (Section 2.4.4). Listed rockfish can be caught in the recreational and commercial halibut fishery. In 2017, we estimated that these halibut fisheries would result in up to 270 lethal takes of yelloweye rockfish, and 40 bocaccio (all lethal).

Other Limiting Factors - The yelloweye rockfish DPS abundance is much lower than it was historically. The fish face several threats, including bycatch in some commercial and recreational fisheries, non-native species introductions, and habitat degradation. NMFS has determined that this DPS is likely to be in danger of extinction in the foreseeable future throughout all of its range.

The bocaccio DPS exists at very low abundance and observations are relatively rare. Their low intrinsic productivity, combined with continuing threats from bycatch in commercial and recreational harvest, non-native species introductions, loss and degradation of habitat, and chemical contamination, increase the extinction risk. NMFS has determined that this DPS is currently in danger of extinction throughout all of its range.

In summary, despite some limitations on our knowledge of past abundance and specific current viability parameters, characterizing the viability of yelloweye rockfish and bocaccio includes their severely reduced abundance from historical times, which in turn hinders productivity and diversity. Spatial structure for each species has also likely been compromised because of a probable reduction of mature fish of each species distributed throughout their historical range within the DPSs (Drake et al. 2010).

Recovery Plan – Rockfish

The 2017 Recovery Plan for bocaccio and yelloweye rockfish contains the following Recovery Objectives:

1) Continue to improve our knowledge of the current and historical population status of yelloweye rockfish and bocaccio and their habitats. This information is necessary so that populations can be characterized on a management unit basis and a detailed program can be developed for implementing recovery actions to most efficiently achieve the delisting criteria.
2) Reduce or eliminate existing threats to listed rockfish from fisheries/anthropogenic mortality.
3) Reduce or eliminate existing threats to listed rockfish habitats and restore degraded or removed rockfish habitat.

2.2.1 Rangewide Status of the Critical Habitat

Critical habitat has not been designated for the following species: blue whale, fin whale, North Pacific gray whale, and sperm whale. Critical habitat is designated for North Pacific right whales in the Gulf of Alaska and Bering Sea, but it does not occur in the action area. For leatherback sea turtles, critical habitat is designed on the outer coast of Washington within the action area.

For the species with designated and proposed critical habitat in the action area, Table 16 provides a high-level description of the range-wide status of critical habitat for each species. Because the action area encompasses a large portion of Puget Sound, further descriptions of critical habitat conditions and species status within the action area are given in the Environmental Baseline Section 2.3. In general, we describe the designated critical habitat affected by the proposed action by examining the condition and trends of the essential physical and biological features of that habitat. These features are essential to the conservation and recovery of the ESA-listed species because they support one or more of the species' life stages (*e.g.*, sites with conditions that support spawning, rearing, migration and foraging).

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace 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. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

Table 16. Critical habitat, designation date, federal register citation, and status summary for critical habitat considered in this opinion.

Species	**Designation Date and Federal Register Citation**	**Critical Habitat Status Summary**
Southern resident killer whale	11/29/06 71 FR 69054	Critical habitat consists of three specific marine areas of inland waters of Washington: 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. These areas comprise approximately 2,560 square miles of marine habitat. Based on the natural history of the Southern Residents and their habitat needs, NMFS identified three PBFs (PCEs), or physical or biological features, essential for the conservation of Southern Residents: 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. Water quality in Puget Sound, in general, is degraded. Some pollutants in Puget Sound persist and build up in marine organisms including Southern Residents and their prey resources, despite bans in the 1970s of some harmful substances and cleanup efforts. The primary concern for direct effects on whales from water quality is oil spills, although oil spills can also have long-lasting impacts on other habitat features. In regards to passage, human activities can interfere with movements of the whales and impact their passage. In particular, vessels may present obstacles to whales' passage, causing the whales to swim further and change direction more often, which can increase energy expenditure for whales and impacts foraging behavior. Reduced prey abundance, particularly Chinook salmon, is also a concern for critical habitat.
	Proposed expansion 9/19/2020 84 FR 49214	NMFS proposes to designate approximately 15,626.6 mi2 (40,472.7 km2) of marine habitat within the area occupied by SRKWs along the coasts of Washington, Oregon, and California. Combined with the currently designated critical habitat in inland waters of Washington (2,560 mi2 (6,630 km2)), the total designation would comprise approximately 18,186.5 mi2 (47,102.7 km2). In both the currently designated and proposed new critical habitat, areas with water less than 20 ft (6.1 m) deep are not included as critical habitat. 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 coastal areas in Washington include Coastal Area 1—Coastal Washington/Northern Oregon Inshore Area: U.S. marine waters west of a line connecting Cape Flattery, Washington (48°23′10″ N/124°43′32″ W), Tatoosh Island, Washington (48°23′30″ N/124°44′12″ W), and Bonilla Point, British Columbia (48°35′30″ N/124°43′00″ W), from the U.S. international border with Canada south to Cape Meares (45°29′12″ N), between the 6.1-m and 50-m isobath contours. This area covers 1,441.9 mi2 (3,734.6 km2) and includes waters off Clallam, Jefferson, Grays Harbor, and Pacific counties in Washington and Clatsop and Tillamook counties in Oregon. This area contains all three essential features (PBFs) described in the original critical habitat designation (above) with **the primary essential feature of concern for this area being PBF# 2 prey availability**. Coastal Area 2—Coastal Washington/Northern Oregon Offshore Area: U.S. marine waters

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
		west of a line connecting Cape Flattery, Washington (48°23′10″ N/124°43′32″ W), Tatoosh Island, Washington (48°23′30″ N/124°44′12″ W), and Bonilla Point, British Columbia (48°35′30″ N/124°43′00″ W), from the U.S. international border with Canada south to Cape Meares (45°29′12″ N), between the 50-m and 200-m isobath contours. This area covers 4,617.2 mi2 (11,958.6 km2), and as with Area 1, includes waters off Clallam, Jefferson, Grays Harbor, and Pacific counties in Washington and Clatsop and Tillamook counties in Oregon. This area contains all three essential features (PBFs) described in the original critical habitat designation (above) with **the primary essential feature of concern for this area being PBF# 2 prey availability.** Human activities managed under a variety of legal mandates have the potential to affect the habitat features essential to the conservation of Southern Resident killer whales, including those that could increase water contamination and/or chemical exposure, decrease the quantity or quality of prey, or could inhibit safe, unrestricted passage between important habitat areas to find prey and fulfill other life history requirements. Activities that could affect prey in Coastal Areas 1 and 2 are: (1) Salmon fisheries and fisheries that take salmon as bycatch; (2) salmon hatcheries; (3) oil spills and response; (4) military activities; (5) vessel traffic; (6) dredging and dredge material disposal (7) upstream activities (including activities contributing to point-source water pollution, power plant operations). The other coastal areas (Areas 3-6) occur further south along the coasts of Oregon and California, including Monterey Bay.
Humpback Whale, Mexico DPS	Proposed 10/9/2019 84 FR 54354	For the threated MX DPS of humpback whales, NMFS proposes to designate 175,812 square nautical miles of marine habitat off the coasts of Alaska, Washington (including the Strait of Juan de Fuca), Oregon, and California as occupied critical habitat that are seasonal feeding areas that contain the essential prey feature, and are critical in supporting population growth and recovery of this wide-ranging threatened DPS. NMFS identified a prey biological feature that is essential to the conservation of the whales. The prey essential feature was specifically defined as follows: Prey species, primarily euphausiids and small pelagic schooling fishes of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth. Whales from this DPS travel to U.S. coastal waters specifically to access energy-rich feeding areas, and the high degree of loyalty to specific locations indicates the importance of these feeding areas.
Humpback Whale, Central America DPS	Proposed 10/9/2019 84 FR 54354	NMFS proposes to designate 48,459 square nautical miles of marine habitat off the coasts of Washington (including the Strait of Juan de Fuca), Oregon, and California as occupied critical habitat that contain the essential prey feature and serve as the only major feeding areas for this DPS; thus, these areas are critical to supporting population growth and recovery of this endangered DPS. NMFS identified a prey biological feature that is essential to the conservation of the whales. The prey essential feature was specifically defined as follows: Prey species, primarily euphausiids and small pelagic schooling fishes of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Leatherback turtle	2/27/2012 77 FR 4169	The final rule revises the current critical habitat for the leatherback sea turtle (Dermochelys coriacea) by designating additional areas within the Pacific Ocean. This designation includes approximately 16,910 square miles (43,798 square km) stretching along the California coast from Point Arena to Point Arguello east of the 3,000-meter depth contour; and 25,004 square miles (64,760 square km) stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000-meter depth contour. The designated areas comprise approximately 41,914 square miles (108,558 square km) of marine habitat and include waters from the ocean surface at extreme low water down to a maximum depth of 262 feet (80 m). The PBF essential for conservation of leatherback turtles is the occurrence of prey species, primarily scyphomedusae (jellyfish) of the order Semaeostomeae (*Chrysaora, Aurelia, Phacellophora,* and *Cyanea*), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks. Leatherbacks feed off the coast of Washington from approximately May to October when waters are warmer.
Puget Sound Chinook salmon	9/02/05 70 FR 52630	Critical habitat for Puget Sound Chinook salmon includes 1,683 miles of streams, 41 square mile of lakes, and 2,182 miles of nearshore marine habitat in Puget Sounds. The Puget Sound Chinook salmon ESU has 61 freshwater and 19 marine areas within its range. Of the freshwater watersheds, 41 are rated high conservation value, 12 low conservation value, and eight received a medium rating. Of the marine areas, all 19 are ranked with high conservation value.
Puget Sound steelhead	2/24/16 81 FR 9252	Critical habitat for Puget Sound steelhead includes 2,031 stream miles. Nearshore and offshore marine waters were not designated for this species. There are 66 watersheds within the range of this DPS. Nine watersheds received a low conservation value rating, 16 received a medium rating, and 41 received a high rating to the DPS.
Hood Canal summer-run chum	9/02/05 70 FR 52630	Critical habitat for Hood Canal summer-run chum includes 79 miles and 377 miles of nearshore marine habitat in HC. Primary constituent elements relevant for this consultation include: 1) Estuarine areas free of obstruction with water quality and aquatic vegetation to support juvenile transition and rearing; 2) Nearshore marine areas free of obstruction with water quality conditions, forage, submerged and overhanging large wood, and aquatic vegetation to support growth and maturation; 3) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.
Southern DPS of eulachon	10/20/11 76 FR 65324	Critical habitat for eulachon includes portions of 16 rivers and streams in California, Oregon, and Washington. All of these areas are designated as migration and spawning habitat for this species. In Oregon, we designated 24.2 miles of the lower Umpqua River, 12.4 miles of the lower Sandy River, and 0.2 miles of Tenmile Creek. We also designated the mainstem Columbia River from the mouth to the base of Bonneville Dam, a distance of 143.2 miles. Dams and water diversions are moderate threats to eulachon in the Columbia and Klamath rivers where hydropower generation and flood control are major activities. Degraded water quality is common in some areas occupied by southern DPS eulachon. In the Columbia and

Species	**Designation Date and Federal Register Citation**	**Critical Habitat Status Summary**
		Klamath river basins, large-scale impoundment of water has increased winter water temperatures, potentially altering the water temperature during eulachon spawning periods. Numerous chemical contaminants are also present in spawning rivers, but the exact effect these compounds have on spawning and egg development is unknown. Dredging is a low to moderate threat to eulachon in the Columbia River. Dredging during eulachon spawning would be particularly detrimental.
Southern DPS of green sturgeon	10/09/09 74 FR 52300	Critical habitat has been designated in coastal U.S. marine waters within 60 fathoms depth from Monterey Bay, California (including Monterey Bay), north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to its United States boundary; the Sacramento River, lower Feather River, and lower Yuba River in California; the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; tidally influenced areas of the Columbia River estuary from the mouth upstream to river mile 46; and certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor), including, but not limited to, areas upstream to the head of tide in various streams that drain into the bays. The Critical Habitat Review Team identified several activities that threaten the PBFs (PCEs) in coastal bays and estuaries and necessitate the need for special management considerations or protection. The application of pesticides is likely to adversely affect prey resources and water quality within the bays and estuaries, as well as the growth and reproductive health of Southern DPS green sturgeon through bioaccumulation. Other activities of concern include those that disturb bottom substrates, adversely affect prey resources, or degrade water quality through re-suspension of contaminated sediments. Of particular concern are activities that affect prey resources. Prey resources are affected by: commercial shipping and activities generating point source pollution and non-point source pollution that discharge contaminants and result in bioaccumulation of contaminants in green sturgeon; disposal of dredged materials that bury prey resources; and bottom trawl fisheries that disturb the bottom (but result in beneficial or adverse effects on prey resources for green sturgeon).
Puget Sound/Georgia Basin DPS of bocaccio	11/13/2014 79 FR68042	Critical habitat for bocaccio includes 590.4 square miles of nearshore habitat and 414.1 square miles of deepwater habitat. Critical habitat is not designated in areas outside of United States jurisdiction; therefore, although waters in Canada are part of the DPS's range, critical habitat was not designated in that area. Based on the natural history of bocaccio and their habitat needs, NMFS identified two physical or biological features, essential for their conservation: 1) Deepwater sites (>30 meters) that support growth, survival, reproduction, and feeding opportunities; 2) Nearshore juvenile rearing sites with sand, rock and/or cobbles to support forage and refuge. Habitat threats include degradation of rocky habitat, loss of eelgrass and kelp, introduction of non-native species that modify habitat, and degradation of water quality as specific threats to rockfish habitat in the Georgia Basin.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Puget Sound/Georgia Basin DPS of yelloweye rockfish	11/13/2014 79 FR68042	Critical habitat for yelloweye rockfish includes 414.1 square miles of deepwater marine habitat in Puget Sound, all of which overlaps with areas designated for bocaccio. No nearshore component was included in the CH listing for juvenile yelloweye rockfish as they, different from bocaccio, typically are not found in intertidal waters (Love et al., 1991). Yelloweye rockfish are most frequently observed in waters deeper than 30 meters (98 ft) near the upper depth range of adults (Yamanaka et al., 2006). Habitat threats include degradation of rocky habitat, loss of eelgrass and kelp, introduction of non-native species that modify habitat, and degradation of water quality as specific threats to rockfish habitat in the Georgia Basin.

2.3 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).

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, as well as on-going human development that are properly part of the environmental baseline vs. cumulative effects. Therefore, all relevant future climate-related environmental conditions and effects of on-going human development in the action area are described in this section as the environmental baseline.

We recognize that the listed species in the action area face multiple threats from on-going human development in addition to climate change as a baseline condition. There are also substantial efforts being made to recover proper ecosystem function in the Salish Sea. Future Federal actions that are unrelated to the proposed action are typically not considered in this section because they require separate consultation pursuant to Section 7 of the ESA. However, for this opinion, we have relied upon some studies (e.g. oil spill risk assessments, noise, population viability analyses) where the analysis does not necessarily parse out baseline, effects of the action, and cumulative effects as per Section 7 regulatory definitions. For example, future added traffic could come from projects that would trigger Section 7 ESA consultation. However, it is not practicable to separate those out in the available models. Additionally, some of the future traffic assumptions are from potential developments in British Columbia, which would come under the purview of the Canadian government, but would nonetheless affect the action area and would not undergo future Section 7 consultation. Therefore, in some instances, we have combined the analysis of baseline conditions or on-going effects with cumulative effects, because we either cannot properly make the distinction between the two, or the analysis makes logical sense to describe the fact patterns together. The Risk Assessments section below describes this in more detail.

This section presents a general description of the current state of the Salish Sea ecosystem, followed by information on baseline information for traffic, oil spill risk, transfer errors (small spills at the BP facility), vessel collisions/ship strikes of whales and turtles, and anthropogenic noise (acoustics). Following these general discussions that relate to the action, species specific information for the action area is presented.

2.3.1 Baseline Ecosystem Function

The Puget Sound ecosystem is in decline (U.S. Commission on Ocean Policy, 2004; Ruckelshaus and McClure, 2007; The Heinz Center, 2008). Human population growth in the Puget Sound region increased from about 1.29 million people in 1950 to about 4.22 million in 2005, and is expected to reach 5.36 million by 2025. The Puget Sound Partnership is Washington State's agency leading the region's collective effort to restore and protect Puget Sound. The Partnership assesses 29 vital signs as indicators of the "state of the Sound" (http://www.psp.wa.gov/sos.php). In 2017, the Partnership reported Ten Vital Sign indicators are getting better, nine have mixed results, six are not improving, and four are getting worse. The report concludes that the Puget Sound recovery community has made progress in restoring habitat, but marine water quality continues to deteriorate, and some species, like Chinook salmon and Southern Resident killer whales are "dangerously below federal recovery goals and are not improving." For ecosystem recovery targets, of the 290 Near Term Actions included in the 2014-2016 Action Agenda, just 41 percent got underway and were completed. The Partnership found that lack of funding is the biggest barrier. The Partnership's 2017 report calls for increased commitment to recovery, suggesting that Washington State work with British Columbia to address clean water, habitat protection, vessel traffic, and vessel noise. This "state of the Sound" is representative of the health of the larger Salish Sea.

2.3.2 Baseline Vessel Traffic

The following is taken directly from the Biological Evaluation for the project:

> "Since 2000, WDOE has maintained data and produced an annual report entitled 'Vessel Entries and Transits for Washington Waters' (VEAT) to provide information about commercial vessel traffic in Washington waters. These annual reports include relevant classifications of Cargo and Passenger vessels (C&P), Tank Ships and Tank Barges that travel along the routes likely to be used by the tank vessels calling at the North Wing of the BP Marine Terminal. The VEAT reports show that overall vessel traffic in Puget Sound has experienced a slight decline over the past 15 years (Table 17; Figure 26). The 2015 sum annual traffic, of relevant classification, in the Action Area was 17,486 transits (Table 17), which is based on two transits per call (a vessel must make a trip in and a trip out of Puget Sound to complete a "call")."

Table 17. Puget Sound Shipping Traffic 2000-2015 (Table 3.1-1 from BE)

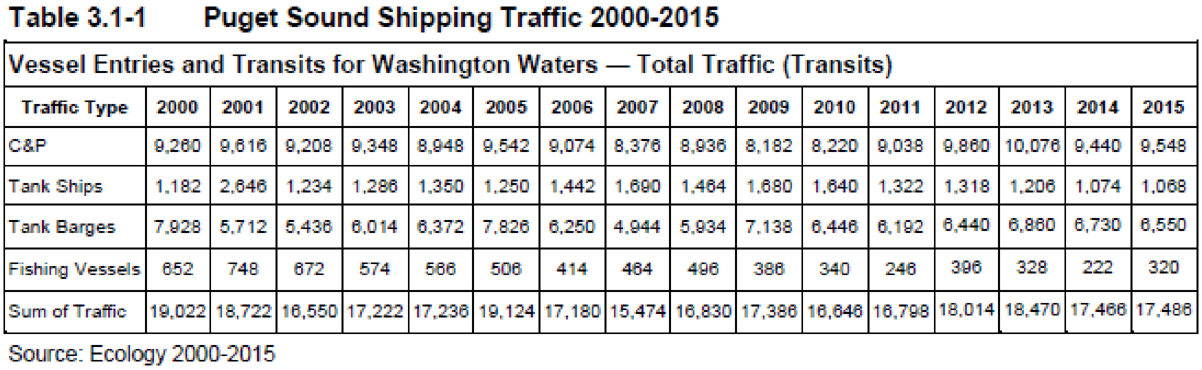
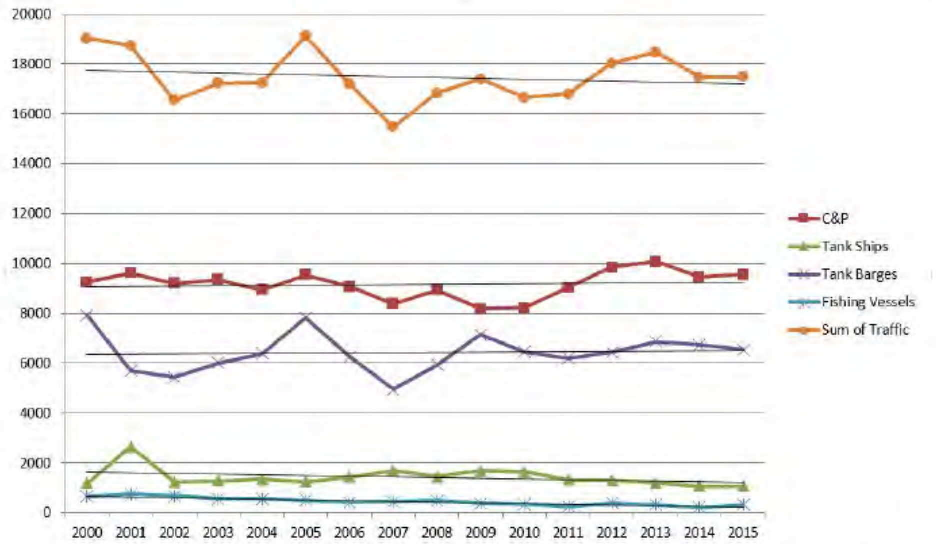


Table 3.1-1 Puget Sound Shipping Traffic 2000-2015

Vessel Entries and Transits for Washington Waters — Total Traffic (Transits)																
Traffic Type	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
C&P	9,260	9,616	9,208	9,348	8,948	9,542	9,074	8,376	8,936	8,182	8,220	9,038	9,860	10,076	9,440	9,548
Tank Ships	1,182	2,646	1,234	1,286	1,350	1,250	1,442	1,690	1,464	1,680	1,640	1,322	1,318	1,206	1,074	1,068
Tank Barges	7,928	5,712	5,436	6,014	6,372	7,826	6,250	4,944	5,934	7,138	6,446	6,192	6,440	6,860	6,730	6,550
Fishing Vessels	652	748	672	574	566	506	414	464	496	386	340	246	396	328	222	320
Sum of Traffic	19,022	18,722	16,550	17,222	17,236	19,124	17,180	15,474	16,830	17,386	16,646	16,798	18,014	18,470	17,466	17,486

Source: Ecology 2000-2015



Source Ecology 2000-2015

Figure 3.1-1 Puget Sound Shipping Traffic 2000-2015

Baseline Vessel Traffic to BP Marine Terminal

> “BP vessel call records from January 2000 through December 2014 show that an annual average of 317 vessel calls occurred at the BP Cherry Point dock. These calls included tank ships delivering crude oil and partially-refined intermediate feed stocks to the refinery and tank ships or barges exporting refined petroleum products to market destinations (Table 18). During this time period the number of vessel calls at BP Cherry Point Dock have ranged from a low of 250 in 2011 to a high of 416 in 2007 (Table 18). The annual maximum number of calls (416) occurred in 2007 and consisted of 191 crude oil carriers and 225 refined petroleum product carriers.”

Table 18. Monthly and Annual Vessel Calls at BP Cherry Point (2000-2014)(Table 3.1-2 from BE).

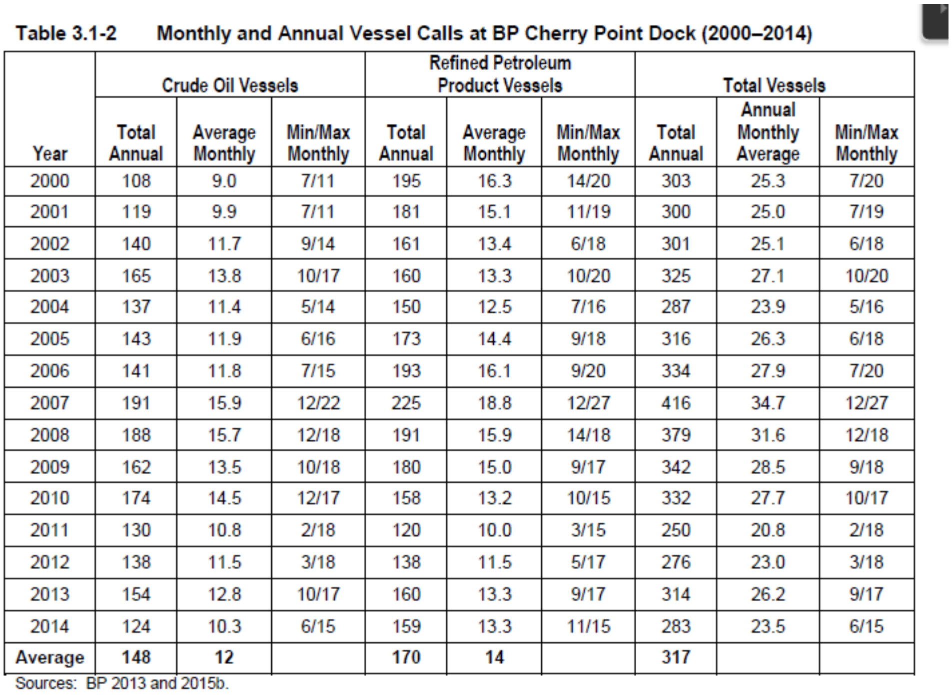


Table 3.1-2 Monthly and Annual Vessel Calls at BP Cherry Point Dock (2000–2014)

	Crude Oil Vessels			Refined Petroleum Product Vessels			Total Vessels		
Year	Total Annual	Average Monthly	Min/Max Monthly	Total Annual	Average Monthly	Min/Max Monthly	Total Annual	Annual Monthly Average	Min/Max Monthly
2000	108	9.0	7/11	195	16.3	14/20	303	25.3	7/20
2001	119	9.9	7/11	181	15.1	11/19	300	25.0	7/19
2002	140	11.7	9/14	161	13.4	6/18	301	25.1	6/18
2003	165	13.8	10/17	160	13.3	10/20	325	27.1	10/20
2004	137	11.4	5/14	150	12.5	7/16	287	23.9	5/16
2005	143	11.9	6/16	173	14.4	9/18	316	26.3	6/18
2006	141	11.8	7/15	193	16.1	9/20	334	27.9	7/20
2007	191	15.9	12/22	225	18.8	12/27	416	34.7	12/27
2008	188	15.7	12/18	191	15.9	14/18	379	31.6	12/18
2009	162	13.5	10/18	180	15.0	9/17	342	28.5	9/18
2010	174	14.5	12/17	158	13.2	10/15	332	27.7	10/17
2011	130	10.8	2/18	120	10.0	3/15	250	20.8	2/18
2012	138	11.5	3/18	138	11.5	5/17	276	23.0	3/18
2013	154	12.8	10/17	160	13.3	9/17	314	26.2	9/17
2014	124	10.3	6/15	159	13.3	11/15	283	23.5	6/15
Average	**148**	**12**		**170**	**14**		**317**		

Sources: BP 2013 and 2015b.

> "Vessels transiting to the BP Marine Terminal from Alaska, Oregon, California, and international origins enter the Strait of Juan de Fuca and travel to Port Angeles, Washington, where a pilot comes onboard…. Tankers (except double hull tankers less than 40,000 deadweight [DWT]) carrying oil or oil products are required to pick-up two escort tugs between buoy "R," north of New Dungeness Lighthouse, before transiting to the BP Marine Terminal. Most vessels then transit through Rosario Strait to the southern reach of the Strait of Georgia and onto the BP Marine Terminal at Cherry Point. In Rosario Strait, large commercial vessels—typically laden tankers—are limited to one-way traffic by USCG vessel traffic rules. Thus, no large commercial ship may enter Rosario Strait for passage if another large commercial ship is transiting in the opposite direction. In rare instances, vessels transiting to the BP Marine Terminal may travel north through Haro Strait and then northeast through Boundary Pass to the BP Marine Terminal at Cherry Point. Vessels check-in with the joint USCG/Canadian Coast Guard (CCG) Cooperative Vessel Traffic Service prior to entering the Strait of Juan de Fuca and remain under either USCG or CCG control the entire time they are transiting to/from ports within the Strait of Juan de Fuca, Puget Sound, or the Georgia Strait. Transits of vessels to and from the BP Marine Terminal occur primarily within a Traffic Separation Scheme . . . operated jointly by the USCG and CCG.
>
> Articulated Tugs-and-Barges (ATBs) and traditional barges (collectively referred to as barges), and some tank ships may transit to the BP Marine Terminal from Puget Sound (generally Seattle and Tacoma). From Puget Sound, these vessels transit westbound through Admiralty Inlet then turn north and pursue a course in the traffic separation lane along the western side of Whidbey Island to its intersection with Rosario Strait. They then enter Rosario Strait and transit north to the BP Marine Terminal.

> Vessels approaching the BP Marine Terminal at Cherry Point may be directed by the USCG Vessel Traffic Service (VTS) to come to anchor at the designated temporary anchorage offshore of Vendovi Island if the berths are already in use….Vessels departing from the BP Marine Terminal at Cherry Point would take the routes described above in reverse utilizing the southbound or outbound traffic separation lanes as appropriate. Tank ships and barges having called at the BP Marine Terminal at Cherry Point may transit to the refineries located at March Point in Padilla Bay adjacent to Anacortes. There are two routes to Anacortes; the Huckleberry-Saddlebag Route and the Guemes Channel Route. To use the Huckleberry-Saddlebag Route, vessels depart the traffic separation lane adjacent to Lummi Island and enter the channel between Lummi Island and Sinclair Island. Passing Vendovi Island, they navigate between Huckleberry and Saddlebag Islands to enter Padilla Bay. The second route makes use of the one-way traffic lane south through Rosario Strait past Cypress Island. The route then turns eastward into Guemes Channel and enters Padilla Bay…. BP-owned or chartered vessels are directed by BP to use the Guemes Channel route as the preferred route.
>
> Prior to operation of the North Wing, the greatest annual number of calls to the BP Marine Terminal was 303 calls to the South Wing in 2000. However, this number of calls does not reflect the estimated maximum capacity of the BP Marine Terminal with only the South Wing operating."

Table 2 in Section 1.3 below shows the calculated number of 385 annual vessel calls under the current business case (today's market conditions/business model) that BP would handle at a one-winged pier. Table 2 arrives at this figure by calculating the maximum capacity of the facility from 1998, prior to construction of the North Wing, and translating that year's operations to reflect changes in shipping behavior, by which smaller crude oil cargoes would require more vessels to achieve the same full-capacity operation of the single pier. Additionally, Table 2 includes an estimated reduction in total crude oil imports offset by an increase in refined fuel shipments. The baseline assumption is that BP would handle 140 crude oil ships plus 245 refined product ships for a total of 385 vessel calls per year at a one winged pier. The estimate of 385 ship calls in a one-wing scenario does include fluctuations for weather and dock maintenance. Therefore, while it is reasonable to assume that other factors such as economic changes or other logistical challenges could cause BP to receive fewer than 385 ship calls in some years, such assumptions are speculative in nature. Therefore, the baseline assumes that BP Cherry Point would receive up to 385 ships a year at one winged pier, although as Table 18 shows, BP has often operated with fewer shipments (with both wings in operation). How frequently BP would experience a drop in ship calls from 385, and how much of a drop, is impossible to say, but our assumption is that it would not happen frequently or involve a significant drop in ship traffic.

2.3.3 Baseline Oil Spill Risk in the Salish Sea

Oil Spill Risk in the Action Area

The Washington State Department of Ecology and the Puget Sound Partnership describe the risk of oil spill in the region as an "inherent risk associated with having over 15 billion gallons of oil transferred around our state every year" (https://fortress.wa.gov/ecy/publications/documents/1108002.pdf). 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 remains at risk from serious spills because of the heavy volume of shipping traffic and proximity to petroleum refining centers in inland waters (WDOE 2015). Numerous oil tankers transit through the inland waters of the Salish Sea throughout the year. The magnitude of risk posed by oil discharges in the action area is difficult to precisely quantify. The total volume of oil spills declined from 2007 to 2013, but then increased from 2013 to 2017 (WDOE 2017). WDOE notes that the percent of potential high-risk vessels that were boarded and inspected between 2009 to 2017 declined from 26 percent inspected in 2009 to 12.2 percent by 2017, implying that fewer inspections may exacerbate risk (WDOE 2017).

Prior to the adoption of recent regulatory and other measures to prevent spills, Neel et al. (1997) reported that shipping accidents were responsible for the largest volume (59 percent; 3.4 million gallons) of oil discharged during major spills in Washington from 1970 to 1996. Other sources were refineries and associated production facilities (27 percent; 1.5 million gallons) and pipelines (14 percent; 800,000 gallons). There have been eight major oil tanker spills exceeding 100,000 gallons in the state's coastal waters and on the Columbia River since the 1960s, with the largest estimated at 2.3 million gallons in 1972 within the action area at Cape Flattery near the mouth of the Strait of Juan de Fuca (Table 20). Grant and Ross (2002) did not report any major vessel spills from British Columbia during this same period. One spill of 100,000 gallons is known to have occurred in Canadian waters at the mouth of the Strait of Juan de Fuca in 1991 (Neel et al. 1997). In 2015, the bulk carrier, Marathassa, spilled approximately 700 gallons of bunker C fuel in English Bay, Vancouver, BC. Oil from the spill traveled 7.5 miles and fouled 10 beaches in Vancouver, West Vancouver, and North Vancouver, BC (https://thenarwhal.ca/what-we-may-never-know-about-vancouver-english-bay-oil-spill/). In addition to these incidents, there have been a number of near accidents resulting from vessel groundings, collisions, power loss, or poor vessel condition (Neel et al. 1997). Puget Sound's five oil refineries are located on the Puget Sound shoreline at Anacortes (two facilities), Ferndale, Cherry Point, and Tacoma. Pipelines connecting to refineries and oil terminals at ports represent another potential source of coastal spills, such as occurred with the Olympic Pipeline in Bellingham, Washington in 1999. For scale, the Exxon Valdez accident resulted in a spill of 11 million (11,000,000) gallons. That volume of oil outflow occurred after the accident because the ship was single-hulled and in a remote location, making accident response measures extremely difficult. An accident of that size is extremely unlikely in Puget Sound because crude oil ships are double-hulled and accident response efforts are likely to be more effective in the Salish Sea because of the response measures that are in place in the Northwest Response Plan. The Deepwater Horizon oil spill in the Gulf of Mexico spilled an estimated 134 million (134,000,000) gallons. That scale of accident occurred because the crude oil leak was at the seafloor in the Gulf of Mexico, not from a ship.

Table 20. (Table 13 from DEIS) Oil Spills of 100,000 Gallons or More from vessels, facilities, and pipelines in Washington from 1960's to 2003.

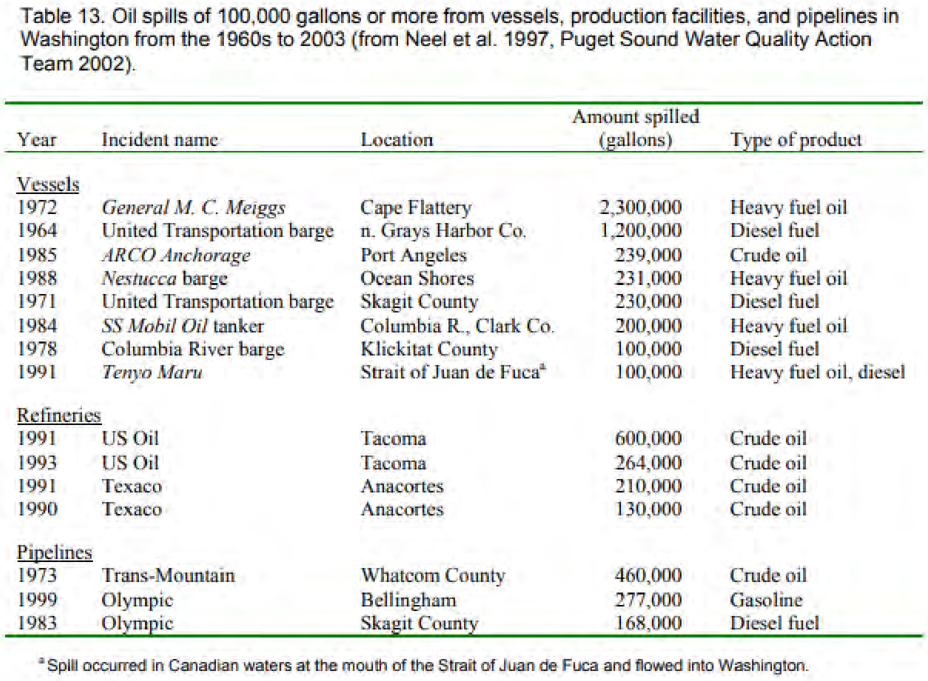


Table 13. Oil spills of 100,000 gallons or more from vessels, production facilities, and pipelines in Washington from the 1960s to 2003 (from Neel et al. 1997, Puget Sound Water Quality Action Team 2002).

Year	Incident name	Location	Amount spilled (gallons)	Type of product
Vessels				
1972	*General M. C. Meiggs*	Cape Flattery	2,300,000	Heavy fuel oil
1964	United Transportation barge	n. Grays Harbor Co.	1,200,000	Diesel fuel
1985	*ARCO Anchorage*	Port Angeles	239,000	Crude oil
1988	*Nestucca* barge	Ocean Shores	231,000	Heavy fuel oil
1971	United Transportation barge	Skagit County	230,000	Diesel fuel
1984	*SS Mobil Oil* tanker	Columbia R., Clark Co.	200,000	Heavy fuel oil
1978	Columbia River barge	Klickitat County	100,000	Diesel fuel
1991	*Tenyo Maru*	Strait of Juan de Fuca[a]	100,000	Heavy fuel oil, diesel
Refineries				
1991	US Oil	Tacoma	600,000	Crude oil
1993	US Oil	Tacoma	264,000	Crude oil
1991	Texaco	Anacortes	210,000	Crude oil
1990	Texaco	Anacortes	130,000	Crude oil
Pipelines				
1973	Trans-Mountain	Whatcom County	460,000	Crude oil
1999	Olympic	Bellingham	277,000	Gasoline
1983	Olympic	Skagit County	168,000	Diesel fuel

[a] Spill occurred in Canadian waters at the mouth of the Strait of Juan de Fuca and flowed into Washington.

Oil Spill Prevention and Response

During the late 1980s and early 1990s, Washington State upgraded its efforts to prevent oil spills in response to increased numbers of spills in the state and the Exxon Valdez accident in Alaska. A number of State, Canadian provincial, and Federal agencies now work to reduce the likelihood of spills, as does the regional Oil Spill Task Force, which was formed in 1989. In addition, there is an international body, the International Maritime Organization (IMO), which has adopted conventions, protocols, codes and recommendations concerning maritime safety, the prevention of pollution and related matters, including specific measures regarding oil spills. National statutes enacted in the early 1990s, including the U.S. Oil Pollution Act in 1990 (OPA) and the Canada Shipping Act in 1993, have facilitated spill prevention and response standards. OPA serves as the leading Federal regulatory mechanism to prevent, respond to, and address damage caused by oil spills and created the Oil Spill Liability Trust Fund. OPA requires that all tank vessels greater than 5,000 gross tons operating in the U.S. waters be fitted with a double hull before January 2015. There is a Northwest Area Committee (NWAC) that develops and implements a NWAC plan. There are also a number of industry-initiated safety practices. In addition, there are local organizations such as the Island Oil Spill Association, a community based, nonprofit organization providing prompt first response for oil spills in the San Juan Islands, shoreline protection, wildlife rescue and training for containment and oiled wildlife responders. In 2001, the U.S. Coast Guard, EPA, Department of Interior, Fish and Wildlife Service and NOAA entered into an agreement that provides a framework for cooperation and participation in providing protection of listed species, improve oil spill planning and response procedures and streamline ESA section 7 consultations for oil spill cleanup. Oil spill planning and response procedures are set forth in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The agreement is intended to facilitate compliance with the ESA during an emergency without degrading the quality of an oil spill response, improve oil spill planning and response process, and ensure inter-agency cooperation to protect listed species and critical habitat. Since 1999, Washington State has maintained a rescue tugboat at Neah Bay for about 225 days per year during the winter months to aid disabled vessels and thereby prevent oil spills. These measures appear to have been helpful in reducing the number and size of spills since 1991. In general, Washington's outer coast, the Strait of Juan de Fuca, and areas near the state's major refineries are considered the locations most at risk of major spills (Neel et al. 1997).

Chronic small-scale discharges of oil into oceans greatly exceed the volume released by major spills (Clark 1997) and represent another potential concern. Such discharges originate from numerous sources, such as the dumping of tank washings and ballast water by tankers, the release of bilge and fuel oil from general shipping, and the disposal of municipal and industrial wastes. Chronic oil pollution kills large numbers of seabirds (e.g., Wiese and Robertson 2004), but its impact on killer whales and other marine mammals is poorly documented. The long-term effects of repeated ingestion of sub-lethal quantities of petroleum hydrocarbons on marine mammals are also unknown.

In 2007, the Washington State Department of Ecology published a new Spill Prevention, Preparedness, and Response Program Annual Report describing recent accomplishments (WDOE 2007). The plan describes new rules for oil transfer that were adopted in September of 2006 that provide more universal coverage relating to oil transfers over state waters. The report also shows trends in incidents per transit, which peaked in 2001 (over 2.5 percent), but then declined between 2004-2006 to a low of less than 1 percent. There have been notable decreases in large spills as well as the overall volume of oil spilled, particularly from 2001 to 2006. WDOE summarized all reports of chemical, oil and hazardous waste spills statewide and provided information on response accomplishments in 2006. The report describes the rescue tug program, contingency plan improvements, readiness drills, training, new equipment, enforcement and voluntary compliance programs as well as a number of education and outreach efforts in Washington and the entire region. The oil spill transfer program expands the number of commercial operations regulated by WDOE's oil spill program. More information on oil spill risk modeling results is presented below.

Northwest Area Contingency Plan

The Northwest Area Contingency Plan (NWACP) is the Puget Sound Region's oil spill response plan (https://www.rrt10nwac.com/NWACP/Default.aspx). We completed an ESA consultation with the Environmental Protection Agency in January 2021 on the NWACP (WCRO-2018-00065). The NWACP includes response guidelines to specifically protect killer whales. NOAA Fisheries has worked closely with cooperating agencies and industry to develop hazing methods to deter killer whales from entering spilled oil. The Implementation Plan (https://response.restoration.noaa.gov/sites/default/files/Hazing-Implementation-Plan.pdf) provides guidance for killer whale monitoring and hazing activities. Hazing activities during emergency oil spill response are authorized under MMPA/ESA Research and Enhancement Permit 932-1905 issued to the NOAA Fisheries Marine Mammal Health and Stranding Response

Program (MMHSRP). Whether or not killer whales can be deterred from entering an oil spill is directly related to the degree to which the whales are attracted to an area. It is impossible to predict if or to what degree hazing may or may not be effective in the event of an oil spill.

Risk Assessments

Multiple risk assessments have been produced to assess the existing (baseline) potential for oil spill in the Salish Sea and for various future scenarios among all traffic in the Salish Sea and for BP in particular. These risk assessments are described below. The first study described is not specific to BP. The Washington State Department of Ecology commissioned the 2015 Vessel Traffic Risk Assessment (2015 VTRA) (WDOE 2015) to study current and future risk in the Salish Sea. Note that this study looked at current traffic or "base case" which serves as a surrogate for describing baseline conditions among all boat and ship traffic in the Salish Sea. We also include below the summaries of the future conditions scenario from this study for ease of understanding by keeping the description of the findings together rather than describing parts of the study here under baseline and other parts of the study under cumulative effects (Section 2.6). The future "what if" scenario serves as a means for describing future conditions with the author's assumptions about future traffic. They considered potential increases in traffic from both existing facilities (including BP Cherry Point) in the Salish Sea and potential new facilities in the US and Canada. This study uses the terms "base case" and "what-if case" which are similar to but not synonymous with "baseline" and "cumulative" under ESA regulatory definitions, yet this study is informative as the best available information for informing our analyses. Likewise, for the other studies, we have noted where the information serves to best inform baseline, effects of the proposed action, or cumulative effects and have separated those discussions where readability or logic flow allows.

We note that some of the assumptions for future scenarios among the studies below are now outdated and may overstate future traffic in the near term or it may be decades before future traffic reaches the high estimate figures used in the models. Therefore, the outputs for the risk assessments should be viewed as showing a range of scenarios, not a certain future in terms of traffic composition and risk. We also note that new, future US facilities would undergo separate ESA Section 7 analysis and would therefore not strictly fall under "cumulative," while future British Columbian/Canadian facilities would fall under "cumulative" because they would not undergo future ESA Section 7 consultation. An example of a Canadian facility that could generate future traffic is the Canadian Trans Mountain pipeline. Potential future traffic from this proposed facility is considered in the 2015 VTRA and The Glosten Associates Vessel Traffic Analysis (TGA VTA) described below.

Vessel Traffic Risk Assessments- Oil Spill Risk

The first traffic assessment presented below was commissioned by the Washington State Department of Ecology. The second two assessments were commissioned by the USACE specifically for the proposed action. The results of each of these studies need to be viewed in light of the specific assumptions, data, and statistical methods employed. None of the studies can predict future spills and the results should be viewed with appropriate caution, understanding, and context. Moving and shipping crude oil is inherently dangerous (WDOE 2015).

2015 Vessel Traffic Risk Assessment- Oil Spill Risk
The Washington State Department of Ecology commissioned the 2015 Vessel Traffic Risk Assessment (2015 VTRA) (WDOE 2015). The study provides information about the risks of oil spills from commercial vessel traffic operating in the Salish Sea. The study also models potential impacts from planned future developments. The general prediction in the Salish Sea is for an overall increase of all traffic over time (WDOE 2015).

The VTRA (2015) summary is as follows taken directly from WDOE's Summary Sheet with interpretive notes added by NMFS in [brackets]:

> "The 2015 VTRA followed a collaborative analysis approach, using a quantitative risk analysis model developed by the principal investigators over the previous twelve years and two studies. The process included:
>
> - Updating the Puget Sound VTRA model with 2015 vessel traffic data to create an understanding of the movements of commercial vessels in the Salish Sea, referred to as the "base case" [baseline];
> - Defining "what-if" cases that added potential vessel traffic to the base case to reflect marine terminal projects that could become operational by 2025; [surrogate for cumulative effects of added traffic or representative of on-going baseline conditions as a result of continued human population growth and development]
> - Identifying and modeling risk mitigation measures to provide information about their potential to reduce accidents and oil spill risks; and
> - Providing estimates for the likelihood of accidents during one-, ten-, and 25-year periods, for different spill sizes. The base case results serve as the basis for understanding existing conditions and comparing the effects of potential future changes. The primary what-if case added 1,600 cargo and tank vessels to 2015 traffic, to include 177 bunkering/fueling operations, representing potential projects in Washington and British Columbia. The 1,600 vessel what-if case represents approximately a 40% increase in the number of focus vessels (excluding oil barge counts) entering/leaving the Strait of Juan de Fuca at its western entrance.
>
> After reviewing the what-if case model results, the workgroup, WDOE, and the principal investigators defined potential risk mitigation measures, which were organized into portfolios, or combinations of multiple measures. These include:
>
> - Improvements to international and federal standards and practices for vessel safety and vessel traffic management that are in the process of being implemented;
> - Rescue tug(s) for Haro Strait and Boundary Pass, stationed in Sidney, BC;
> - Tug escort for articulated tug barges (ATBs) and towed oil barges in Puget Sound;
> - Removal of the current size restriction (125,000 deadweight tons) on oil tankers in Puget Sound; and
> - Escort of outbound tankers from Kinder Morgan's Westridge Marine Terminal to the Pacific Ocean. Key points to consider:

- Results should be considered in the context of the assumptions used in the model, which are documented throughout the report.
- The 2015 VTRA process focused on prevention of accidents and oil spills. Oil spill trajectory and fate and effect modeling to show the environmental, economic, and cultural impacts of spills were not within the scope of this study.

Oil spills from commercial vessels are “low probability/high consequence events.”

- Ninety-eight percent of [modeled] accidents did not result in oil loss for both the base case and the 1,600 vessel what-if case. All of the potential oil loss evaluated in the model was the result of less than two percent of potential accidents.
- Large spills are less likely than smaller spills. For the base case, the potential chances of one or more spills occurring in ten years are 0.5% for the largest spill size (average spill size of 1.8M gallons), 0.6% for a spill with an average size of 430,000 gallons, and 54% for a spill with an average size of 12,000 gallons.
- The 1,600 what-if case [i.e., worse-case/cumulative effect of increased traffic in the future] showed an increase in potential accident frequency of 11% and an increase in potential oil loss of 85% compared to the base case. For this what-if case, the potential chances of one or more spills occurring in ten years are 1.4% for a spill with an average size of 1.4M gallons, 0.95% for a spill with an average size of 447,000 gallons, and 57.3% for a spill with an average size of 18,000 gallons.
- These results are not predictions of how many or what size oil spills will occur. Rather, the model results show potential accident frequency and potential oil loss. The results provide a tool for tribes and stakeholders to compare potential differences between the base case, what-if cases, and risk mitigation measures.
- Risk varies by geographic area. For the 1,600 vessel, what-if case, the largest increases in potential oil loss and potential accident frequency were at the entrance to the Strait of Juan de Fuca and in the Haro Strait/Boundary Pass waterway zone. The largest increase in potential oil loss by volume was in the Haro Strait/Boundary Pass waterway zone.
- Risk in a complex system is best managed systemically. While the effectiveness of risk mitigation measures varied across the geographic areas, the greatest overall reductions in potential oil loss came from a combined portfolio of five risk mitigation measures (listed under “Process”), rather than any single action.
- Within the portfolio of five risk mitigation measures, the measure intended to approximate current and pending improvements to vessel traffic management and vessel safety had the greatest effect. However, regulatory changes are difficult to model quantitatively. The model makes “maximum benefit” assumptions about the potential effect of these pending changes. This assumption was not used in other risk mitigation measures.
- Removing the 125,000 deadweight ton restriction on oil tankers in the Puget Sound was shown to increase potential oil loss.
- Tug escorts for articulated tug barges and towed oil barges reduced potential accidents by 15% and potential oil loss by 3%, compared to the 1,600 vessel what-if case.

- Although a rescue tug stationed in Sidney, BC showed limited effectiveness as modeled in the study, the graphical representations of approximate escort coverage in the report could inform future discussions of rescue tugs."

WDOE's 2015 VTRA also investigated where the relative risk is greatest with the Salish Sea. Figure 27 below from the report shows that higher relative risk occurs within areas proximal to Cherry Point within Guemes Channel, Rosario Strait, and Haro Strait ranking high on relative risk percentages.

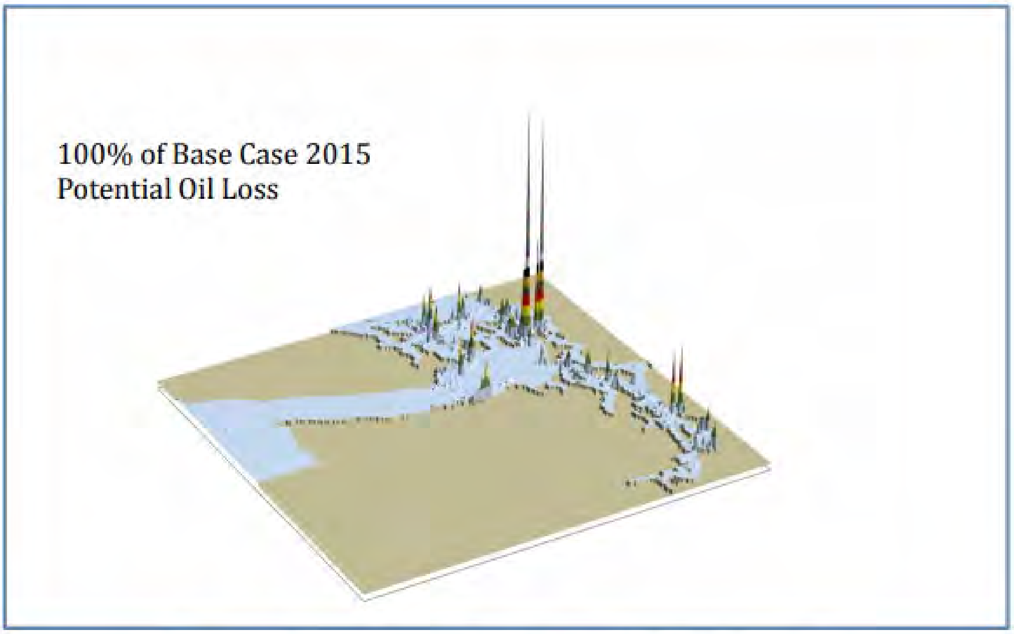


Figure 2-18. 3D Geographic profile of Base Case 2015 POTENTIAL oil loss.

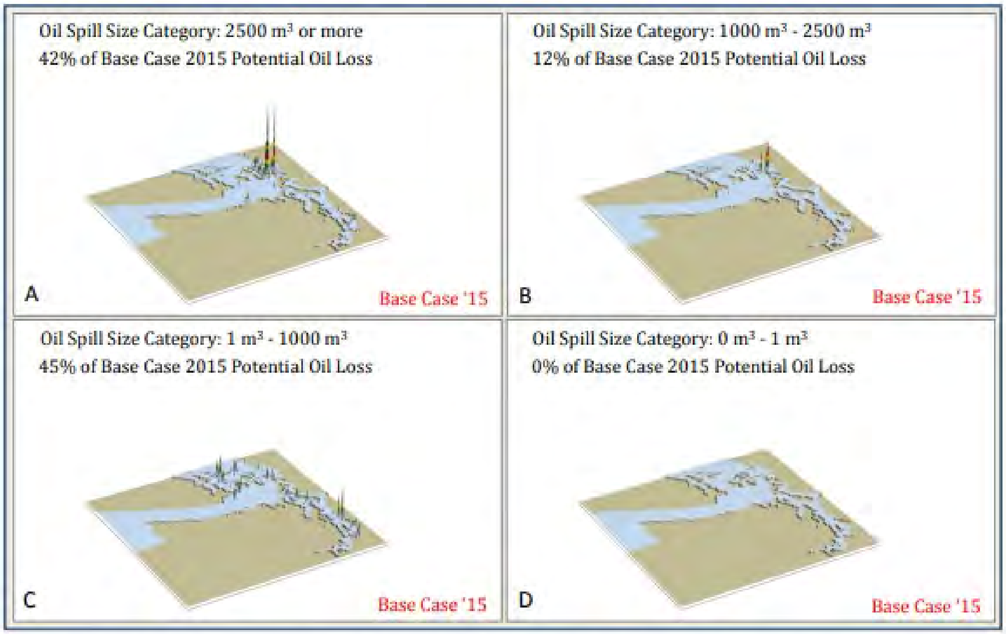


Figure 2-19. Components of 3D Geographic profile of Base Case 2015 POTENTIAL oil loss.

Figure 27. Figures 2-18 and 2-19 from WDOE's 2015 VTRA

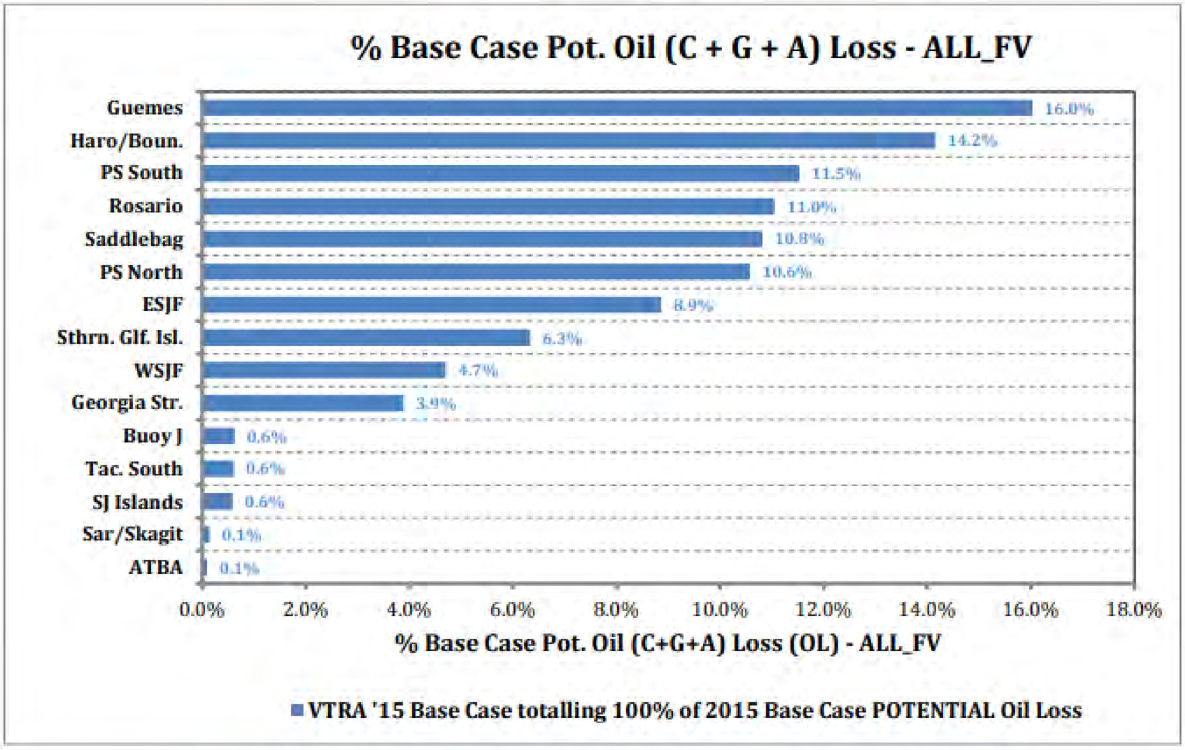


Figure 2-21. Percent overall POTENTIAL Oil Loss by waterway zone for Base Case 2015

Figure 28. Figure 2-21 from WDOE's 2015 VTRA showing relative risk with the geography of the Salish Sea (C = collision, G = grounding A = allisions). Much of the risk occurs within the Core Summer habitat of Southern Resident killer whales.

Project Specific Oil Risk Assessments

The USACE prepared a Draft Final EIS for the North Wing to examine the potential for spills of crude oil and refined product associated with vessel transit and during transfer operations at the dock. Two vessel traffic studies regarding potential spill risk were prepared for the EIS. The George Washington University Vessel Traffic Risk Analysis (GWU VTRA) is useful for characterizing baseline oil spill risk and is presented below (van Dorp et al, 2008). The USACE's EIS presents a more detailed summary and the full report is contained in Appendix C of the EIS (http://www.nws.usace.army.mil/Missions/Civil-Works/Regulatory/News-and-Updates/). The second study, **Glosten Associates Model Results TGA VTRA,** is presented in the effects of the action section of this opinion because it models potential future conditions (TGA 2013).

George Washington University Vessel Traffic Risk Analysis (GWU VTRA). A team led by George Washington University (GWU) conducted this model analysis (van Dorp et al. 2008). The GWU team used a computer-based simulation of traffic movement to identify potential interactions between vessels calling at the BP Cherry Point dock and other vessels transiting the Strait of Juan de Fuca, Admiralty Inlet, and the southern portion of the Strait of Georgia.

Interactions between vessels and potential accidents were simulated, and the oil outflow from potential accidents was assessed.

This study focused on differences in accident risk for a one-winged versus a two-winged pier at BP's Cherry Point facility. The maximum number of vessel calls simulated for the two-winged pier was 329, which is slightly higher than the actual average of 317 between 2000 and 2014, but less than BP's calculated operational use of 385 ships per year for a one-winged pier, and this study did not model the maximum calculated use of 420 calls for a two-winged pier or for a 385 rolling average. This study did consider the potential Gateway Pacific Terminal (GPT) added traffic for some of the future scenarios. The GPT was a proposal for a new dry goods bulk carrier facility at Cherry Point. The GPT would have added in the range of 400 bulk carrier ship calls to the region. The GPT terminal was not approved by the USACE, so some of the future scenario results likely overstate risk in the model (the GPT ships would have added risk to the traffic pattern by adding more ships even though they were not going to carry crude oil)

This study is useful for assessing the No Action alternative from the USACE's EIS of removing the North Wing and it is useful for assessing baseline risk. However, it is not directly applicable to the proposed action because it did not consider the current calculated maximum operational use of 385 ships per year at a one-winged pier or a rolling average of 385 ships per year at a two-winged pier. In general, the GWU VTRA found that at traffic levels up to 335 ships per year at a single-wing facility, operation of a second wing reduces the potential for accident, oil spill, and potential oil spill volume. This is because the two-winged pier reduces risk at the facility and reduces ship wait times and staging near the facility.

The GWU VTRA simulation was calibrated to a known annual accident statistic for a base year (2005). To determine the calibration value for accidents, marine incident/accident records for Puget Sound from multiple sources for an 11-year period (1995–2005) were collected, reviewed, interpreted, and integrated into a single database for collisions, allisions[26], and power and drift groundings. From this database, incidents and accidents involving tankers and tug/barges calling at the BP Cherry Point dock during their operation in the greater Puget Sound were identified. From 1995 to 2005, the database showed that four accidents had occurred: one collision involving a tanker and its tug escort, two allisions while leaving a dock, and one barge grounding as the result of a dragging anchor in heavy winds. None of these four accidents resulted in any reported oil outflow (see Appendix A of the VTRA Report, page A-58). The statistic of four accidents in 11 years (4/11 = 0.3636) was used as the annual accident potential for the base case (Case B – 2005 with North Wing in operation). The value 0.3636 was apportioned among the four accident types based on broader accident statistics, as shown in Table 21 (Table 5-2 of Appendix A of the GWU VTRA Report).

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[26] a violent striking with a fixed object

Table 21. Table 5-2 from DEIS- GWU VTRA Simulation Accident and Oil Outflow Base Case

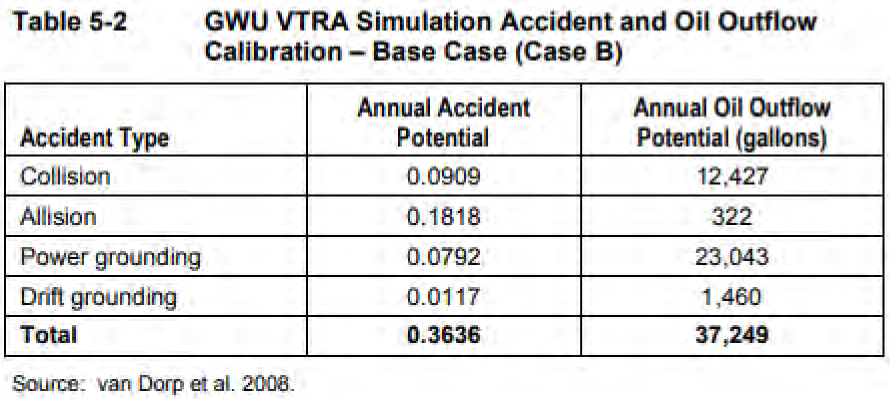


Table 5-2 GWU VTRA Simulation Accident and Oil Outflow Calibration – Base Case (Case B)

Accident Type	Annual Accident Potential	Annual Oil Outflow Potential (gallons)
Collision	0.0909	12,427
Allision	0.1818	322
Power grounding	0.0792	23,043
Drift grounding	0.0117	1,460
Total	**0.3636**	**37,249**

Source: van Dorp et al. 2008.

Because no reported oil outflow had occurred in the four accidents, a theoretical method was used to calculate the expected oil outflow based on the circumstances of likely accident types and the vessel cargo tank configuration of the vessels likely to be involved. The total expected oil outflow for the base year was determined to be 37,249 gallons (see Appendix E of the VTRA Report).

The Glosten Associates Vessel Traffic Analysis (TGA VTA). A second vessel traffic analysis was performed by The Glosten Associates (TGA), a marine sciences and engineering company. The TGA VTA used a statistical model to analyze incremental potential accident and oil outflow at the maximum projected vessel calling volume at the BP Cherry Point dock (TGA 2013). The TGA VTA found an increase in the potential for accidents and oil spills may occur at future traffic levels at the upper limit of vessel traffic projected for operation of the BP Cherry Point dock (up to 420 calls per year) (TGA VTA). More information on this model is presented in Section 2.4.1 Effects of the Action on Species.

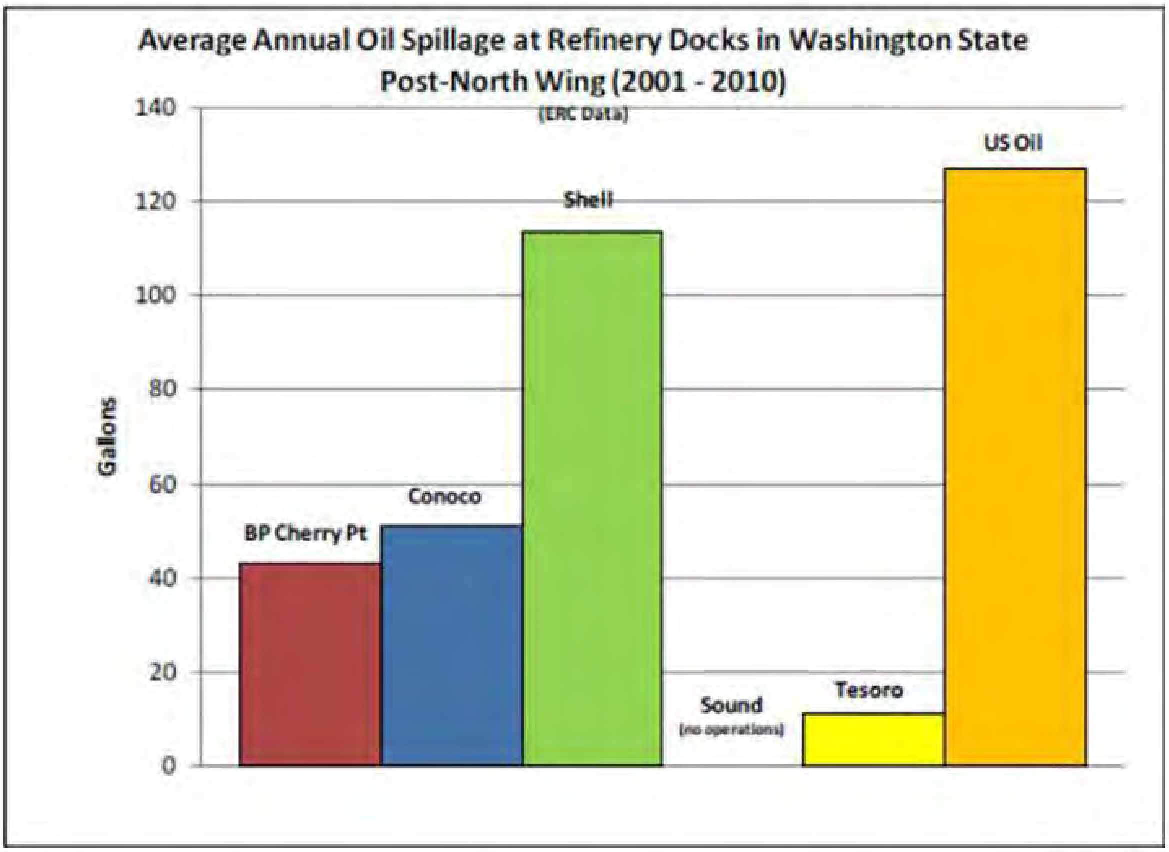
Baseline risk of small spills (transfer errors) at the BP Cherry Point Facility

According to the BE, all areas on the facility that contain piping, control valves, and loading arms are confined within containment curbs that drain to an oily-water collection system. All liquids collected within this system are piped ashore and processed by the refinery. The facility also has a roadway that provides vehicle access to the trestle and facility.

Spill records at the facility for the period from 1990 through 2010 indicate that incidents are infrequent (typically average two per year), and the volume of spills is usually very small. Many of the incidents reported were in quantities of drops or sheen on the water, and with an average spill volume of 9.8 gallons. Since the North Wing became operational in 2001, the average spill volume at the BP Marine Terminal has decreased to 0.65 gallons.

There are six refiners operating in Washington State, including BP Cherry Point. An analysis of refinery spill incident data (ERC 2011) indicates that after the Oil Pollution Act of 1990, BP Cherry Point's dockside spillage amounted to 3 percent of the total Washington refinery dockside spillage. Post-North Wing construction, BP Cherry Point has the second-lowest ranked spillage compared to other operating refineries, behind Tesoro Anacortes, which handles approximately half of the oil that BP Cherry Point handles (Figure 29).

BP Cherry Point's dockside release rate was 30 percent lower than the state average from 1972 to 2010 and 33 percent lower between 2001 and 2010, which coincides with the post-North Wing time period. The addition of the North Wing reduced the number of releases per transfer by 23 percent and volume spilled by 87 percent (ERC 2011). In the period between 2001 when the North Wing went into service and the end of 2014, a yearly average of 101 million gallons of crude oil and refined products were transferred across the BP Cherry Point facility (both North and South Wings). As noted in the release history presented in Figure 29, during that same period, a total volume of approximately 5.25 gallons of crude oil and refined products were spilled to Puget Sound during transfer operations. It should be noted that the total volume spilled over this 13-year period (2001-2014) is seven times less than the annual average reported by WDOE. This is due to how WDOE reports spills. Specifically, any spill under, and up to one gallon is reported as a one-gallon spill. Therefore, the total spill volume reported by WDOE is higher than the quantity actually spilled. Of this total release volume over a 13-year period, nearly 80 percent of that volume was attributable to a single release in 2014 associated with a seal failure on a product loading arm at the South Wing.



Source: ERC 2011

Figure 3.2-2 **Average Annual Dockside Refinery Spillage Post-North Wing.**[12]

Figure 29. Average Annual Transfer Errors/Small Spills at Piers in Washington (Figure 3.2-2 from BE).

Table 22. Table 3.2-2 from BE. Transfer Error/Small Spills History at BP Facility

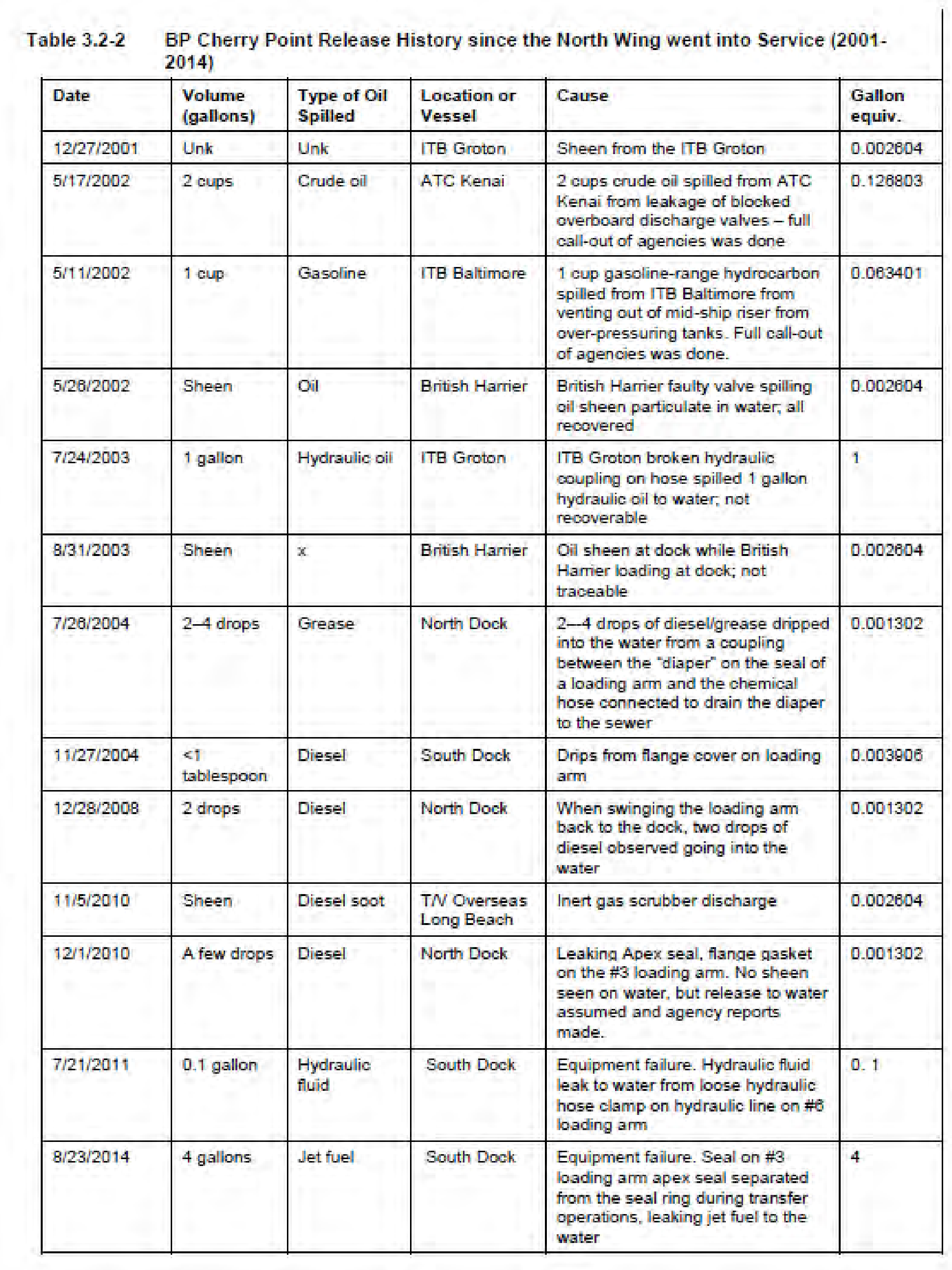


Table 3.2-2 BP Cherry Point Release History since the North Wing went into Service (2001-2014)

Date	Volume (gallons)	Type of Oil Spilled	Location or Vessel	Cause	Gallon equiv.
12/27/2001	Unk	Unk	ITB Groton	Sheen from the ITB Groton	0.002604
5/17/2002	2 cups	Crude oil	ATC Kenai	2 cups crude oil spilled from ATC Kenai from leakage of blocked overboard discharge valves – full call-out of agencies was done	0.126803
5/11/2002	1 cup	Gasoline	ITB Baltimore	1 cup gasoline-range hydrocarbon spilled from ITB Baltimore from venting out of mid-ship riser from over-pressuring tanks. Full call-out of agencies was done.	0.063401
5/26/2002	Sheen	Oil	British Harrier	British Harrier faulty valve spilling oil sheen particulate in water; all recovered	0.002604
7/24/2003	1 gallon	Hydraulic oil	ITB Groton	ITB Groton broken hydraulic coupling on hose spilled 1 gallon hydraulic oil to water; not recoverable	1
8/31/2003	Sheen	x	British Harrier	Oil sheen at dock while British Harrier loading at dock; not traceable	0.002604
7/26/2004	2–4 drops	Grease	North Dock	2—4 drops of diesel/grease dripped into the water from a coupling between the "diaper" on the seal of a loading arm and the chemical hose connected to drain the diaper to the sewer	0.001302
11/27/2004	<1 tablespoon	Diesel	South Dock	Drips from flange cover on loading arm	0.003906
12/28/2008	2 drops	Diesel	North Dock	When swinging the loading arm back to the dock, two drops of diesel observed going into the water	0.001302
11/5/2010	Sheen	Diesel soot	T/V Overseas Long Beach	Inert gas scrubber discharge	0.002604
12/1/2010	A few drops	Diesel	North Dock	Leaking Apex seal, flange gasket on the #3 loading arm. No sheen seen on water, but release to water assumed and agency reports made.	0.001302
7/21/2011	0.1 gallon	Hydraulic fluid	South Dock	Equipment failure. Hydraulic fluid leak to water from loose hydraulic hose clamp on hydraulic line on #6 loading arm	0. 1
8/23/2014	4 gallons	Jet fuel	South Dock	Equipment failure. Seal on #3 loading arm apex seal separated from the seal ring during transfer operations, leaking jet fuel to the water	4

NMFS assumes that these transfer errors will continue as a baseline condition at the South Wing. Transfer errors are also considered in Section 2.4 as effects of the action.

2.3.4 Baseline Facility Wastewater Discharge

Surface water runoff from the BP refinery (piers and upland facility), including rainwater and all areas on the North and South piers that contain piping, control valves, and transfer arms are within containment curbs that drain to an oily water collection system. The system pumps the wastewater from the piers through the refinery's wastewater treatment system. The refinery's wastewater treatment facility processes wastewater from the entire refinery (740 acres). The discharge of treated wastewater into the Strait of Georgia is regulated through BP's National Pollution Discharge Elimination System (NPDES) permit (NPDES Permit No. WA0022900). The discharge point for the subbasin that includes the piers is a diffuser located below the South Pier. The permit and compliance history of the NPDES permit information is available on the WDOE PARIS website. The refinery and associated piers generate many different industrial pollutants. These contaminants have the potential to affect animals by acute lethal or sublethal direct exposure or through indirect food web bioaccumulation.

As part of the NPDES, the sediment near the outfall under the South Pier was tested for a variety of contaminants (ERM 2017). The discharge point is 60 feet below the water surface at the South Pier. Per the NPDES permit, the regulated mixing zone is a circle with a radius of 257 feet measured from the diffuser ports and extends from the seabed to the top of the water surface. The concentration of pollutants at the edge of the mixing zone must meet the NPDES aquatic and human health criteria.

The 2017 ERM report summarized the history of the sediment sampling. The Refinery has conducted numerous seafloor surface sediment investigations, effluent discharge investigations, biological condition surveys, and water quality studies over the past 40 years. BP initiated a pile wrapping and fendering program in 1991 that prevents the flaking of coal tar epoxy from pier piles which is a potential source of PAHs to the adjacent water column and sediments. As of 2009, all of the pier piles coated with coal-tar epoxy have been wrapped and fendered to prevent release of this material. Sea floor sediment studies were conducted in 1974, 1982, 1987, 1988, 1989, 1991, 2000, and 2006. The results of the chemical analyses are summarized below as reported by ERM (2017):

In all studies prior to 1988, chemical concentrations, if detected, were below Sediment Quality Standard (SQS) criteria.

- In the 1988 study, measured constituents were below SQS criteria with the exception of four analytes (mercury and three high molecular weight PAHs).

- The 1991 study showed no SQS exceedances, with the exception of elevated PAHs that were correlated to a flaking of coal-tar epoxy from the pier pilings.

- Four stations exceeded Sediment Management Standard (SMS) criteria for organic compounds in the 2000 study and similar results were measured in two stations during a 2001 supplemental study requested by Ecology.

- In 2006, four under-pier stations exceeded SMS criteria for dibenzofuran and PAHs, but were significantly lower than the 2000 and 2001 results. A fingerprinting program conducted with this study indicated the PAH source was the piling coal-tar epoxy found on the adjacent pilings."

The findings of the 2017 ERM study are further summarized as follows:

> “The 2016 Sediment Recharacterization Study shows that the BP Cherry Point Refinery is in compliance with special condition S10 of their NPDES permit. The Refinery’s wastewater outfall is not impacting the sediment surrounding the outfall and actions taken by BP to reduce coal-tar epoxy releases from pilings are effective. Of the seven stations sampled, two failed the polychaete bioassay (SS-02 and SS-11) under standard conditions. When subjected to a modified bioassay test condition to reduce concentrations of sulfide and ammonia, these two samples passed. This result is consistent with findings of the 2006 study, which observed that certain bioassay test results were influenced by decomposition of organic matter in sediment samples and not from anthropogenic chemicals found in sediment. Chemical concentrations were below SMS criteria in the station SS-02 sediment sample. At station SS-11, five chemicals exceeded the SQS criteria: dibenzofuran, acenaphthene, fluorene, phenanthrene, fluoranthene. None exceeded the SIZmax criteria. The measured concentrations of these compounds were lower than were measured in colocated and nearby samples analyzed in 2006. The decreases are likely a result of measures taken by BP to eliminate the source of chemicals (i.e., pile wrapping) (ERM 2017).”

In April 2020, BP entered into an agreement with WDOE to conduct a receiving waters metals study. The results of the study will not be available for some years. The purpose of the study is to determine the concentration of metals in receiving waters outside of the zone of influence (beyond the regulated mixing zone) (Floyd Snider 2021). The study will look at a variety of heavy metals such as arsenic, cadmium, chromium, copper, mercury, and zinc. This future study indicates that there is still concern over the discharge of these metals.

It is not known to what extent listed species may be affected by the existing discharge of treated wastewater. We do know that residual contaminants remain in the treated wastewater and, despite meeting water quality permit concentrations at the edge of the mixing zone, some of the contaminants may persist in the environment for long periods of time and bioaccumulate (e.g mercury). It is likely that there are on-going adverse effects to some of the species and/or critical habitat elements considered in this consultation as described below.

In 2006, NMFS conducted a status review of Cherry Point Pacific Herring (NMFS 2006 c/NOAA Technical Memorandum NMFS-NWFSC-76, 2006). The study included the following summary of PAH studies that were conducted in the Cherry Point area. West and co-authors (West et al. 2004) examined total PAHs in spawned Pacific herring eggs from Cherry Point, Fidalgo Bay, Quilcene Bay, Port Orchard, and Quartermaster Harbor. PAH levels exceeded the larval effects threshold of 22 ppb in spawned Pacific herring eggs, as determined by Carls et al. (1999), at other spawning locations in Puget Sound (e.g., Port Orchard), but not at Cherry Point (West et al. 2004). Because PAHs do not accumulate in fish, exposure of adult Pacific herring to PAH in Puget Sound was estimated by West et al. (2001), and O’Neill and West (2002) as fluorescing aromatic compounds (FACs), a measure of PAH-metabolites, in Pacific herring bile. Analysis of Pacific herring from six locations—Cherry Point, Semiahmoo Bay, Fidalgo Bay, Port Orchard, Quartermaster Harbor, and Squaxin Pass (West et al. 2001, O’Neill and West 2002)—indicated that “Pacific herring from Central and Southern Puget Sound had higher FACs than those from the Northern Sound and Southern Georgia Basin” (West et al. 2001, p. 45).

Examination of total PAHs in Dungeness crab hepatopancreas samples from four Puget Sound locations and in English sole (*Pleuronectes vetulus*) (as biliary FACs) from 24 Puget Sound locations (both studies included Cherry Point) showed similar trends, with lower PAH or biliary FAC concentrations in the northern areas such as Cherry Point and higher concentrations in the more urbanized South Sound.

Marine mussels (*Mytilus spp*.) have little ability to metabolize hydrocarbons (see references in Carls et al. 2002), and because they are filter feeders their body burden of total PAH contamination serves as an indication of the extent of biologically available oil contamination. Applied Biomonitoring (1999), Applied Biomonitoring and Boettner (2002), and Salazar and Salazar (2002, 2004) reported on studies that used bioaccumulation of PAHs over a 60-day exposure period in tissues of caged mussels as a proxy for the potential total PAH available to Pacific herring embryos and larvae along the Cherry Point Reach in 1998–2000, and at three other sites in Puget Sound in 2000. Between 1998 and 2000, the concentration of PAH in mussels indicated levels that “approached those associated with adverse effects on herring embryo-larval development” (Salazar and Salazar 2004, p. 1). However, exposure of early Pacific herring life stages and adult mussels likely differ in duration, magnitude, and timing, as well as in exposure pathways (Salazar and Salazar 2004). Applied Biomonitoring and Boettner (2002, p. 4) reported that “PAH concentrations measured in mussel tissues were lowest at Cherry Point Reach” and were progressively greater at Fidalgo Bay, Port Gamble, and Brownsville (Port Orchard-Port Madison stock) (Salazar and Salazar 2002). Given these studies, it appears that PAH concentrations at Cherry Point are low, but still potentially concerning for Pacific herring because they spawn near the BP facility.

The likely effects that the treated wastewater discharge is having on the various species and critical habitat in the action area is discussed under each respective species heading below.

2.3.5 Ballast Water

When taking on ballast, organisms present in the surrounding water that are small enough to fit though the ballast intake screen can be taken onboard. During discharge, organisms in the ballast water may be released; the ballast water may contain non-native, nuisance, and exotic species that could cause damage to the marine environment. Non-native species most often have indirect impacts to listed species through habitat alteration, which can result in changes in prey availability, changes in accessible habitat or cover, changes in predation risk due to effects on water clarity, and changes in water quality. Non-native species can also affect listed species or their critical habitat directly through competition, predation, or disease.

To prevent the release of invasive species, all ships calling at the BP Cherry Point facility are required to adhere to strict federal and state regulations regarding the discharge of ballast water within Washington state waters. The BP terminal has the capacity to receive ballast water from product tankers; however, no ballast water has been received at the BP terminal since early 2001. If a vessel does wish to discharge ballast water at the terminal, the ballast water must undergo laboratory analysis prior to discharge. The laboratory test results must be received by BP prior to acceptance of ballast water. This requirement often makes it impractical for vessels to unload ballast water during the short period they are at dock. The BP Marine Terminal does not handle bilge water and oily slops. State and federal regulations prohibit the discharge of these materials without treatment.

Ballast Water Laws and Regulations

Since the mid-1980s, new and existing oil tankers of at least 20,000 dwt and above have been required to be equipped with ballast tanks that are completely segregated from cargo and fuel tanks, a crude oil washing system, and cargo tank protection systems (46 USC 3705).

Under the National Invasive Species Act of 1996 (NISA), an amendment to the Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA), the USCG enforces nationwide ballast water regulations. Vessels calling at ports within the United States from outside the U.S. Exclusive Economic Zone (EEZ), or 200 nautical miles offshore, are required to report ballast water management practices to the National Ballast Information Clearinghouse (NBIC) and to implement on-board plans for managing ballast water. Before entering the EEZ, vessel operators are required to conduct a mid-ocean ballast water exchange. Ballast water also can be discharged to an approved reception facility. In addition, the alternative use of an on-board water treatment system is required by regulation and will be phased in and eventually required on all vessels that seek to discharge ballast water. USCG regulations 33 CFR Part 151 and 46 CFR Part 162 were instituted in June 2012, in an effort to phase out ballast water exchange practices. Vessels calling at U.S. ports must be equipped with an approved on-board ballast water treatment system. This applies to all new ships constructed in or after December 2013. All existing vessels with a ballast water capacity between 1,500 and 5,000 cubic meters (m3) must be in compliance by their first scheduled dry-docking after January 1, 2014. These regulations apply to all vessels calling at the BP Cherry Point facility for unloading crude oil or loading refined petroleum products.

Vessels calling at the BP Cherry Point dock also must comply with state regulations enacted in 2002 under House Bill 2466, the Ballast Water Management Act (Chapter 77.120 Revised Code of Washington [RCW]) that is administered by the Washington Department of Fish and Wildlife (WDFW). This state law regulates the ballast water discharge practices of ships originating from California, southern Oregon, northern British Columbia, and Alaska that are exempt from federal regulations. All vessels calling from these regions are required to exchange ballast water at least 50 nautical miles offshore or to use treatment systems approved by the State before they discharge ballast into state waters. Under this state regulation, all vessel operators must report ballast management practices to the WDFW and the NBIC. In addition, as of July 1, 2007, non-exchanged or untreated ballast water cannot be discharged into Washington State waters; vessels unable to properly manage ballast water are required to retain it onboard.

In 2012, NMFS developed a biological opinion addressing the United States Coast Guard’s national ballast water management program and initial numerical standard. NMFS found that the discharge of ballast water using the initial numerical standard is not likely to jeopardize the continued existence of endangered or threatened species in Puget Sound (and elsewhere) (NMFS 2012c). Vessels employing a Coast Guard approved ballast water management system must meet the following (USCG 2012):

- Organisms greater than or equal to 50 micrometers in minimum dimension, discharge must include fewer than 10 organisms per cubic meter of ballast water,
- Organisms less than 50 micrometers and greater than or equal to 10 micrometers, discharge must include fewer than 10 organisms per milliliter of ballast water,
- Toxicogenic Vibrio cholerae must be at a concentration of less than 1 colony forming unit (cfu) per 100 milliliter,
- Escherichia coli concentration must be fewer than 250 cfu per 100 milliliter, and
- Intestinal enterococci must have a concentration of fewer than 100 cfu per 100 milliliter.

The exchange of ballast water offshore replaces lower salinity ballast water with higher salinity water. The deeper ocean waters tend to contain relatively fewer organisms and any organisms entrained during the deep-water exchange are not likely to survive in fresh or brackish water environments. Vessels that discharge effectively exchanged or partially exchanged ballast water still can pose a moderate risk (PSAT 2007).

Even though vessels transiting to and from the BP facility are expected to comply with the Coast Guard standards, there remains a potential for accidental introduction of species into the Puget Sound if ballast water is discharged that contains organisms capable of colonizing Puget Sound. The impacts of introductions on species will be dependent upon the species that is introduced, its success in reproduction in the river, and the impacts it ultimately has on the natural ecosystem in the river.

The 2012 biological opinion covered Washington, Oregon, Idaho, and parts of Nevada, Montana, Wyoming, and British Columbia (region). The opinion assumed future introductions based on their historic rate of introductions in San Francisco Bay. The opinion cautioned that because San Francisco Bay is the most invaded body of water in the US and possibly the world, that invasion rate can be used as a conservative estimate for all ports in the U.S. (NMFS 2012c). NMFS concluded that the modeled level of impact from all vessel traffic in the multi-state region was not likely to result in jeopardy to listed species or adverse modification of critical habitat. Because the possibility of invasive species introduction is expected to be small for the entire region and the action area is only a portion of the region that was analyzed in the previous opinion, we conclude that the baseline possibility of invasive species introduction from BP traffic to be extremely low at its baseline ship total calculated ship calls of 385 ships per year.

2.3.6 Baseline Vessel Collision/Ship Strike Risk – Large Whales

For the large whale species, data from the Stock Assessments regarding rangewide vessel collisions of large whales is presented in Section 2.2.3 Rangewide Status of the Species. This section presents additional information more specific to the action area. Ship strike information is also presented individually under the individual species sections (Sections 2.2.3). Mortality from collisions with vessels is one of the main human causes of death for large whales. Rockwood et al. (2017) acknowledges that vessel collisions are rarely witnessed and the distribution of strike risk and estimates of mortality are uncertain. Rockwood et al. (2017) estimated ship strike mortality for blue, humpback, and fin whales in U.S. West Coast waters using a statistical model. Mortality estimates from the model were far higher than current minimum estimates derived from stranding records and are closer to extrapolations adjusted for detection probabilities of dead whales. The most conservative model assumptions estimated mortality to be 7.8 times, 2.0 times and 2.7 times the U.S. recommended limit (at the time of publication of the paper), for blue, humpback, and fin whales respectively, suggesting that death from vessel collisions may be a significant impediment to population growth and recovery. Comparing across the study area (U.S. waters offshore from California, Oregon and Washington), the majority of strike mortality occurs in waters off California (outside of the action area), from Bodega Bay south and tends to be concentrated in a band approximately 24 Nm (44.5 km) offshore and in designated shipping lanes leading to and from major ports. This area is outside of and to the south of the action area for the proposed action. Although a similar study by Nichol et al. (2017) found that, based on vessel traffic and whale densities, humpback whales were most likely be struck at the continental shelf edge and at the mouth and within the Strait of Juan de Fuca for humpback whale strikes that occur within the action area. They also found that the offshore approaches and inside the western portion of the strait pose the most risk for fin whale vessel strikes for the strikes that occur within the action area.

Figure 30 is taken from Rockwood et al. (2017). The figure shows actual stranding data compared to modeling results for relative risk by species along the U.S. West Coast. Case A in the figure shows actual blue whale stranding have occurred outside of and to the south of the action area along the California Coast. The model results for blue whale show slightly elevated risk within the action area in a fan extending out from the mouth of the Strait of Juan de Fuca. Case B shows the greatest risk to humpback whales (for the combined stock of the Central America DPS, Mexico DPS, and non-listed Hawaii DPS) along the California coast and also within the action area in a fan shape at the mouth of the Strait of Juan de Fuca. Case C shows the greatest risk for fin whales is also along the California coast. Within the action area, the mouth of the Strait of Juan de Fuca shows very low risk for fin whales. The strandings of fin whales within the Salish Sea were from fin whales that were carried into the action area on the bows of ships. These whales were likely hit on the outer coast and then carried into the Salish Sea. More specific information by species in the action area is presented below under Baseline Conditions for each species.

The ongoing threat of vessel collisions to large whales is expected to continue as a baseline condition, and likely increase over time as all shipping traffic increases over time with human population growth (baseline and cumulative). In addition, for whale populations that are increasing, there may be a correlated increase in the number of whales struck by ships simply because there would be more whales in the paths of ships. Additional species-specific information is presented below for each species.

Baseline vessel strike risk to SRKW is presented below in Section 2.3.7 and for leatherback turtles under Section 2.3.14, below.

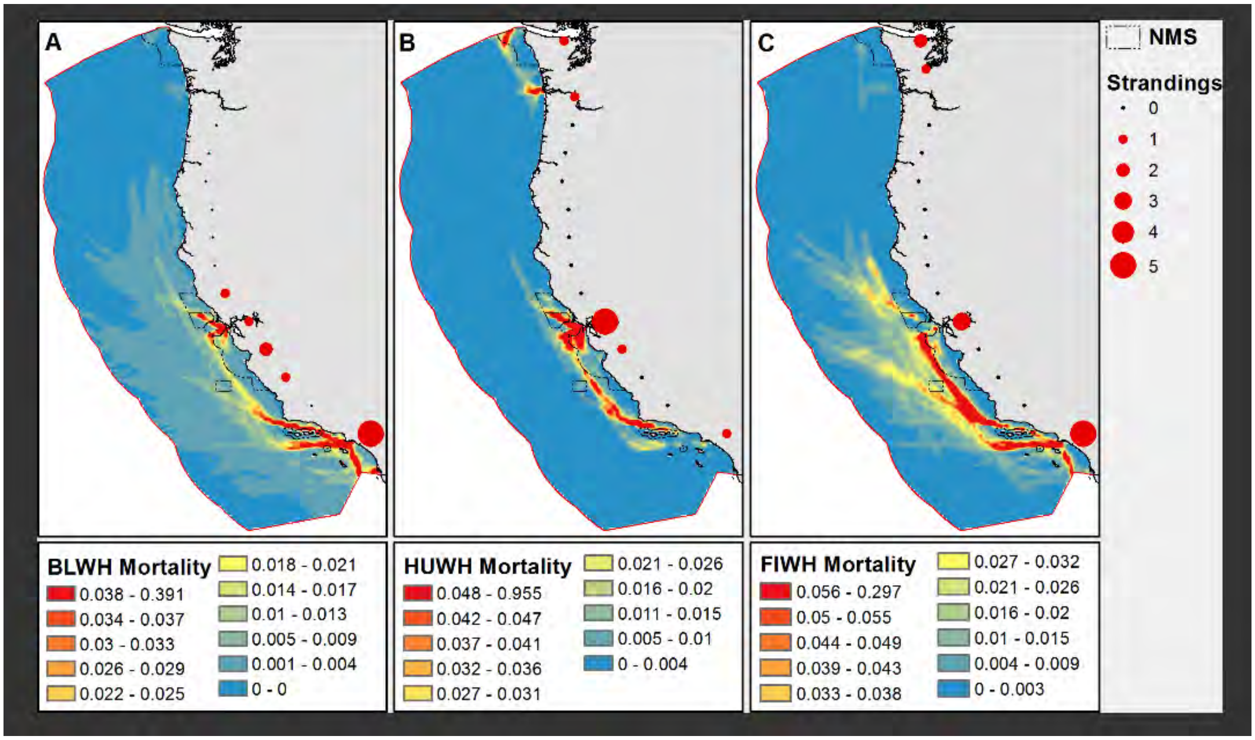


Figure 30. This figure is copied from Rockwood et al. (2017). The figure shows actual strandings along the U.S. West Coast and relative risk from the modeling results. Puget Sound/Salish Sea is located at the top of the image. The results are smoothed distribution of blue (BLWH) (A), humpback (HUWH) (B), and fin whale (FIWH) (C) mortality estimated using Model 2. Warmer colors represent higher mortality and values are predicted mortalities per ~144 km2 grid cell for the 6-month study period. Red circles represent attitudinally binned ship strike stranding records from 2006–2016. Dashed lines are National Marine Sanctuary boundaries.

2.3.7 Baseline Vessel Noise in the Action Area

Vessel noise is a significant concern for SRKW and increasing levels of anthropogenic sound in the world's oceans (Andrew *et al.* 2002), such as those produced by shipping traffic, are also a habitat concern for large whales, particularly for baleen whales (fin, humpback, blue, etc.) that communicate using low frequency sound (Andrew *et al*. 2002). Sounds are described in terms of pressure in decibels (dB) with underwater sounds referenced to dB in relation to micropascals (re 1 uPa at 1 meter) and in Hertz (Hz) for frequency of sound.

The following baseline acoustic information is taken directly from the BE:

> "Existing underwater sound levels in the Action Area can serve as a baseline from which to measure potential impacts associated with the proposed action on ESA listed species. Ambient noise conditions in the marine environment are dependent on source, propagation, and absorption conditions. Commercial shipping traffic, ferry vessel traffic, wind, rain, and biological organisms are the main contributors to ambient noise levels in Puget Sound. Oceanic traffic influences sound spectral levels from 10 Hz to beyond 10 kHz (Bassett 2010) with the dominant components occurring at low frequencies (5 to 500 Hz; Hildebrand 2004). Ships generate noise primarily by (a) propeller action, (b)

propulsion machinery, and (c) hydraulic flow over the hull. The broadband and tonal components produced by cavitation account for 80-85 percent of ship-radiated noise power (Ross 1987 as cited in Hildebrand 2005). Additional vessel noise results from propulsion machinery such as diesel engines and gears, and major auxiliaries such as diesel generators. Likewise, Bassett (2010) states that the source level of sound from commercial ships varies based on ship speed, condition of the vessel, vessel load, and on board activities. While true, the received sound levels recorded in various studies on the effects of sound on marine mammals in Puget Sound (Bassett 2010, Bassett et al., 2012, and Veirs and Veirs 2005) record the integrated output from all these sources. Given these available studies do not analyze the component contributions to vessel sounds and the overwhelming component is cavitation, the component contributions to underwater sound levels are not consider[ed] further in this analysis.

"The most common source of anthropogenic noise in Admiralty Inlet is vessel traffic (Bassett et al. 2012). Background sound data has not been collected specific to the proposed action. However, Bassett et al. (2010) analyzed ambient noise sources at a location in eastern Admiralty Inlet, just west of Admiralty Head at Fort Casey State Park and identified permanent noise (noise present when all identifiable sources have been removed, lowest level of background recurring noise) at the site as 98 dB re 1 μPa. Further, from May 2010 to May 2011, Bassett et al. (2012) conducted an assessment of ambient noise at a location in northern Admiralty Inlet and prepared a sound budget in which sound energy levels are attributed to various source levels. The Action Area for the 2012 study included the contiguous waters within a 20 km (12.4 mile) radius of a point 700m (0.43 mile) to the southwest of Admiralty Head. As in Bassett (2010) the major contributor to sound was vessel traffic, but unlike Bassett (2010), Bassett et al. (2012) included vessel traffic in their definition of ambient sound levels. The sound recordings were paired with information from the U.S. Coast Guard Nationwide Automatic Identification System (AIS), which allowed for the association of a specific vessel with its recorded signal. Over the course of their study, Bassett et al. (2012) collected data on 1,363 unique AIS transmitting vessels. The AIS data allowed them to calculate source sound level for each of the vessels observed…."

"Bassett et al. (2012) found, based on overall presence, container ships, passenger ferries and tugs, were the most common vessel types in their study area. As expected, the larger faster ships were the loudest. They estimated the source levels (re 1 μPa at 1 meter) for each of the vessel types as 186 dB_{rms} for containerships, 185 dB_{rms} for bulk carriers, 180 dBrms for vehicle carriers, 180 dBrms for general cargo ships, **181 dB_{rms} for oil and chemical tankers** [emphasis added], 173 dB_{rms} for ferries, and 172 dB_{rms} for tugs. Larger fishing vessels (trawlers) and fishing vessels with diesel engines were estimated to generate a source level of 165 dB_{rms} re 1 μPa at 1 meter. Basset et al. (2012) also estimated that total sound energy input in their study area by vessel traffic was over the course of the year of their study was 438 megajoules and of that container ships were responsible for 57 percent of the input, followed by bulk carriers at 16 percent. **Oil/chemical tankers were responsible for 2 percent of the energy input** [emphasis added].

> “As in 2010, Bassett et al. (2012) found large commercial vessels, including vehicle carriers and bulk carriers, were also common. An AIS-transmitting vessel was found to be present within the study area 90 percent of the time, and multiple vessels were present 68 percent of the time. The mean broadband sound pressure level (SPL10) at the recording site was 119.2 ± 0.2 dB re 1 µPa (95 percent confidence interval), and the maximum was 140 dBrms re 1 µPa associate with the passage of container ships transiting at a speed of 23.4 knots at a distance of 2.7 km at its closest approach to the recorder. These measured noise levels are comparable to values from Haro Strait off of the west coast of San Juan Island, reported by Veirs and Veirs (2006), indicating they are likely representative of baseline conditions within the Action Area. Veirs and Veirs (2006) also found that recreational vessels can increase background noise on average 5-10 dB higher than the average large commercial ships.”

The sound pressure emitted from ships decreases with distance from a ship, although within Puget Sound, broadband sound pressure levels exceed 120 dB, with 120dB being the current acoustic criterion for behavioral harassment of marine mammals for continuous sound types (120 dB re 1 lPa) in the United States (NMFS 2018f). However, the current acoustic criteria are based on broadband measurement and do not take into account frequency-specific hearing capabilities that differ among marine mammal groups. Bassett et al. (2012) points out a general need for frameworks that are able to treat anthropogenic noise in a more biologically relevant manner:

> “At close range (e.g., within 10 km of the source), different types of vessel activity increase noise levels across a broader range of frequencies than is often considered. Below 1 kHz, ship traffic regularly increases noise levels by 25 dB above background levels. At higher frequencies, extending up to 30 kHz, one-third octave band SPLs [sound pressure levels] regularly increase by 10–20 dB . . . . These increases in ambient noise from shipping traffic are sufficient to regularly mask communicative sounds used by many marine mammals unless they are able to compensate vocally [Holt et al., 2009 as reference in Bassett et al., 2012]. Because the Main Basin of Puget Sound is also relatively narrow (approximately 10–20 km wide), large commercial vessels transiting the area are expected to elevate broadband ambient noise levels over the entire width of the channel to levels in excess of 120 dB” (Basset et al. 2012).

For all of Puget Sound, the Biological Evaluation notes that the GWU VTRA notes that tank ship traffic calling at the BP Marine Terminal accounts for 1.1 percent of all traffic in Puget Sound (normalized for time spent in transit) and 2.6 percent of all traffic in Puget Sound when adding barges calling at Cherry Point. Since the majority of the general barge traffic is on routes to the southern reaches of Puget Sound, it can be inferred that approximately 1.1 percent of the ocean-going traffic entering Puget Sound and transiting the Strait of Juan de Fuca is traffic destined for the BP Marine Terminal. In terms of frequency, large commercial vessels and supertankers have powerful engines and large, slow-turning propellers. These ships produce high sound levels, mainly at low frequencies. At these frequencies, the noise is dominated by propeller cavitation noise combined with dominant tones arising from the propeller blade rate. A large bulk cargo ship called the Overseas Harriette has been used previously as a model. This ship had a dominant frequency of 50 Hz.

Although large vessels primarily emit low frequency noise, researchers are expanding their scope to assess the effects of noise from large ships that transit through the Salish Sea, but that do not engage in whale watching. Viers et al., 2015, found that noise from large ships extends into frequencies used by SRKW for echolocation. This means vessels not targeting the whales can still cause disturbance and impair the whales' ability to find food and interact with each other. The researchers measured underwater sound pressure levels for 1,582 unique ships that transited the summer core critical habitat of the Southern Resident killer whales during 28 months between March, 2011, and October, 2013. Median received spectrum levels of noise from 2,809 isolated transits were found to be elevated relative to median background levels not only at low frequencies (20–30 dB re 1 µPa^2/Hz from 100 to 1,000 Hz), but also at high frequencies (5–13 dB from 10,000 to 96,000 Hz). Thus, noise received from ships at ranges less than 3 km extended to frequencies used by odontocetes (toothed whales, including Southern Resident killer whales and sperm whales). The researchers found that most ship classes show a linear relationship between source level and vessel speed with a slope near +2 dB per m/s (+1 dB/knot). Mean ship speeds during measurements were 7.3 ± 2.0 m/s (14.1 ± 3.9 knots).

Because of the growing evidence that large ships generate sound that could impact Southern Resident killer whales, the Vancouver [British Columbia] Fraser Port Authority began a voluntary slowdown trial in 2017 and, based on those findings, again requested that large ships voluntarily slowdown in 2018 (Vancouver Fraser Port Authority 2018). The Port's ECHO program led a research trial in the summer of 2017 to evaluate how slowing vessels down might decrease underwater noise, and how this could potentially affect the behavior and foraging of the whales. In the trial design, consideration was given to navigational safety and potential biological, cultural, and economic implications. The trial was conducted between August 7 and October 6, 2017, over an approximately 16 nautical mile distance through Haro Strait (a key foraging habitat for the Southern Residents) where large commercial and government vessels, including Washington State ferries, were asked to slow to 11 knots. During the two months of the trial, 951 piloted commercial vessel transits through Haro Strait were reported, with 577 transits (61 percent) identified as having participated in the trial. This translated to 44 percent of vessel transits achieving a speed of less than 12 knots, and 55 percent achieving a speed of less than 13 knots.

Vessel participation was monitored using Automated Identification System (AIS) receivers to identify vessel names, speed and location. During the trial and during representative baseline periods, data from underwater listening stations in Haro Strait and the Strait of Georgia, and a hydrophone located in the waters just off Lime Kiln State Park on San Juan Island, Washington were analyzed to understand how the slowdown trial affected underwater noise. Analysis of vessel source levels indicated that slowing vessels down significantly reduced underwater noise emissions, when compared to normal speeds. Mean speed reductions varied by vessel type from 2.1 knots for bulk/general cargo ships, to as high as a 7.7 knot reduction in speed for container ships. These slower speeds resulted in reduced mean broadband (across all sound frequencies measured) vessel source levels of between 5.9 decibels (dB) for bulk/general cargo ships, and 11.5 dB for container ships. In general, slowing vessels reduced vessel noise emissions over the entire noise frequency range measured. Assessment of total ambient noise received at the Lime Kiln hydrophone (located in an important Southern Resident foraging area) indicated that when compared to the baseline period, noise levels during the trial were reduced by a median value of

1.2 dB. This is approximately equivalent to a 24 percent reduction in sound intensity. Small and recreational boat traffic was not targeted in this study, but was noted to significantly affect noise levels measured at Lime Kiln. To better assess the changes in noise resulting from slower large commercial vessels, ambient noise data were filtered to include only times when large vessels were within 6 kilometers of the hydrophone, to remove times of small boat presence, and remove times of high wind and current which can also affect received ambient noise levels. These filtered data showed a median reduction in broadband ambient noise levels of 2.5 dB, which is approximately equivalent to a 44 percent reduction in sound intensity.

Data from the trial was used to conduct computer modelling of vessel generated underwater noise for the Haro Strait region. At a receiver location near Lime Kiln, the noise model indicated that the speeds and participation rates achieved during the trial likely resulted in noise reductions of between 0.6 dB on an average traffic day (14 piloted vessel transits) and 1.5 dB on a high traffic day (21 piloted vessel transits). This correlates well to the actual median noise reduction value of 1.2 dB measured at Lime Kiln during the trial period.

Vessel sounds in coastal waters are most likely from large ships, tankers and tugs. 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).

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).

A Southern Resident killer whale behavioral response model used the data from the regional noise model to evaluate potential reductions in disturbance to killer whale foraging from reduced noise. The model indicated that the speeds and participation rates achieved during the trial could result in an 11.5 percent reduction in affected foraging time for an average traffic day, and 10.3 percent reduction for a high traffic day, when compared to baseline conditions (Lacy 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 whale watching vessels 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 percent 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).

The hearing range of humpback whales and other low-frequency mysticetes is believed to extend between 7 and 25,000 Hz. Their peak sensitivity is between about 500 and 10,000 Hz, with acoustic sensitivity falling off sharply below and above that range (Southall et. al 2007 and NOAA 2015). As referenced in Bassett el al., below 1 kHz, ship traffic regularly increases noise levels by 25 dB above background levels. At higher frequencies, extending up to 30 kHz, one-third octave band SPLs [sound pressure levels] regularly increase by 10–20 dB. These increases in ambient noise from shipping traffic are sufficient to regularly mask communicative sounds used by many marine mammals unless they are able to compensate vocally (Holt et al., 2009 as reference in Bassett et al., 2012). Recent studies have shown that humpback whales continue to produce songs during their migrations and occasionally within their feeding grounds (Vu et al. 2012). A study in the waters around Ogasawara Island found that humpback whales temporarily stopped singing instead of modifying the frequency of their songs in the presence of large, noisy vessels (Tsujii et al. 2018).

Because the Main Basin of Puget Sound is relatively narrow (approximately 10–20 km wide), large commercial vessels transiting the area are expected to elevate broadband ambient noise levels over the entire width of the channel to levels in excess of 120 dB. Ships on the outer coast will produce more noise related to greater speed, with noise dissipating with distance from ships, but not for 10s of kilometers from the source.

The existing tanker-related noise in the Salish Sea, including existing BP-bound ships, likely cause some type of behavioral disturbance or harassment, including displacement, site abandonment (Gard 1974; Reeves 1977; Bryant et al.1984), and masking (Richardson et al. 1995) when whales and ships closely co-occur. These disturbances likely cause short-term displacement and avoidance, alteration of diving or breathing patterns, and less responsiveness when feeding. The existing vessel noise may also cause acoustically induced stress (Miksis et al. 2001 in NRC 2003) which can cause changes in heart rate, blood pressure, and gastrointestinal activity. Stress can also involve activation of the pituitary-adrenal axis, which stimulates the release of more adrenal corticoid hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg 1987, Rivest and Rivier 1995) and altered metabolism (Elasser et al. 2000), immune competence (Blecha 2000) and behavior.

Recent research on humpback whales in a high vessel traffic area near Juneau, Alaska, did not show elevated stress hormones (Teerlink et al., 2018). This suggests that humpback whales in that area may have habituated to the high numbers of whale watching vessels and the associated vessel noise. This evidence indicates that animals do respond and modify behavioral patterns in the presence of noise, although adequate data do not exist yet to quantitatively assess or predict the significance of minor alterations in behavior and shifts in energy budgets or accumulation of stress responses to the health and viability of marine mammal populations. Tanker related noise likely does not cause direct physical injury (i.e. eardrum damage). Many whale species have been observed exhibiting social behavior with small boats and larger vessels such as ferries and tug boats, which indicates that whales can become accustomed to engine noise in certain circumstances (Teerlink et al., 2018).

Other Sources of Noise in the Action Area

In-water construction activities are permitted by the Army Corps of Engineers (USACE) 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.

2.3.8 Baseline Condition - Southern Resident Killer Whale, Designated and Proposed Critical Habitat

Critical habitat for the Southern Resident killer whale DPS was designated on November 29, 2006 (71 FR 69054) (Figure 31) (NMFS 2006b). 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. Proposed critical habitat occurs along the Washington coast and contains all three of the essential features with prey resources (PBF #2) being the primary concern (Figure 31, 84 FR 49214).

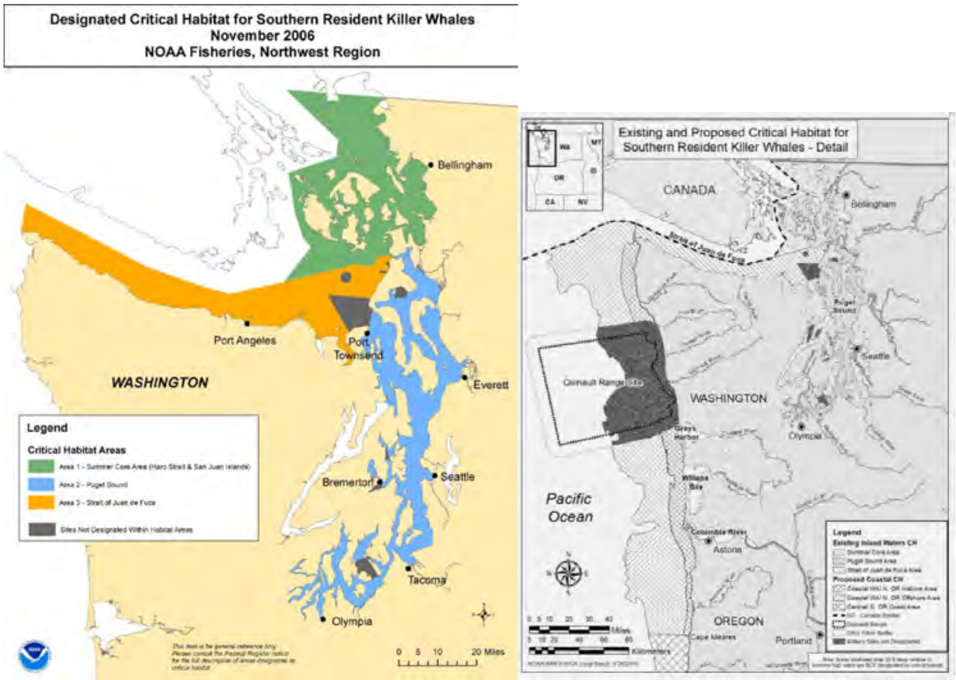


Figure 31. SRKW Designated and Proposed Critical Habitat.

The action area covers much of the range of the Southern Resident killer whales. Ships transiting to and from the Cherry Point facility pass through the critical habitat Area 1- Summer Core Area and Area 3- Strait of Juan de Fuca (Figure 31). The Summer Core Area is bordered to the North and West by the US/Canadian border, and includes waters surrounding the San Juan Islands, the U.S. portion of the Southern Strait of Georgia, and areas directly offshore of Skagit and Whatcom counties. The Strait of Juan de Fuca Area is bordered on the southeast by the entrance to Admiralty Inlet, Deception Pass Bridge, San Juan, and Skagit Counties to the northeast, the U.S. Canadian border to the north, and Bonilla Point/Tatoosh line to the west. Each of the three pods that comprise the Southern Resident population regularly use the Strait of Juan de Fuca as a passage from the Summer Core Area and Puget Sound to access oceanic waters, however, the whales are not known to spend long periods of time in localized areas in the Strait and sightings of Southern Residents in the Strait are limited (NMFS 2006b). Vessels calling at the BP Marine Terminal regularly pass through the outer coast, the Strait of Juan de Fuca Area, and the Summer Core area in the San Juan Islands region. Ships transiting to Cherry Point may also call at other facilities within Puget Sound Area 2 of the critical habitat designation at Ports in Seattle and Tacoma. Figure 32 shows the frequency of Southern Resident sightings in the Salish Sea. The total number of sightings from 1976-2014 indicates the relative frequency of the whales' presence in different locations within the inland waters.

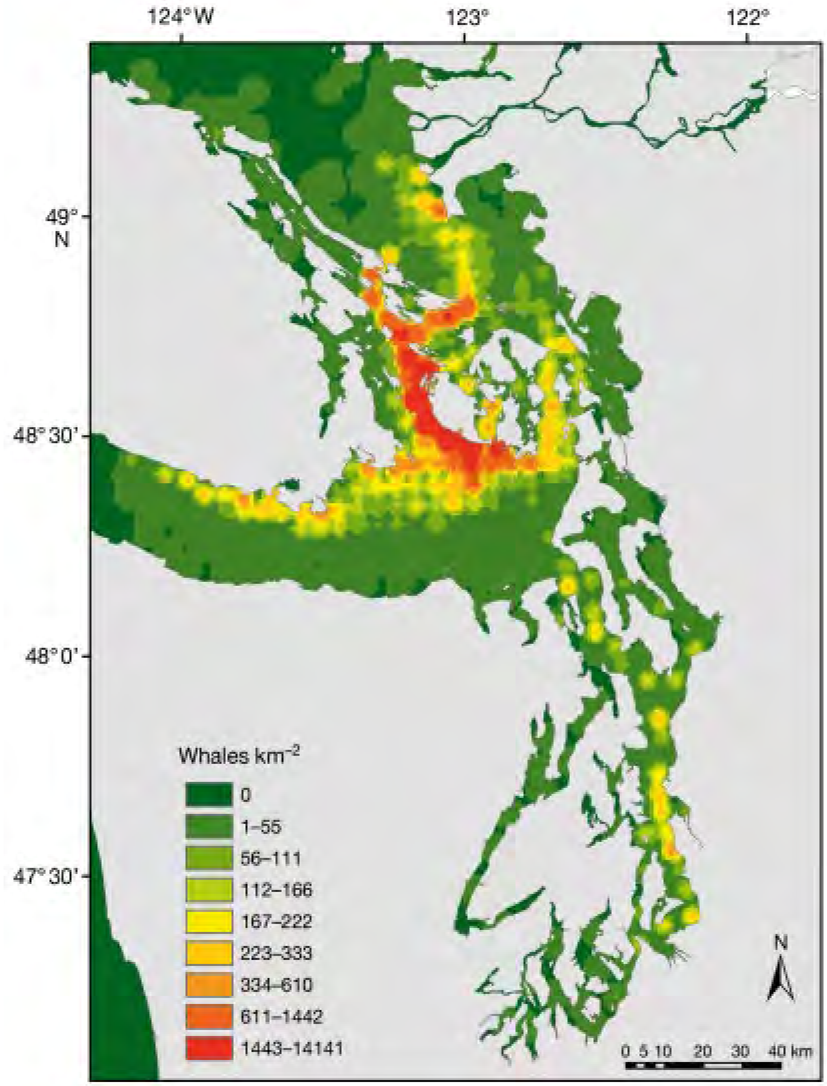


Figure 32. Copied from Olson et al 2018 Southern resident killer whale density (number of whales km−2) based on effort-corrected data in the Salish Sea from 1976-2014.

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 2019a).

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). 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. For the coastal areas, PBF#2 is identified as the primary management concern. The action area overlaps with Coastal Areas 1 and 2. Activities that could affect prey in Coastal Areas 1 and 2 are: (1) Salmon fisheries and fisheries that take salmon as bycatch; (2) salmon hatcheries; (3) oil spills and response; (4) military activities; (5) vessel traffic; (6) dredging and dredge material disposal (7) upstream activities (including activities contributing to point-source water pollution, power plant operations).

Water Quality and Southern Resident Killer Whale

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 (PSP 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 (2019a), 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 (WDOE) 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.

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). Also, 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 shown declines in the 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). No matter the cause, these changes would result in lower caloric value of individual salmon.

Passage Conditions - SRKW

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 impact foraging behavior (Ferrara et al. 2017). Ship noise is an ongoing disturbance to SRKW.

For SRKW, 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 ¼ mile voluntary "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. San Juan County expanded this area in 2018 to include a ¼ mile no vessel zone to Cattle Point with additional recommendations for speed. As described in the Effect Section, WDFW formally extended the voluntary no-go zone from Mitchell Point all the way to Cattle Point in 2018. This zone extends a quarter mile seaward along its entire length, except for the area around Lime Kiln where it extends a half mile seaward. The voluntary speed limit applies to the area within 400 yards of the whales, beyond the voluntary no-go zone. In 2018, the Pacific Whale Watch Association updated their industry guidelines stating "Vessels will remain a minimum of 1⁄2 mile (880 yards) from the light beacon of the Light House at Lime Kiln State Park on San Juan Island when whales are in the vicinity. Vessels will remain a minimum of 1⁄4 mile (440 yards) from the main shoreline of the west side of San Juan Island when between Mitchell Point to Cattle Point (facing south)." The Canadian Fisheries Minister is also considering new regulations to protect killer whales in Canadian waters.

Ship noise is discussed in detail previously under Section 2.4.4.1.

Oil Spill Risk and Southern Resident Killer Whales

In the Northwest, Southern Resident killer whales 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, late reproductive maturity, low reproductive rate, specialized diet, and social behavior of staying in groups, among other attributes (Jarvela-Rosenberger et al. 2017). Oil spills have occurred in the range of Southern Residents in the past, and there is potential for spills in the future as an ongoing baseline condition (See Section 2.3.4). The possibility of a large spill is considered one of the most important short-term threats to killer whales and other coastal organisms in the northeastern Pacific (Krahn et al. 2002).

Baseline Population Viability of Southern Resident Killer Whales[27]

Several studies have used a technique known as population viability analysis (PVA) to assess the future risk of extinction of the Southern Resident population. PVAs rely on known life history parameters to reach their conclusions and usually assume that conditions observed in the past will continue in the future. Limitations in models can produce unreliable results for a variety of

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[27] We note here that this discussion includes future scenarios. We cannot necessarily distinguish in these studies between baseline conditions (e.g. ongoing effects that increase over time as baseline condition) versus what we would define as cumulative effects under ESA as the authors did not draw these definitional distinctions. We have kept these discussion in one place under the Baseline Section for ease of understanding rather than to split up the information and present some of it in the Cumulative Effects Section.

reasons, such as the use of inaccurate demographic data and failure to correctly consider environmental variables and parameter uncertainty (Beissinger and Westphal 1998, Reed et al. 1998). Thus, PVA forecasts should be viewed with some caution.

The initial PVAs of the Southern Residents conducted by Taylor and Plater (2001) and Krahn et al. (2002) were updated by Krahn et al. (2004a), who examined Southern Resident demographic information from several time periods (1974-2003, 1990-2003, and 1994-2003) to estimate extinction risk. Mean survival rates varied among periods and were highest from 1974-2003 and lowest from 1994-2003. In contrast, the model used a single fecundity rate, averaged from 1974-2003, for all simulations. The study considered seven values of carrying capacity for the population ranging from 100 to 400 whales, three levels of catastrophic event (e.g., oil spill or disease) frequency ranging from none to twice per century, and three levels of catastrophic event magnitude in which 0, 10, or 20 percent of the animals died per event.

Analyses indicated that the Southern Residents have extinction probabilities of less than 0.1 to 3 percent in the next 100 years and 2 to 42 percent in the next 300 years under the scenario that the population's survival rates from 1974-2003 (29-year period) continue into the future. However, the likelihood of extinction was greater if future survival rates match those from 1990-2003 or 1994-2003 (described as "last 10-year period" in the report). The most pessimistic predictions were associated with survival rates from 1994-2003, with extinction risks predicted at 6 to 19 percent in 100 years and 68 to 94 percent in 300 years. In all cases, higher extinction risks were linked to lower carrying capacities and more frequent and severe catastrophes. Krahn et al. (2004) also assessed the population's probability of slipping to a level of "quasi-extinction," which was defined as the stage at which 10 or fewer males or females remained, thereby representing a threshold from which the population was not expected to recover. These simulations suggested that the Southern Residents have a 1 to 15 percent chance of reaching quasi-extinction in the next 100 years and a 4 to 68 percent chance in the next 300 years if survival rates from 1974-2003 continue. Predictions were again most pessimistic using survival data from 1994-2003, with the risk of quasi-extinction predicted at 39 to 67 percent in 100 years and 76 to 98 percent in 300 years. As before, higher risks within each category were tied to smaller carrying capacities and greater threats of catastrophic events.

Given the existing number of individuals in the low 70s, which is less than the lowest number of 100 individuals assumed in the model as the carrying capacity, and the recent decline in numbers from 86 whales in 2010 to 74 whales in 2018 (with few successful births in recent years), the more pessimistic scenarios may be the most probable in the next 100 years. The model output pertaining to 100 individuals as the carrying capacity with a poor survival rate period (1994-2003 described as "last 10 years" in the report) is shown in Table 23 below. The PVA shows that at 100 individuals, with 1994-2003 survival estimates, the probability of quasi-extinction (defined as less than or equal to 10 males or females) in 100 years with *no* catastrophes is 40 percent. Adding a catastrophe with a 1 percent (probability of 0.01) annual chance that kills 10 percent of the population (i.e. 90 percent of killer whales survive the event), the quasi-extinction probability rises to 47 percent in 100 years. Adding a catastrophe with a 1 percent annual chance that kills 20 percent of the population, the quasi-extinction probability is 52 percent. Adding a catastrophe with a 2 percent annual chance that results in a 20 percent loss of the population, results in a 67 percent probability of quasi-extinction in 100 years. This model shows that there is already a very high probability of extinction in the next 100 years without a catastrophic event. The model shows that adding even a rare (1 percent annual chance) event with 90 percent of whales *surviving* the event, starts to push the probability of extinction to near 50 percent (47 percent). Note that the report refers to an event, such as an oil spill, disease, or lack of food, as “catastrophic” if it kills 10 to 20 percent of the Southern Resident killer whale population. The term catastrophic is describing the effect on the population from the event, not the event itself. The catastrophe events and their probabilities in this PVA do not relate directly to the oil spill risk models presented in this opinion.

Table 23. This table is copied from by Krahn et al. (2004). It shows survival scenarios and quasi-extinction risk.

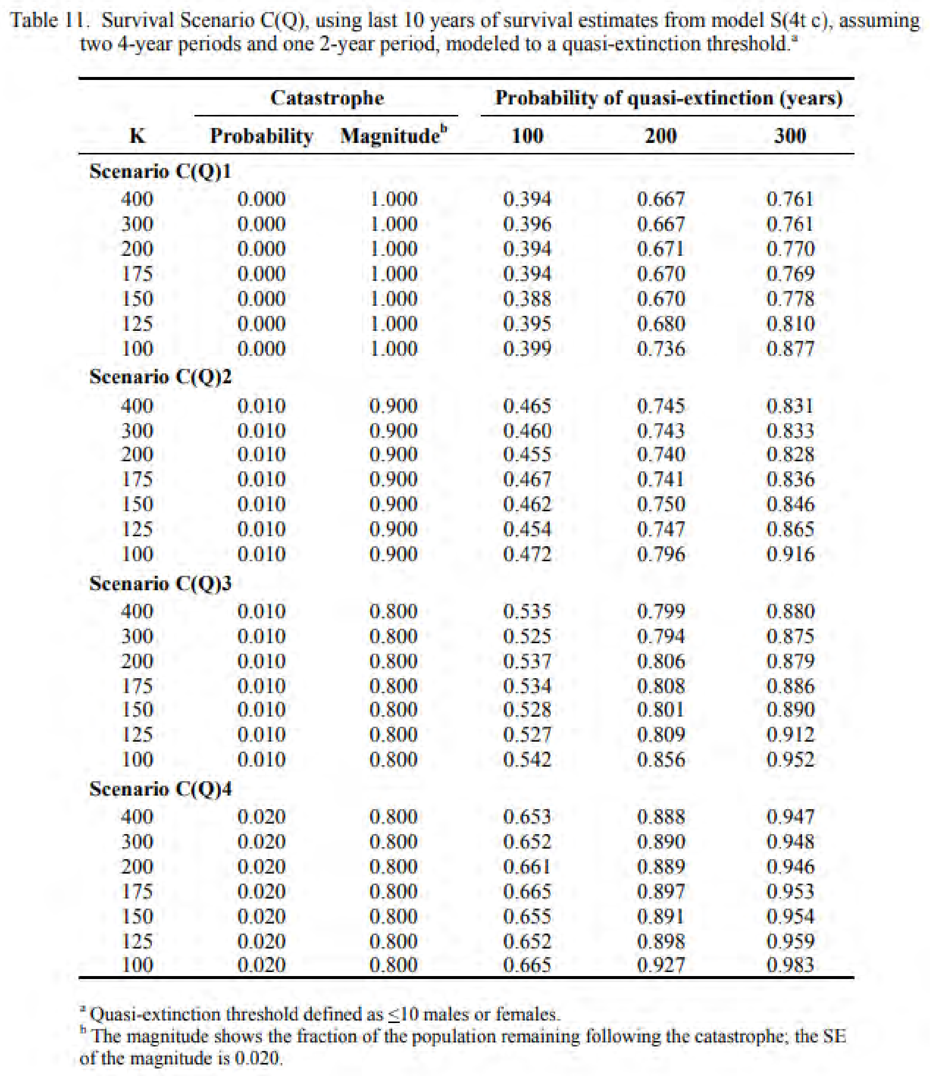

Table 11. Survival Scenario C(Q), using last 10 years of survival estimates from model S(4t c), assuming two 4-year periods and one 2-year period, modeled to a quasi-extinction threshold.[a]

	Catastrophe		Probability of quasi-extinction (years)		
K	**Probability**	**Magnitude[b]**	**100**	**200**	**300**
Scenario C(Q)1					
400	0.000	1.000	0.394	0.667	0.761
300	0.000	1.000	0.396	0.667	0.761
200	0.000	1.000	0.394	0.671	0.770
175	0.000	1.000	0.394	0.670	0.769
150	0.000	1.000	0.388	0.670	0.778
125	0.000	1.000	0.395	0.680	0.810
100	0.000	1.000	0.399	0.736	0.877
Scenario C(Q)2					
400	0.010	0.900	0.465	0.745	0.831
300	0.010	0.900	0.460	0.743	0.833
200	0.010	0.900	0.455	0.740	0.828
175	0.010	0.900	0.467	0.741	0.836
150	0.010	0.900	0.462	0.750	0.846
125	0.010	0.900	0.454	0.747	0.865
100	0.010	0.900	0.472	0.796	0.916
Scenario C(Q)3					
400	0.010	0.800	0.535	0.799	0.880
300	0.010	0.800	0.525	0.794	0.875
200	0.010	0.800	0.537	0.806	0.879
175	0.010	0.800	0.534	0.808	0.886
150	0.010	0.800	0.528	0.801	0.890
125	0.010	0.800	0.527	0.809	0.912
100	0.010	0.800	0.542	0.856	0.952
Scenario C(Q)4					
400	0.020	0.800	0.653	0.888	0.947
300	0.020	0.800	0.652	0.890	0.948
200	0.020	0.800	0.661	0.889	0.946
175	0.020	0.800	0.665	0.897	0.953
150	0.020	0.800	0.655	0.891	0.954
125	0.020	0.800	0.652	0.898	0.959
100	0.020	0.800	0.665	0.927	0.983

[a] Quasi-extinction threshold defined as ≤10 males or females.

[b] The magnitude shows the fraction of the population remaining following the catastrophe; the SE of the magnitude is 0.020.

Lacy et al., (2017) performed a similar PVA that focused on various anthropogenic threats to the Southern Resident killer whales and possible management actions and future developments that could affect the trajectory of the whale population and their risk of extinction. The analysis focused on Chinook salmon availability, anthropogenic noise from boats and ships, PCB contamination, vessel collisions, oil spill, and the cumulative and interacting effects that these may have on fecundity (capacity to produce offspring) and the resulting population growth rate projections. The authors ran multiple model scenarios. For two of the scenarios, the authors looked at “cumulative threats” or the cumulative impacts of possible increases in threats, based in part on an environmental impact assessment submitted to the Canada National Energy Board (CNEB 2014) evaluating effects of the proposed Canadian Trans Mountain Pipeline and associated oil tanker traffic[28]. For this PVA model, projected increases in anthropogenic threats do not relate to a specific project proposal, but rather a general trend in the number of port expansions, pipeline proposals, and liquefied natural gas terminal proposals pending at the time of modeling work for the British Columbia inland waters of the Salish Sea. Note that the author's use of the term “cumulative” is not synonymous with the definition of “cumulative effects” under the ESA Section 7 regulations.

For a low level development scenario, the authors used the catastrophe option in the model to add the possibility of large (>104,000 bbl)[NMFS assumes that a barrel-bbl- of oil equals 42 gallons, therefore 104,000 barrels equals 4,368,000 gallons] and smaller (>52,000 bbl)[2,184,000 gallons] oil spills. The frequencies of a big spill (0.21 percent chance per year/probability of 0.0021) and a smaller spill (1.08 percent/probability of 0.0108) were based on an industry projections of the likelihood of such spills caused by proposed increases in tanker traffic as reported in Det Norske Veritas (2013). The authors then looked at how and where an oil spill might occur and spread and overlaid that with the critical habitat of the Southern Resident killer whales. Based on the percent overlap of oil coverage and critical habitat, they estimated that if the larger oil spill were to occur, about 50 percent of the Southern Resident killer whales would be killed due to direct exposure to the oil. For a smaller spill, they estimated that 12.5 percent of the whales would be killed by exposure to oil. Note that WDOE’s 2015 VTRA study (see Sections 2.3.3 and 2.3.4), modeled a spill size of 1,800,000 gallons as having a 0.05 percent chance in one year (0.0005 probability), although these models are not directly comparable and have different basic assumptions in the model inputs.

For the second “cumulative threat” scenario with higher level impacts of development, they doubled the frequency of oil spills. These scenarios also included an increase in vessel noise and disturbance of feeding, with the current vessel presence of 85 percent of time increased to 92.5 percent in the low-level scenario and to 100 percent in the high level scenario. The authors also included a probability of additional deaths of killer whales due to vessel collisions, with one death per decade in the low level and two deaths per decade in the high-level scenario. For these 2 scenarios, the authors kept the level of PCB contamination steady. The authors also included possible declines in Chinook abundance related to climate change with a projected 25 percent (low scenario) or 50 percent (high scenario) decrease in Chinook over the next 100 years (Figure 32 and Table 24).

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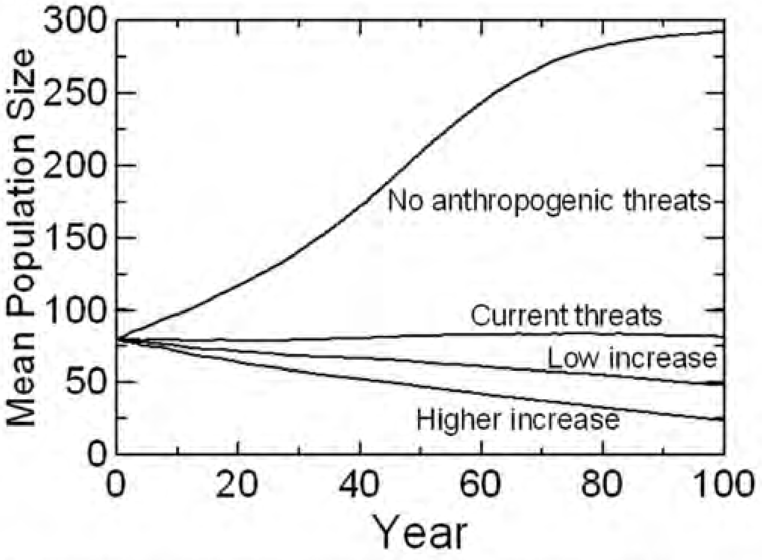
[28] We note here that this discussion includes future scenarios. We cannot distinguish in this study between baseline conditions (e.g. ongoing effects that increase over time as a baseline condition) versus what we would define as cumulative effects under ESA as the authors did not draw these distinctions. We have kept this discussion in one place under the Baseline Section of this opinion rather than to split up the information and present some of it in the Cumulative Effects Section.

Figure 3



Mean projected SRKW population sizes for scenarios with (from top to bottom): no anthropogenic noise or contaminants; current Chinook abundance, noise, and PCBs; reduced Chinook, increased noise, and additional threats of oil spills and ship strikes as estimated for low level impacts of future industrial development; and these increased and additional threats with higher level impacts of development.

Figure 33. Figure 3 Copied from Lacy et al., (2017)

Table 24. Copied from Lacy et al., (2017)

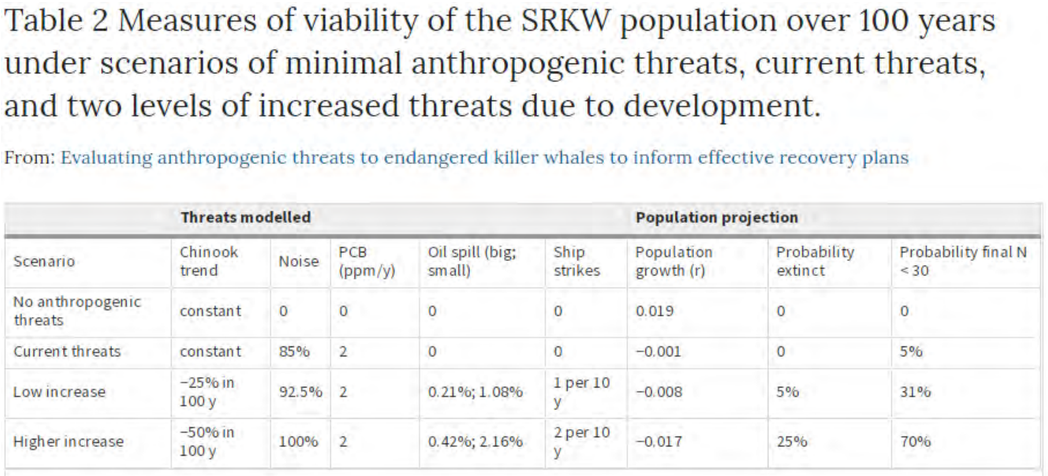


Table 2 Measures of viability of the SRKW population over 100 years under scenarios of minimal anthropogenic threats, current threats, and two levels of increased threats due to development.

From: Evaluating anthropogenic threats to endangered killer whales to inform effective recovery plans

	Threats modelled					Population projection		
Scenario	Chinook trend	Noise	PCB (ppm/y)	Oil spill (big; small)	Ship strikes	Population growth (r)	Probability extinct	Probability final N < 30
No anthropogenic threats	constant	0	0	0	0	0.019	0	0
Current threats	constant	85%	2	0	0	−0.001	0	5%
Low increase	−25% in 100 y	92.5%	2	0.21%; 1.08%	1 per 10 y	−0.008	5%	31%
Higher increase	−50% in 100 y	100%	2	0.42%; 2.16%	2 per 10 y	−0.017	25%	70%

To explore potential demographic projections, Lacy et al. (2017) constructed a population viability assessment that considered sub-lethal effects and the cumulative impacts of threats (contaminants, acoustic disturbance, and prey abundance). They found that over the range of scenarios tested, the effects of prey abundance on fecundity and survival had the largest impact on the population growth rate. Furthermore, they suggested in order for the population to reach the recovery target of 2.3 percent growth rate, the existing acoustic disturbance from vessels would need to be reduced in half and Chinook salmon abundance would need to be increased by 15 percent (Lacy et al. 2017). Acoustic disturbance is described in more detail below.

Southern Resident Killer Whale Baseline Demographic Vulnerability

Because there are so few individuals in this population, it is susceptible to demographic stochasticity – randomness in the pattern of births and deaths among individuals in a population. Several other sources of stochasticity can affect small populations and contribute to variance in a population's growth and extinction risk. Other sources include environmental stochasticity such as sudden change in weather/climate patterns that affects their food sources or a natural disaster, or fluctuations in the environment that drive fluctuations in birth and death rates, and demographic heterogeneity, or variation in birth or death rates of individuals because of differences in their individual fitness. In combination, these and other sources of random variation combine to amplify the probability of extinction, known as the extinction vortex (Gilpin and Soulé 1986, Fagen and Holmes 2006, Melbourne and Hastings 2008). With smaller population size comes greater risk associated with stochastic events and greater risk of reduced biological fitness in a given population as a result of inbreeding (inbreeding depression).

Population growth is also important because of the influence of demographic and individual heterogeneity on a population's long-term viability. Population-wide distribution of lifetime reproductive success can be highly variable, such that some individuals produce more offspring than others, and male variance in reproductive success can be greater than that of females (i.e., 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, while others might produce more offspring. The smaller the population, the more critical an individual's reproductive success has on the population's growth or decline (i.e., Coulson et al. 2006). For example, there are currently 26 reproductive aged females (ages 11-42) in the Southern Resident killer whale population, but only 14 have successfully reproduced in the last 10 years (CWR unpubl. data). This further illustrates the risk of demographic stochasticity for a small population like Southern Resident killer whales – the smaller a population, the greater the chance that random variation will result in too few successful individuals to maintain the population.

Although the small size of the population makes them vulnerable to demographic stochasticity, recent changes in survival were not related to stochastic variation caused by the population's small size (e.g., random patterns in births or deaths) or to annual fluctuations in survival. Modeling of annual survival data determined that overall survival was relatively constant within approximately seven-year periods, but differed greatly between consecutive periods (Krahn et al. 2004). Greater than average survival rates were detected from 1974-1979, 1985-1992, and 2001-2002, but rates were below average from 1980-1984 and 1993-2000. Krahn et al. (2002) therefore suggested that survival patterns were more likely influenced by an external cause, such as periodic changes in prey availability or exposure to environmental contaminants. In the summer of 2018, three of the whales died, including L92, a 23-year old male who was declared missing then dead in June. In August 2019, a calf died within minutes of being born, while J50, a three-year old female, is presumed dead after going missing in early September 2018.

Southern Resident Killer Whale Vulnerability to Vessel collisions

Vessel strikes on killer whales are rare, but do occur and can result in injury or mortality (Gaydos and Raverty 2007). Killer whale vessel strikes are more rare than larger whale strikes presumably because killer whale swimming and social behavior is dolphin-like, making them inherently more aware of ship movement at the surface in a similar manner as other dolphin species (killer whales are the largest animal in the dolphin family). Whereas large whales do not maneuver in the same manner, making them relatively more susceptible to vessel strike. According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS West Coast Region, no human-caused killer whale mortality or serious injuries were reported from non-fisheries sources between 2007 and 2011 (Carretta et al. 2013). There was documentation of a whale-boat collision in Haro Strait in 2005 which resulted in a minor injury to a whale. In 2006, whale L98 (also known as Luna) was killed during an OGV interaction. L98's unique behavior may have contributed to this accident. L98 became separated from his pod at a young age and lived alone in Nootka Sound where he regularly interacted socially with boats. Both of these collisions were from small tankers, in contrast to the large OGVs likely to be transiting to and from the proposed facility. There have been several Southern Resident killer whale deaths between 2002 and 2017 that have been attributed to “trauma”, which could have been from ship or small boat collisions, but the findings are not conclusive. These deaths include L60, an adult female, in 2002; L112, a juvenile female with blunt force trauma to the head; J34, an adult male, in 2016 with blunt force trauma to the head (Stranding Network). Several dead transient killer whales have also been found with trauma as the cause of death in the Northwest during this same time period.

Southern Resident Killer Whale and Facility Wastewater

Although we identify the treated wastewater as adversely affecting PBFs of SRKW critical habitat (as described in the next section below), it is not likely that individual whales experience adverse exposure to contaminants through bioaccumulation/biomagnification from BP's treated effluent because the numbers of exposed Chinook are likely very small and the odds of a whale actually eating an exposed fish are extremely small, and the level of contaminants picked up by those particular fish would also be extremely small, thus making or contributing to any adverse health effects from exposed Chinook extremely unlikely.

SRKW presence is fairly rare in the Cherry Point area, making direct exposure to the mixing zone unlikely or extremely rare and transitory. However, toxic contaminants have been identified as one of three key threats to SRKW, and the biological report supporting the original designation of critical habitat states that because of their long life span, position at the top of the food chain, and their blubber stores, killer whales accumulate high concentrations of contaminants. PAHs and heavy metals among the concerns (NMFS 2006, internal citations omitted).

The priority metals that WDOE has identified for monitoring for BP are antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc. The available data indicate that Southern Residents are not at risk of health effects from nickel, selenium, silver, and zinc. Some of these compounds are essential elements to the nutrition of marine mammals (e.g., aluminum, nickel, selenium, and zinc; Das et al. 2003) and are generally found in low levels in marine mammals distributed throughout the world's oceans (see Appendices 10-5 to 10-8 in O'Shea 1999 for summaries of selected surveys of metals and trace element concentrations in tissues of seals, sea lions, toothed whales, baleen whales, sea otters, dugongs, manatees, and polar bears). Therefore, these essential elements found in low concentrations in marine mammals distributed globally are not anticipated to cause adverse health effects for SRKW. Although silver is not considered an essential element for mammals, its toxicity is generally not a concern and it has not been measured often in marine mammals (O'Hara et al. 2003). For these reasons, NMFS does not believe that the existing treated wastewater is causing any health effects from these compounds and we do not discuss these compounds further.

Metals can bioaccumulate in the aquatic environment (EPA 2007). However, most metals (with the exception of methylmercury), do not appear to biomagnify and are regulated and excreted through metabolic processes (Gray 2002, EPA 2007). Upper trophic-level predators can still accumulate metals even in the absence of biomagnification (Reinfelder et al. 1998). However, low levels of arsenic, chromium, copper, and lead have been measured in marine mammal tissues (O'Shea 1999, Grant and Ross 2002, Das et al. 2003). Although high cadmium levels are measured in some marine mammals, cadmium is known to combine with metallothionein (a protein molecule) to mitigate the toxic effects (Dietz et al. 1998, Klaassen et al. 2009). Further, no toxic effects of cadmium have been observed in marine mammals. Although threshold levels at which adverse health effects occur are currently unknown for these metals, the available data indicate that the low levels measured in their tissues do not pose a health risk to marine mammals (O'Shea 1999).

In marine mammals, metals generally do not bioaccumulate and may be detoxified and/or eliminated. However, chronic exposure to metals such as mercury, cadmium, copper, and lead, may present a moderate and/or localized health risk to killer whales. Available studies do not indicate that BP contributes biologically significant levels of these metals. Applied Biomonitoring and Boettner (2002) examined bioaccumulation of arsenic, mercury, cadmium, copper, lead, zinc, and selenium in mussels deployed for 60 days along the Cherry Point Reach, and at Fidalgo Bay, Port Gamble, and Brownsville (within the Port Orchard-Port Madison Pacific herring spawning grounds). Although all mussels accumulated metals, the concentrations were "lower than those known to elicit effects" (Applied Biomonitoring and Boettner 2002, p. 112) in either mussels or Pacific herring. However, as Applied Biomonitoring and Boettner (2002, p. 112) stated, these effect levels "are based primarily on acute effects by measuring mortality endpoints that could underestimate potential chronic effects from long-term exposures to low metal concentrations in the field." Based on this available data, it appears that BP's wastewater contributes some level of these metals to the marine environment, but likely not at a level that would have a significant impact on the marine mammals considered in this opinion.

The contaminants of gravest concern to SRKW are PAHs, PCBs, and PBDEs. BP does not contribute PCBs and PBDEs to the marine environment. PCBs have been banned since 1979 and PBDEs are associated with flame retardants in manufactured goods. For PAHs, previous sediment studies performed at the BP facility detected levels that were not at concentrations sufficient to cause listing on the Washington Department of Ecology 303(d) list of "impaired waters" or the imposition of a "sediment impact zone" (SIZ) (WDNR 2017). The PAH contaminants were detected in a localized area around the discharge locations under the industrial outfalls with concentrations of PAHs below the current sediment quality standards (SQS), as set by the WDOE. Contaminants were also detected in sediment at the pilings containing creosote, linked to the wood treatment materials for those pilings (Wigfield, personal communication, 2008 as referenced in NMFS 2006). The pilings have since been wrapped to contain the PAHs. This information coupled with the previously discussed caged mussel study indicates that the baseline PAH contribution by current BP operations is too low to contribute to adverse exposure of SRKWs.

Southern Resident Killer Whale Critical Habitat and Wastewater

The two PBFs relevant to this consultation are water quality and prey species. Chinook salmon are the preferred prey of SRKW, particularly in summer months, and their abundance and condition are affected in part by water quality conditions in marine environments. Although we know relatively little about prey preferences in the other seasons, the majority of the evidence suggests that SRKW consume salmon consumed year-round. Coho salmon contributed to over 40 percent of their diet in late summer. Chum salmon, sockeye, and steelhead were also part of their diet, but to a lesser extent (Mongillo 2016, internal citations omitted).

As described above, water quality as a PBF in designated critical habitat of Puget Sound is likely to be slightly, but chronically, diminished by the contribution of a range of contaminants in the immediate vicinity of the mixing zone. To the degree that salmonids, particularly Chinook salmon are affected by this contaminant load, these fish, as the prey PBF for SRKW, are equally affected. This can present as reduced growth, reduced survival, or in some cases bioaccumulated contaminants, all of which are detrimental to this feature of critical habitat. The scale of this affect to SRKW critical habitat is likely very small because Chinook salmon exposure to the mixing zone is likely limited to a very small number of individual fish, relative to their respective populations, and extremely brief because the mixing zone is far offshore, whereas Chinook salmon juveniles are generally shoreline oriented and more likely to feed at the surface and migrate closer to shore, outside of the mixing zone.

Baseline Threats to All Whales in the Action Area

Scientific Research Permits. NMFS issues scientific research permits to allow research actions that involve take of whales. Currently there are 12 permits that allow directed research on whales, typically involving either targeted capture or sampling of individuals that may have stranded or been incidentally taken in some other manner. These permits allow a suite of activities that include observation, tagging, tracking, and collection of biological data and samples. These activities are intended to be non-injurious, with only minimal short-term effects. But the risks of incurring an injury or mortality as a result of directed research cannot be eliminated.

Fisheries Interactions. Entrapment and entanglement in fishing gear has been identified as a significant source of mortality to endangered whales (Carretta et al. 2013). In 2016, 71 whales were reported as entangled off the coasts of Washington, Oregon, and California (NMFS 2017e). This is the highest annual total since NOAA Fisheries started keeping records in 1982. Humpback whales were the predominant species reported as entangled, confirmed in 42 separate cases. The majority of whale entanglements reported off California, Oregon, and Washington from 2000 to 2012 (46 percent) were identified as trap/pot gear (NMFS 2014). To date, no ESA Section 7 or 10 consultations have been done for State managed Dungeness crab fisheries which have resulted in large numbers of entanglements (because these are State managed, ESA Section 7 consultation requirement has not been triggered). There are multiple types of federally-managed fisheries on the West Coast known to have been involved with entanglements and each has gone through ESA section 7 consultation. The opinions found no jeopardy to marine mammals (e.g., NMFS 2016c, NMFS 2017d, NMFS 2018d, and NMFS 2019f).

2.3.9 Baseline Conditions of Humpback whales in the Action Area (Mexico DPS and Central America DPS) and Designated Critical Habitat

Humpback whales were common in Puget Sound and the Georgia Strait in the early 1900s. By the late 1900s, there were few sightings of humpback whales in Puget Sound (Calambokidis et al. 1990) due to the effects of commercial whaling on the population size. Since 2000, humpback whales have been sighted with increasing frequency in the inland waters of Washington (Falcone et. al. 2005). In 2014 and 2015, sightings sharply increased to around 500 each year (Orca Network) with over 1,200 sightings reported annually by members of the public or whale watch groups since 2017 (Miller 2020). The number of sightings do not directly translate to the number of whales in Puget Sound. The same individuals are sighted multiple times. The increase in sightings indicates a general increase in the number of humpback whales utilizing the Salish Sea. Washington inland water opportunistic sightings primarily occur from May through October, but sightings have occurred in every month of the year (Orca Network 2012; Miller 2020). Humpbacks have been sighted as far as the northern Strait of Georgia, and around the San Juan Islands. In south Puget Sound, humpbacks have been sighted in highly urbanized Commencement Bay near Tacoma and even in Budd Inlet near Olympia.

On the outer coast, a study by Calambokidis et al. (2004) found humpback whale sightings were concentrated between the Juan de Fuca Canyon and the outer edge of the continental shelf, in an area known as “the Prairie" (Figure 34). A small area east of the mouth of Barkley Canyon and north of Nitnat Canyon where water depth was 125-145 meters (410-476 feet) had the highest density of sightings all year (Calambokidis et al. 2004). Figure 35 shows sightings along the west coast. This area overlaps with the action area as ships leave the Strait of Juan de Fuca and head to the open ocean to the west or to ports along the west coast to the north and south.

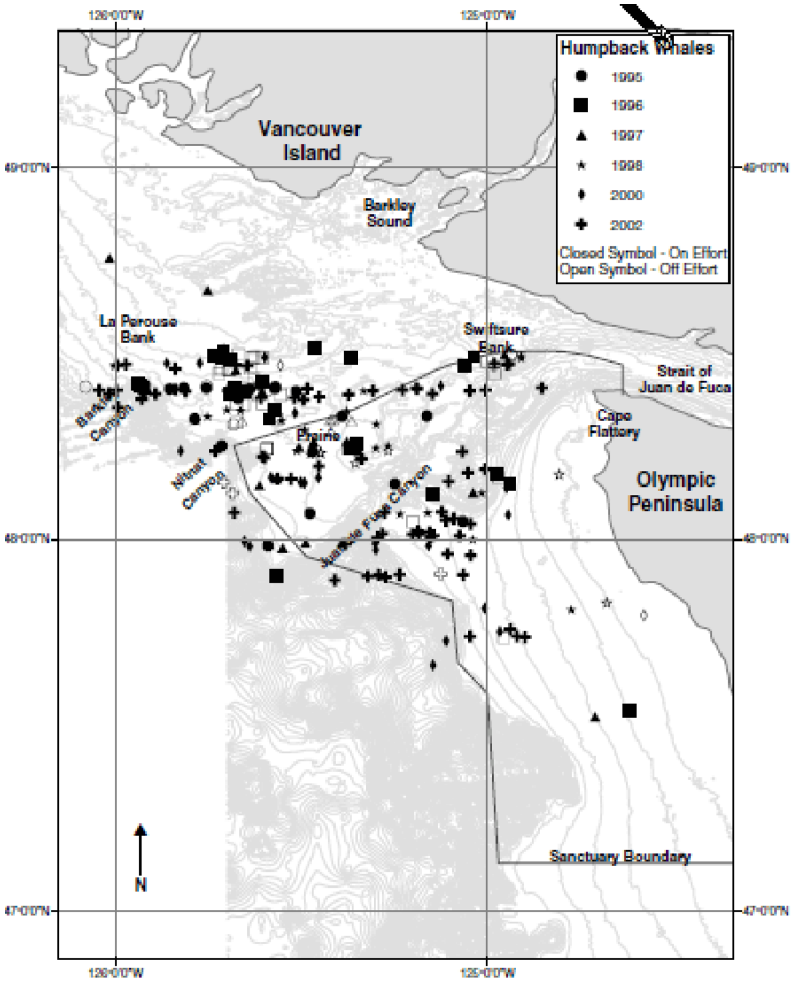


Figure 34. Copied from by Calambokidis et al. (2004) Sighting of Humpback Whales west of the entrance to the Strait of Juan de Fuca.

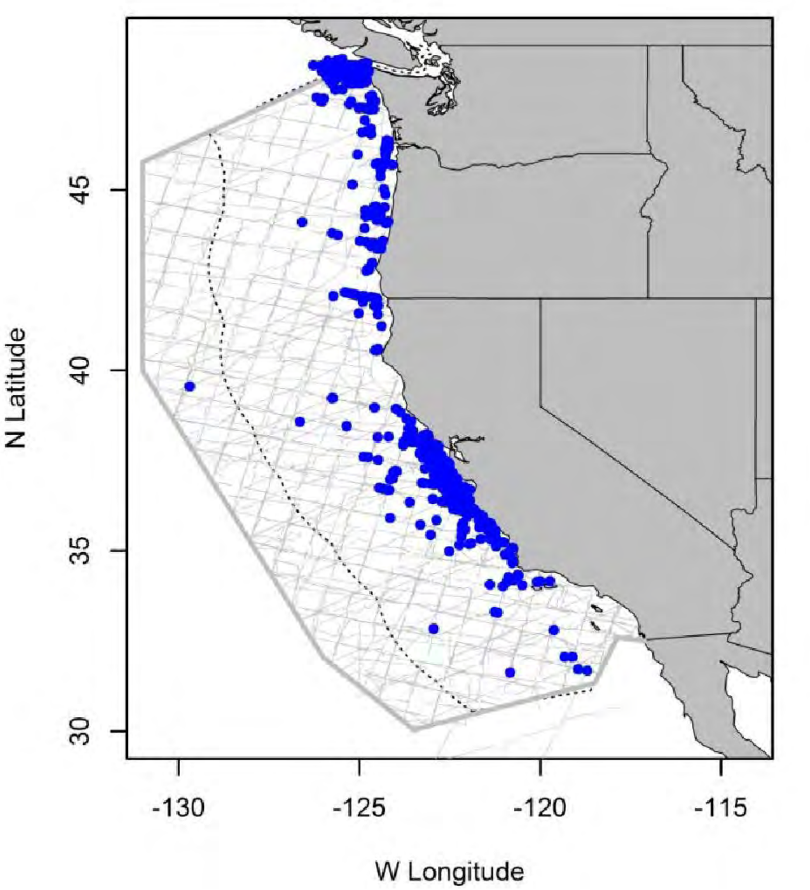


Figure 35. Humpback whale sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2014. Dashed line represents the U.S. EEZ, thin lines indicate completed transect effort of all surveys combined (copied from 2019 Stock Assessment).

Humpback Whale Vulnerability to Vessel collisions. Vessel collisions are a significant source of mortality to whales (Kraus 1990). The WCR maintains a stranding database and includes marine mammal death and injury records from vessel collisions, which extends beyond the action area. In 2004, a humpback whale stranded dead in Washington with injuries consistent with those caused by a ship strike. In 2008, in Washington, two humpback whales stranded dead with injuries consistent with those caused by a ship strike. Carcasses were recovered in 2018 and 2020 with injuries suggesting they had experienced a ship strike. On two different occasions in 2019 and 2020, a Washington State ferry struck a humpback whale. While a carcass wasn't retrieved in either incident, both were presumed to be fatal.

Vessel strikes of humpback whales reported in Canadian waters are shown in Figure 36, including the action area in the Puget Sound/Salish Sea. The figure is taken from The Mariners Guide to Whales, Dolphins, and Porpoises of Western Canada by the Coastal Oceans Research Institute. Per this report, "Thirty cetacean-vessel collisions categorized as "definite" or "probable" were reported to the B.C. Marine Mammal Response Network hotline and investigated by Fisheries and Oceans Canada from 2004-2011. These collisions involved killer whales, humpback whales, grey whales, fin whales and harbor porpoise. The majority of these witnessed and reported strikes involved smaller vessels (less than 15m), however, this number likely underrepresents the frequency of vessel strikes and the involvement of larger vessels. Smaller vessels are more likely to detect, and therefore report, a strike because the impact is more easily felt and visibility of animals off the bow is more apparent. These are vessel strike numbers, not reports of dead whales. The fate of the whales is not reported in this source.

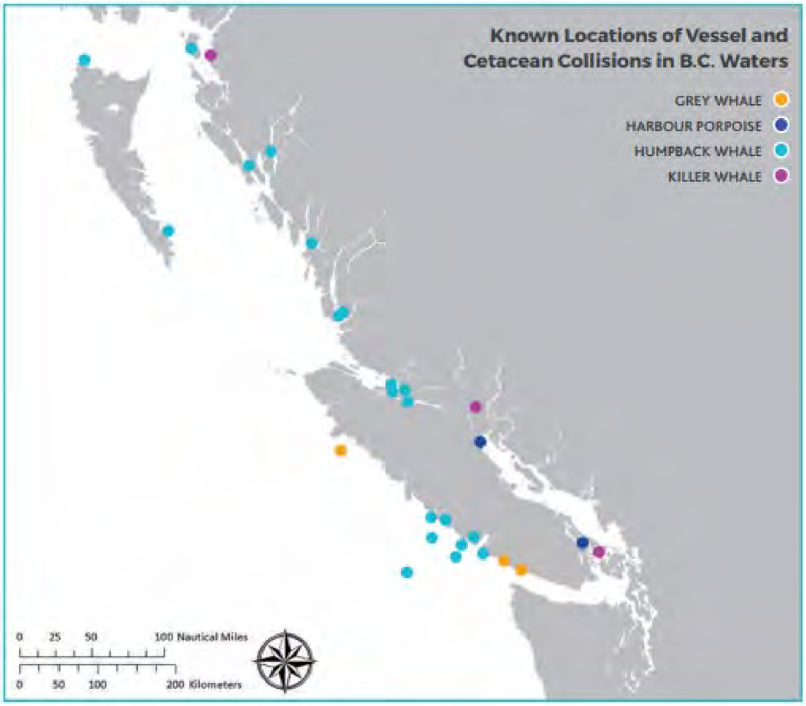


Figure 36. Vessel strike reports in Canadian Waters copied from The Mariners Guide to Whales, Dolphins, and Porpoises of Western Canada by the Coastal Oceans Research Institute (Fisheries and Oceans Canada). Puget Sound/Salish Sea is the inland water located toward the bottom of the map.

Based on available information for the proportion of humpback whales from various DPSs that occur in Washington, for the action area, NMFS assumes that up to 8.7 percent of the whales are from the endangered Central America DPS, 27.9 percent are from the threatened Mexico DPS, and the remainder are from the non-listed Hawaii DPS.

Humpback Whales and Facility Wastewater

The treated effluent from the BP facility is not likely to have any measurable effects on listed humpback whales considered in this opinion because of the absence or rarity of these animals in the vicinity of the BP Cherry Point and the previously discussed studies that indicate that the presence of contaminants at Cherry Point are at very low levels (Section 2.3.5). Any direct exposure to the mixing zone or exposed prey would be rare and have insignificant health effects. The treated discharge likely has no effect on critical habitat of humpback whales because the designation does not extend into the Strait of Georgia near the location of the BP facility as shown below.

Critical Habitat of Mexico and Central America DPSs Humpback Whale

The action area overlaps with the designated critical habitat for the Mexico and Central America DPS of humpback whales in the Strait of Juan de Fuca and extending out along the coast of Washington (Figures 37 and 38). The PBF identified in the final critical habitat listing is the essential feature of prey availability defined as, "Prey species, primarily euphausiids and small pelagic schooling fishes of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth" (86 FR 21082). Within the action area, Figure 34 shows where humpback whales densities are highest off the coast of Washington in the seasonal feeding area known as the Prairie. Although humpback whales are generalist predators and prey availability can vary seasonally and spatially, substantial data indicate that the humpback whales' diet is consistently dominated by euphausiid species and small pelagic fishes, such as northern anchovy (*Engraulis mordax*), Pacific herring (*Clupea pallasii*), Pacific sardine (*Sardinops sagax*), and capelin (*Mallotus villosus)* (86 FR 21082). Four broad categories of actions, or threats, are identified in the proposed listing as having the potential to negatively impact the essential prey feature and the ability of feeding areas to support the conservation of listed humpback whales in the North Pacific: Climate change, direct harvest of the prey by fisheries, marine pollution, and underwater noise. Each of these threats could independently or in combination result in the need for special management or protections of the essential prey feature. We do not have specific information on conditions of the essential prey feature and the combined impacts of these threats within the action area. The listing acknowledges that: (1) the nature and extent of climate impacts have varied across study areas and species; however, in many cases, ocean warming has led to negative impacts on humpback whale prey species; (2) direct harvest of prey species by fisheries can reduce food availability, but fishery management plans consider the needs of whales in their harvest planning; (3) although pollution was not identified as a significant threat to any of the North Pacific DPSs of humpback whales in the recent status review, consumption of contaminated or low quality prey may negatively affect the health, population growth, and ultimately the recovery of listed humpback whales; and (4) whether and how specific humpback whale prey are currently being impacted by various noise sources and levels (e.g. seismic survey, pile driving) is not yet clear, but the available information is sufficient to indicate that ocean noise poses a management concern for many fish and invertebrate species such that they may require management considerations or protection.

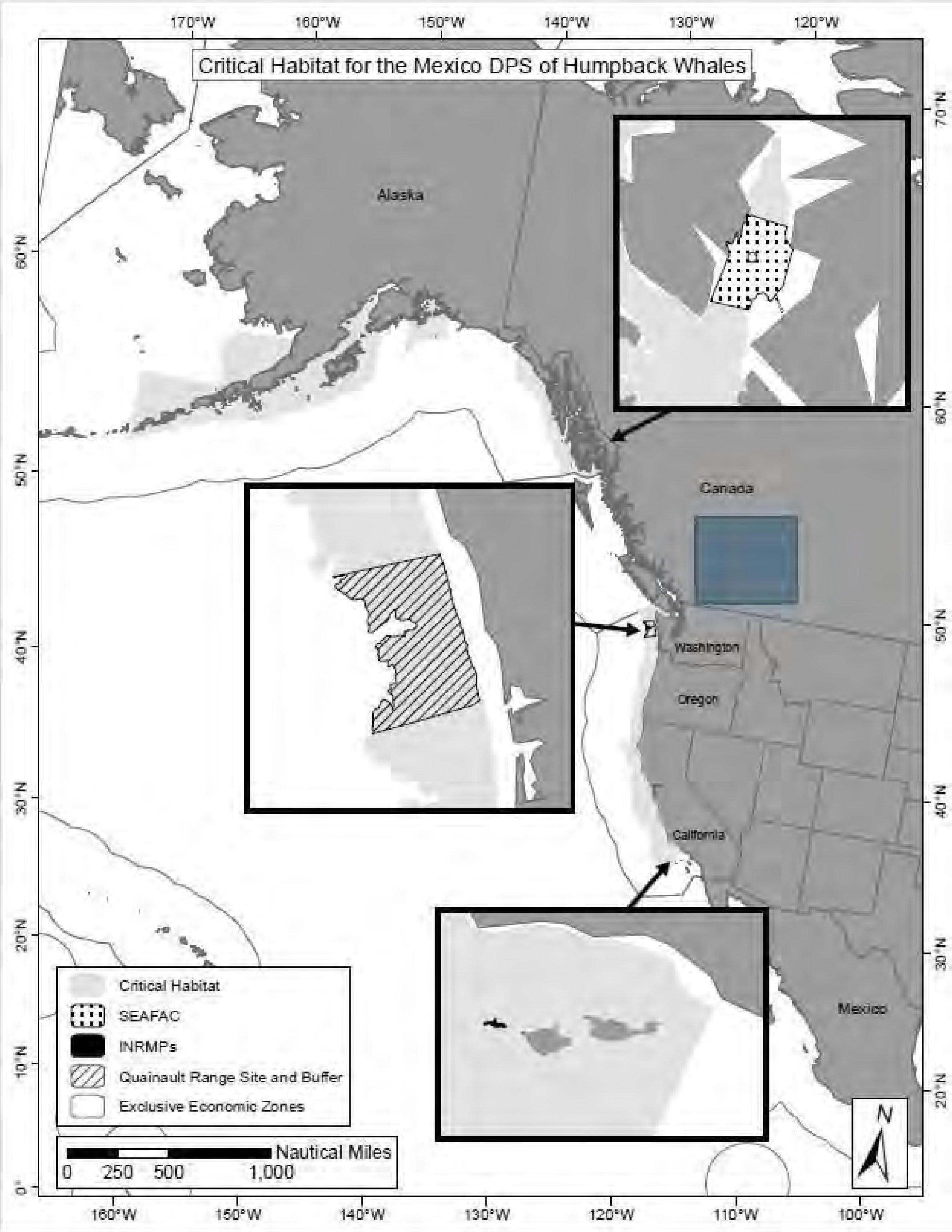


Figure 37 Critical Habitat for Mexico DPS Humpback Whale. The designation extends into the Salish Sea in the Strait of Juan de Fuca.

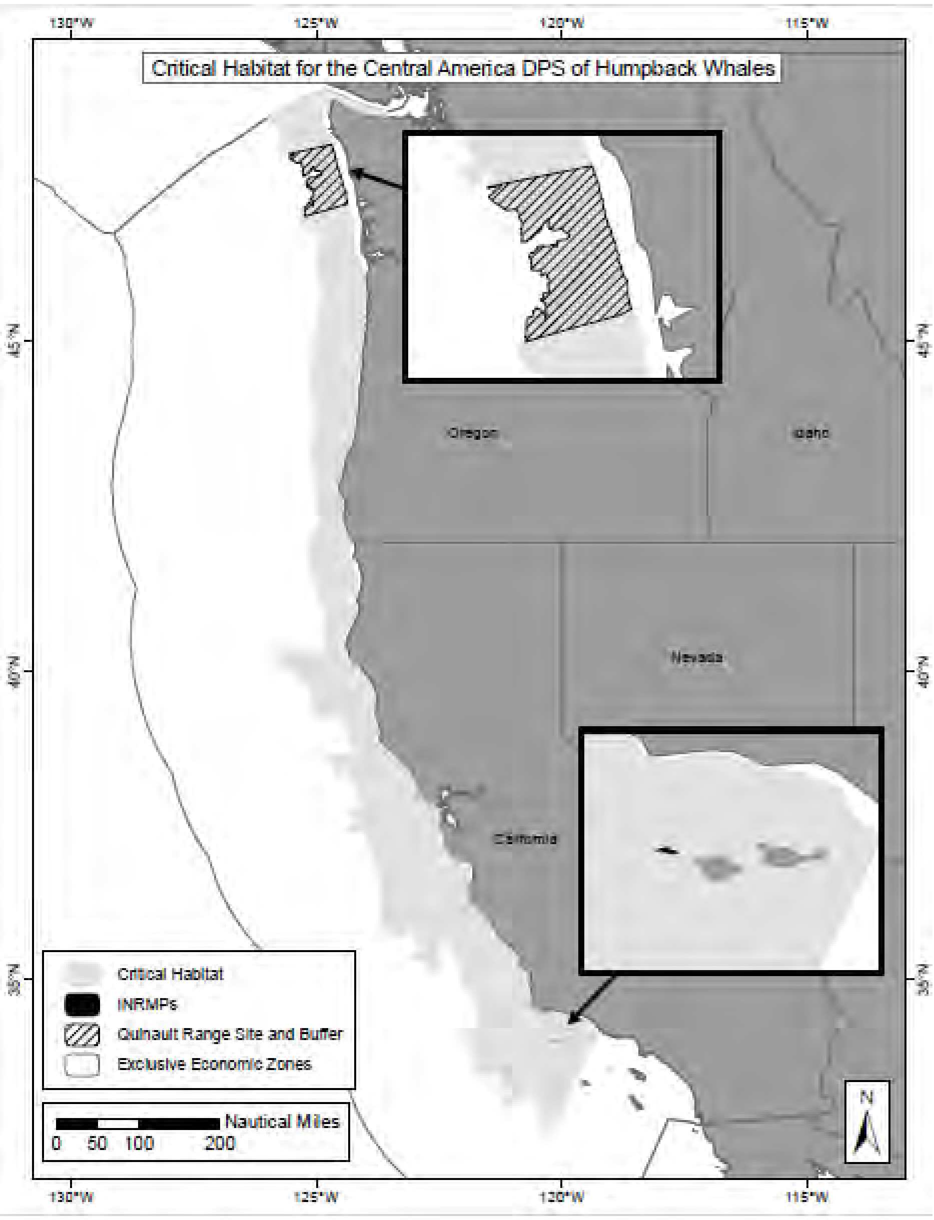


Figure 38. Critical Habitat of Central America DPS Humpback Whale. The proposed designation extends into the Salish Sea in the Strait of Juan de Fuca.

2.3.10 Baseline Conditions of Blue Whales in the Action Area

The Eastern North Pacific population of blue whales is the population occurring within the closest proximity to the action area. They feed in Californian waters in the summer/fall (from June to November) and migrate south to productive areas off Mexico in the winters (Carretta et al. 2007). Historically blue whales were not common along the coast of Washington; however, they did occasionally occur (Calambokidis et al. 2004). The 2019 SAR notes that there is evidence of a northward shift in blue whale distribution with increasing numbers of blue whales found in Oregon and Washington waters during a 1996-2014 line-transect surveys (Barlow 2016) and satellite tracks of blue whales in Gulf of Alaska and Canadian waters between 1994 and 2007 (Bailey *et al.* 2009). More than a dozen blue whales were aggregated off the coast of Oregon along with two sighted off of Washington state in the summer of 2019[29]Consequently, blue whales may occur, but are not expected to be common in the outer coast portion of the action area. There have been no reported vessel collisions of blue whales in the action area.

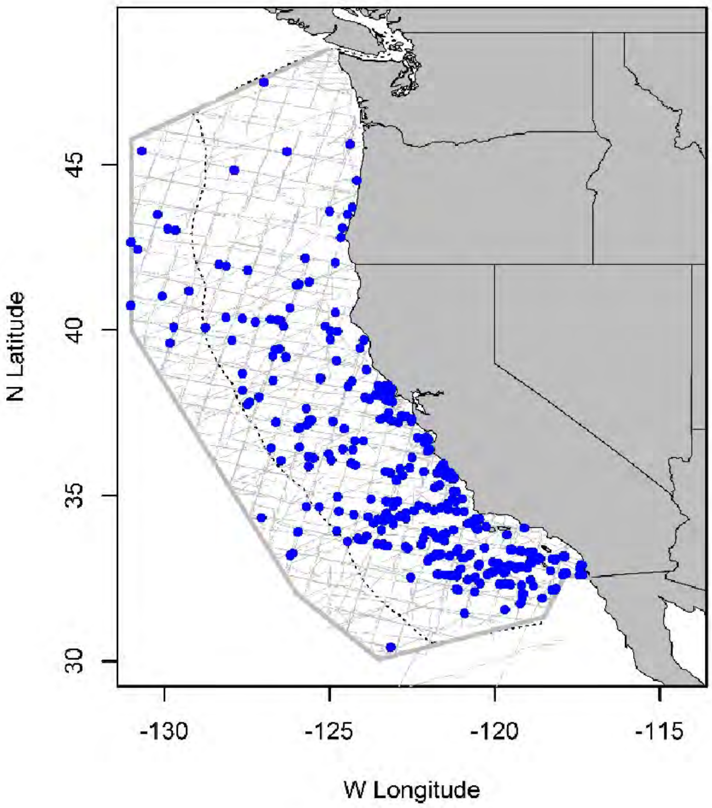


Figure 39. Copied from 2019 SAR. Blue whale sighting locations based on aerial and summer/autumn shipboard surveys off California, Oregon, and Washington, 1991-2014 Dashed line represents the U.S. EEZ; thin lines represent completed transect effort for all surveys combined.

Vessel collisions of Blue Whales – Blue whales spend roughly 46 percent and 90 percent of their time within the top 30 meters of the water column during the day and night respectively, making them vulnerable to vessel strikes (Calambokidis et al. 2019). From 1998-2013, the total estimated number of observed or assumed mortality and serious injury attributed to vessel collisions off the U.S. West Coast is approximately 13 blue whales (WCR Stranding Database). Vessel collisions were implicated in the deaths of 12 and one serious injury of blue whales, from 2007-2018 (Carretta *et al.* 2013; Carretta et al. 2017; Carretta et al. 2020). Five of these deaths occurred in 2007, the highest number recorded for any year. The other ship strike deaths

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[29] https://www.opb.org/news/article/blue-whales-washington-coast-sighting-oregon/#:~:text=The%20largest%20animals%20on%20the,offshore%20of%20Oregon%20this%20summer.&text=This%20blue%20whale%20was%20spotted,%2C%20Washington%2C%20in%20late%20July

occurred in 2009 (2 whales), in 2010 (2 whales), 2016 (1 whale), and 2018 (1 whale). During this time period, there were an additional nine serious injuries (i.e., an injury that is more likely than not to result in mortality) of unidentified large whales attributed to vessel collisions (Carretta *et al.* 2013; Carretta et al. 2017; Carretta et al. 2020). Several blue whales have been photographed in California with large gashes in their dorsal surface that appear to be from vessel collisions (Carretta *et al.* 2014). Blue whale mortality and injuries attributed to vessel collisions in California waters averaged 1.9 per year during 2007-2011. The high number of vessel collisions observed in 2007 resulted in NOAA implementing a mitigation plan that includes NOAA weather radio and USCG advisory broadcasts to mariners entering the Santa Barbara Channel to be observant for whales, along with recommendations that mariners transit the channel at 10 knots or less. The Channel Islands National Marine Sanctuary also developed a blue whale ship strike response plan. Additional plan information can be found at http://channelislands.noaa.gov/focus/alert.html. Documented ship strike deaths and serious injuries are considered minimum values because they are derived from counts of whale carcasses which have consistently low detection rates. Because of this negative bias, Redfern *et al.* (2013) stress that the number of ship strike deaths of blue whales in the California current likely exceeds the potential biological removal (*i.e.,* 2.3 whales per year; Carretta *et al.* 2014).

Facility Wastewater and Blue Whales

The treated effluent from the BP facility is not likely to have any measurable effects on listed blue whales considered in this opinion because of the absence of these animals in the vicinity of the BP Cherry Point opinion and the previously discussed studies that indicate that the presence of contaminants at Cherry Point are at very low levels (Section 2.3.5 and additional information presented in the SRKW section on marine mammals and contaminants). We do not expect any direct exposure to the mixing zone and exposed prey would be rare and have insignificant health effects.

2.3.11 Baseline Conditions Fin Whale

Fin whales are year-round residents off the coast of California and are summer residents off Oregon and rarely pass through Washington. Puget Sound Express, a whale watching company, reported seeing a fin whale in the Salish Sea in 2015 and again in 2016 (https://www.pugetsoundexpress.com/large-fin-whale-sighted-again-in-salish-sea/). Aerial surveys conducted by Brueggeman et al. (1992) off the Oregon and Washington coasts observed 13 groups of 27 fin whales between June and January. All of the fin whales were observed off Oregon, with all but five whales in waters on the continental slope (200 to 2,000 meters [656- to 6,562 feet] deep). The whales not observed in slope waters included a group of two about 200 km (124 miles) offshore in November and a group of three on the shelf just south of the Columbia River in January. The former group was traveling south, suggesting they were migrating back to the wintering grounds. Except for these two groups, all of the other whales were observed during June and July. No calves were observed with any of the whales. Green et al. (1993) reported sighting two fin whales during aerial surveys off Oregon and Washington between March and May in 1992 but did not report the location. An estimated 2,636 fin whales occur off the coasts of California, Oregon, and Washington during summer/fall based on shipboard surveys in 2001 and 2005 (NMFS 2010a) (Figure 40). In the Salish Sea, Towers et al. (2018) found photographic evidence of at least 13 unique individuals during 43 encounters from

1999 to 2017, documenting live fin whales in Queen Charlotte, Johnstone, Georgia and Juan De Fuca Straits and the only confirmed sightings between Vancouver Island and continental North America since 1930. Consequently, fin whales may occur, but are not expected to be common in the action area.

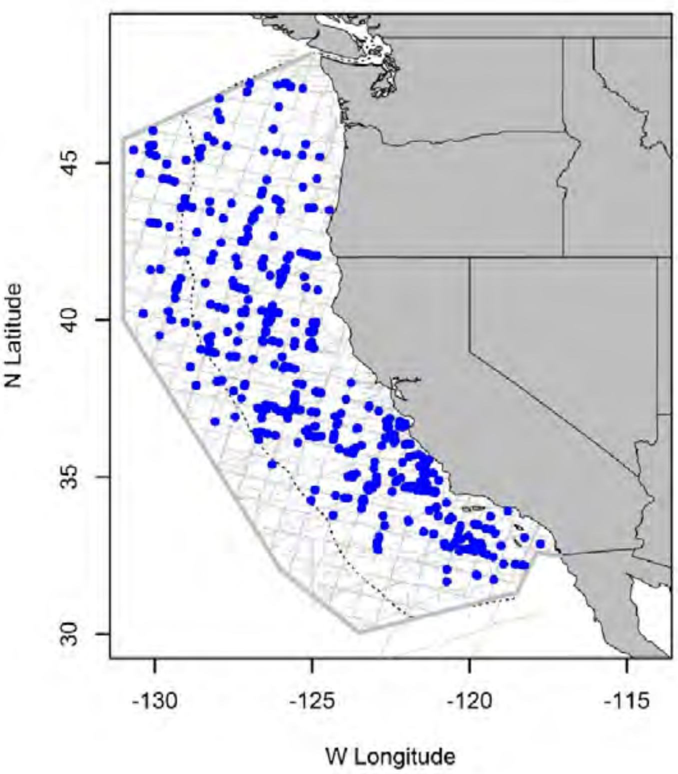

Figure 40. Fin whale sighting locations based on shipboard surveys off California, Oregon, and Washington, 1991-2014. Dashed line represents the U.S. EEZ; thin lines indicate completed transect effort of all surveys combined. Puget Sound/Salish Sea is located at the top of the map.

Vessel collisions/Ship Strikes in the Action Area Fin whales have been reported struck and killed by large OGVs along the entire West Coast (including areas outside of the action area). In 2009, a dead fin whale was carried in on the bow of an OGV into Tacoma, Washington in the action area. Towers et al. (2018) reports 12 dead fin whales, all with evidence of vessel collisions, within the Salish Sea between 1986 and 2017 (Figure 41). Most (88 percent) of the sightings of live fin whales occurred between July and October and no individuals were documented dead or alive between January and April. The authors suggest that fin whales in the inland waters may be at greater risk to vessel collisions than in less confined waters further offshore. Although, the precise locations of the mortality events could not always be determined (Douglas et al. 2008), with several incidents of whales draped over the bow of a ship that had just returned to port from more open waters. Nichol et al. (2017) modeled that the risk of vessel strike near Vancouver Island for fin whales was greatest in the offshore approaches to the Strait of Juan de Fuca and in the western portion of the Strait.

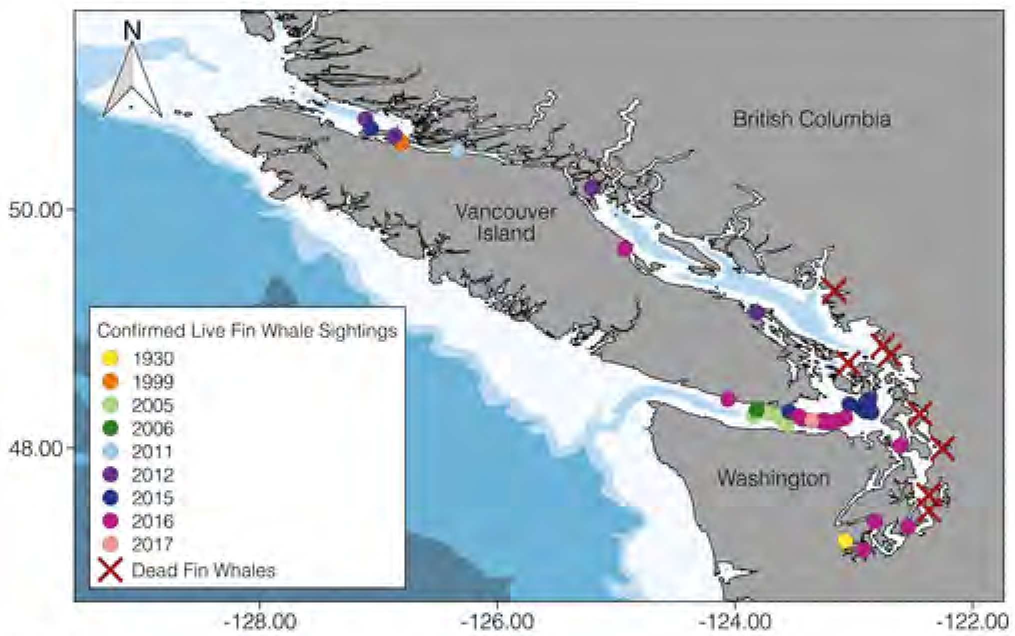

FIGURE 1.
Locations of all confirmed sightings of Fin Whales between Vancouver Island and continental North America by year and locations where carcasses of dead Fin Whales struck by ships were documented.

Figure 41. Copied from Towers et al. (2017) http://www.bioone.org/doi/abs/10.1898/NWN17-16.1

Facility Wastewater and Fin Whales

The treated effluent from the BP facility is not likely to have any measurable effects on listed fin whales considered in this opinion because of the absence or rarity of these animals in the vicinity of the BP Cherry Point opinion and the previously discussed studies that indicate that the presence of contaminants at Cherry Point are at very low levels (Section 2.3.5 and additional information presented in the SRKW section on marine mammals and contaminants). Any direct exposure to the mixing zone or exposed prey would be rare and have insignificant health effects.

2.3.12 Baseline Conditions Western North Pacific Gray Whales

Although there is potential for WNP gray whales to occur along the Washington coast, available data indicate that occurrence is likely to be extremely rare in the action area because the population is so small and the action area is not within this population's primary range. The primary range of Western North Pacific (WNP) gray whales is along the east coast of the Asia continent in the Western North Pacific Ocean. The Western North Pacific gray whales are rare, with population estimates of only 200 individuals. However, tagging, photo-identification, and genetic studies have identified WNP gray whales in Russian foraging areas along the Aleutian Islands, through the Gulf of Alaska, and south to the Washington State and Oregon coasts (Mate *et al.* 2011), and to the southern tip of Baja California and back to Sakhalin Island (IWC 2012). Weller et al. (2012) matched 6 whales (3 whales in both 2004 and 2008) to the WNP population near Barkley Sounds off the west coast of southern Vancouver Island. The facility's past and ongoing wastewater discharge likely has no effect on this species because these whales are so rare that exposure to treated wastewater or exposed prey is extremely unlikely or would be so transient as to be inconsequential (See also Section 2.3.5 and the analysis under SRKW and Wastewater)

2.3.13 Baseline Conditions North Pacific Right Whale

The North Pacific right whale population was severely depleted by legal and illegal commercial whaling up until 1999 (Brownell et al. 2001, Wade et al. 2011a). It is thought this stock migrates from high-latitude feeding grounds in summer to more temperate waters during the winter, possibly well offshore (Scarff 1986, Clapham et al. 2004). Only 43 right whales were observed in the 1980s and 1990s in the eastern North Pacific, with five of those occurring off California or Mexico and one off the coast of Washington. The one whale sighted off Washington was in 1992, while none have been sighted off of Oregon as of 2001 (Brownell *et al*. 2001). In more recent years, there have been two sightings of single right whales in the waters of British Columbia. The first was observed off Haida Gwaii on 9 June 2013 and the second, a large adult, was seen in the Strait of Juan de Fuca on 25 October 2013. Two right whale calls were detected on a bottom-mounted hydrophone off the Washington Coast on 29 June 2013 (Širović et al. 2015). No right whale calls were detected in previous years at this site. It is likely that right whales were never common off the coast of Oregon and Washington (Scarff 1986, 1991). Aboriginal and commercial whaling records indicate that right whales were not common off the west coast of North America even during the early stages of whaling (Townsend 1935, Scarff 1986, Mitchell and Reeves 2001). Their migration patterns are unknown, but are believed to include north-south movements between summer and winter feeding areas. Given this available information, we presume that right whales would occur rarely in the action area on the outer coast of Washington, and would be very rare in the Salish Sea.

While no information is available on the North Pacific right whale hearing range, it is anticipated that they are low-frequency specialists similar to other baleen whales. Thickness and width measurements of the basilar membrane have been conducted on North Atlantic right whale and suggest an estimated hearing range of 10 Hz-22 kHz based on established marine mammal models (Parks et al. 2007b). Low-frequency anthropogenic noise such as ship traffic can mask the hearing capabilities of whales, potentially affecting critical life-history events (NRC 2003), and can result in increased stress levels in right whales (Rolland et al. 2012).

Right whales are slow-moving animals and are susceptible to injury or mortality by ship strike. Vessel collisions are considered the primary source of human-caused mortality of right whales in the North Atlantic (Cole et al. 2005). However, due to their rare occurrence and scattered distribution, it is impossible to assess the threat of vessel collisions to the North Pacific population. Changes in oceanographic conditions that impact the availability of zooplankton (Stabeno et al. 2012), the primary prey of North Pacific right whales, has the potential to impact the health and fitness of this stock. A number of factors, including a warming climate, are expected to significantly change the distribution and abundance of zooplankton within key feeding areas for the North Pacific right whale in the future (Mueter and Litzow 2008).

The facility’s past and ongoing wastewater discharge likely has no effect on this species because these whales are so rare that exposure to treated wastewater or exposed prey is extremely unlikely or would be so transient as to be inconsequential (See also Section 2.3.5 and the analysis under SRKW for marine mammal exposure to contaminants).

2.3.14 Baseline Conditions Sperm Whale

Sperm whales are very rare in the action area, although one sperm whale was sighted in the action area in the Puget Sound/Salish Sea near the San Juan Islands in Haro Strait in March 2018. Increasing levels of anthropogenic sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for deep-diving whales like sperm whales that feed in the ocean's "sound channel." Three sperm whales have been reported as stranded on the Washington outer coast (Douglas et al. 2008).

Vessel Collisions of Sperm Whales From 1998-2013, the total estimated number of observed or assumed mortality and serious injury attributed to vessel collisions off the U.S. West Coast is approximately 4 sperm whales (WCR Stranding Database). One of the stranded sperm whales on the Washington coast had propeller marks (Douglas et al. 2008). Sperm whales interactions with large OGV are rarely reported within the action area, although they are likely vulnerable to vessel collisions off the West Coast of the U.S. Carcasses that do not drift ashore may go unreported, and those that do strand may show no obvious signs of having been struck by a ship. Two whales described as "possibly sperm whales" are known to have died in U.S. waters in 1990, after being struck by OGV (Barlow *et al.* 1997). In 2007, in Florence, Oregon (outside of the action area), a calf stranded dead with obvious signs of propeller trauma. In 2009, a sperm whale carcass washed ashore at Point Reyes, California (outside of the action area) with severe bruising and hemorrhaging along the dorsum, consistent with injuries likely to have been caused from a ship strike.

Sperm Whale and Facility Wastewater

The facility's past and ongoing wastewater discharge likely has no effect on this species because these whales are so rare that exposure to treated wastewater or exposed prey is extremely unlikely or would be so transient as to be inconsequential (See also Section 2.3.5 and the analysis under SRKW for marine mammal exposure to wastewater).

2.3.15 Baseline Conditions Leatherback Turtle

Leatherbacks regularly occur off the coast of Washington, especially off the mouth of the Columbia River (outside of the action area) during the summer and fall when large aggregations of jellyfish form (WDFW 2012b). Observations, telemetry data, and gillnet captures of leatherbacks off the Washington coast, identified turtles south of Cape Flattery and in deeper offshore water (WDFW 2012b). Leatherback turtles occur in the action area, more commonly on the outer coast, with rare occurrence in the inland waters of the Salish Sea.

Based on satellite tracking data from leatherbacks nesting on western Pacific beaches or foraging off California, some leatherbacks will move into U.S. coastal waters as early as the spring, often coming directly from foraging areas in the eastern equatorial Pacific (Benson *et al.* 2011). Leatherbacks will move into areas of high abundance and density of gelatinous prey, *e.g.*, *Chrysaora fuscescens* and *Aurelia spp.*, along the West Coast when upwelling relaxes and sea surface temperatures increase and retention areas develop (Benson *et al.* 2011). These coastal foraging areas are primarily upwelling "shadows," regions where larval fish, crabs, and jellyfish are retained in the upper water column during relaxation of upwelling. Three main areas of foraging have been documented on the U.S. West Coast: in California over the coastal shelf in waters of 14-16° C, particularly off of central CA; along the continental shelf and slope off of Oregon and Washington, particularly off the Columbia River plume (to the south of the action area); and offshore of central and northern California at sea surface temperature fronts in deep offshore areas, although this area was not regularly used (Benson *et al.* 2011).

Researchers estimated an average of 178 leatherbacks were present between the coast and roughly the 50-fathom isobath off California (Benson *et al.* 2007b). Abundance over the study period was variable between years, ranging from an estimated 20 leatherbacks (1995) to 366 leatherbacks (1990) (Benson *et al.* 2007b). Along the coast of Washington, past and present population status is difficult to quantify, but research using satellite telemetry indicates that the state's outer coast (especially the area near the Columbia River plume outside of the action area) is an important foraging area for the species (Benson et al. 2011). This suggests that an unknown number of the turtles annually visit Washington. The Washington Department of Fish and Wildlife reports that for many years, commercial and sport fishermen have noted occasional sightings of single individuals or small groups of leatherbacks off the coast of Washington (Stinson 1984; E. Holman pers. comm. 2016 as quoted in Sato 2017). There were 78 documented occurrences from a variety of sources from 1975 to 2013, with records extending from the mouth of the Columbia River north to Cape Flattery. In aerial surveys conducted off the coasts of California, Oregon, and Washington between 1989 and 1992, Bowlby et al. (1994) noted that 14 of 19 leatherbacks (74 percent) counted during the survey were sighted in Washington waters. At-sea sightings (documented or otherwise), strandings, and a limited number of aerial surveys cannot provide an accurate or complete representation of population status or explain fluctuations, since the data provided are limited by survey effort and reliance on incidental reporting. Nevertheless, Sato (2017) concludes that the number of western Pacific leatherbacks in Washington is likely decreasing over time, based on the strong declines in the nesting population in Indonesia.

Critical habitat for leatherback turtle has been designated at the western extent of the action area in the vicinity of J Buoy (Figure 42, 77 FR 4170). Critical habitat does not extend into the Strait of Juan de Fuca or Puget Sound; therefore, vessels calling at the BP Marine Terminal would pass through a northern portion of leatherback turtle critical habitat on the outer coast of Washington. The habitat feature for conservation of leatherback turtles is the occurrence of prey species, primarily *scyphomedusae* (jellyfish) of the order *Semaeostomeae* (*Chrysaora, Aurelia, Phacellophora, and Cyanea*), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks.

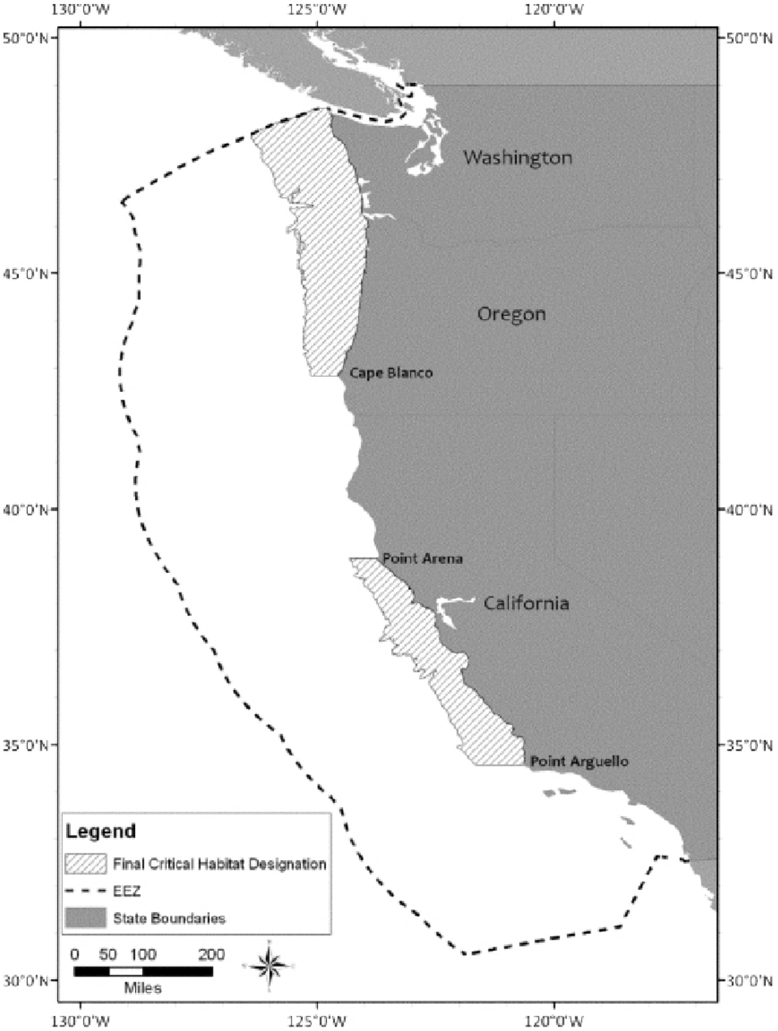

Figure 42. Designated Critical Habitat for U.S. West Coast Leatherback Turtle

Vessel Collision and Leatherback Turtle

Vessel collisions are occasionally a source of injury and mortality to sea turtles along the West Coast. A review of the stranding database indicates that leatherbacks are reported most often as stranded due to the impact by vessel strikes compared to other sea turtles along the West Coast (Figures 43 and 44). Confirmed stranding data related to vessel collisions is not available for the action area. In this case, we looked at stranding data from California as a comparison. As with California, ship strikes to leatherback sea turtles are likely to occur in offshore foraging areas, which overlaps with current shipping routes. Of leatherback strandings documented in central California between 1981 and 2016, 11 were determined to be the result of vessel strikes (7.3 percent of total; NMFS unpublished data). Between 2000 and 2005, there were three reported boat collisions with leatherbacks off the California coast, and the fate of these turtles is unknown (SWR stranding database). Two of the reports documented damage to the carapace, head, or flippers. In 2008, there was another boat collision reported off Cayucos Point, California and the turtle was observed dead (Carretta *et al.* 2013). Vessel collisions likely go largely unreported, and may pose a threat to leatherbacks in foraging areas like the Gulf of the Farallones in Northern California (Benson *et al.* 2007b).

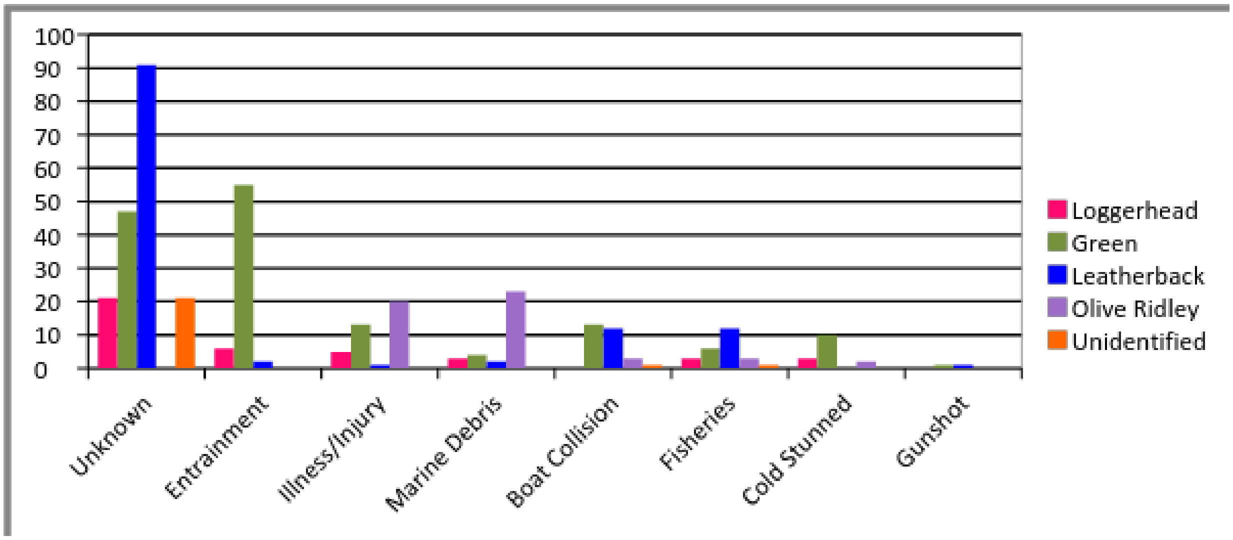

Figure 43. Known causes of sea turtle strandings off the U.S. West Coast, 1957–2009.

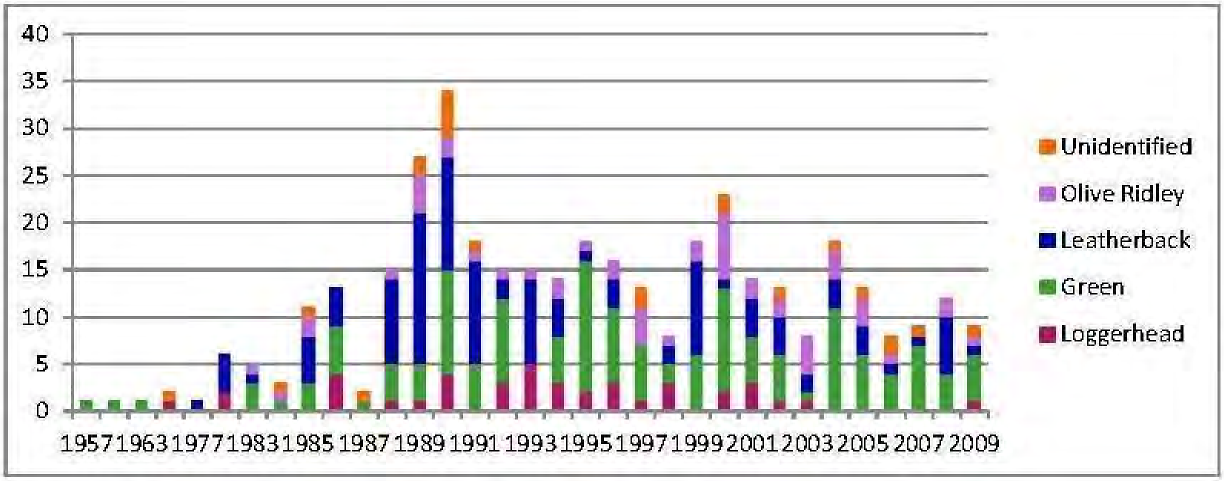

Figure 44. Sea turtle strandings documented off the U.S. West Coast, 1957–2009.

Leatherback and Facility Wastewater

The facility's past and ongoing wastewater discharge likely has no effect on this species because these turtles are so rare that exposure to treated wastewater or exposed prey is extremely unlikely, or would be so transient as to be inconsequential (See also Section 2.3.5 and the analysis under SRKW and Wastewater)

2.3.16 Baseline Conditions Puget Sound Chinook Salmon

The action area is coextensive with much of the range of the Puget Sound Chinook salmon with the inland waters of the Salish Sea, so the status of the species in the action area is essentially the same as the rangewide status of the species (Section 2.2.3.9). All of the 22 extant populations from the five major river basins in the Puget Sound region rear in and transit through the action area as juvenile fish make their way to sea and as adult spawners returning to their natal rivers.

The Puget Sound Chinook salmon ESU is a composite of many individual populations of naturally spawning Chinook salmon and a number of hatchery stocks. The boundary of the Puget Sound Chinook salmon ESU extends from the Nooksack River in the north to southern Puget Sound, includes Hood Canal, and extends westerly out the Strait of Juan de Fuca to the Elwha River. Among the 22 populations, fish from the Nooksack and Skagit rivers are most likely to occur seasonally in the Cherry Point area. The Skagit River and its tributaries constitute what was historically the predominant system in Puget Sound containing naturally spawning populations. There are two independent populations of Puget Sound Chinook salmon in the Nooksack basin: North Fork Nooksack River (including Middle Fork), and South Fork Nooksack River. These salmon are distinct from Chinook salmon in the rest of Puget Sound in their genetic attributes, life history, and habitat characteristics. They are the only populations in the Strait of Georgia region, and they are two of only six Chinook runs left in Puget Sound that return to their rivers in spring (as opposed to fall spawners). For these reasons, the Nooksack populations are considered essential to the recovery of the Puget Sound Chinook ESU (Ruckelshouse et. al., 2006).

The action area contains designated areas for PBFs #4 and #5 for PS Chinook salmon. For PBF #6, the TRT described the PBF's but did not map specific areas as described below. Therefore, this opinion does not specifically address effects to PBF #6 as specific areas are not designated.

> PBF (4) Estuarine areas free of obstruction and excessive predation with: (i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.
>
> PBF (5) Nearshore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.
>
> PBF (6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation. For this PBF, NMFS did not identify specific offshore marine areas of Puget Sound and the Pacific Ocean. For salmonids in offshore marine areas beyond the nearshore extent of the photic zone, it becomes more difficult to identify specific areas where essential habitat features that may require special management considerations can be found. The TRT did identify certain prey species that are harvested commercially (e.g., Pacific herring) as physical or biological features essential to conservation that may require special management considerations or protection. However, because salmonids are opportunistic feeders we could not identify "specific areas" beyond the nearshore marine zone where these or other essential features are found within this vast geographic area occupied by Pacific salmon. Prey species move or drift great distances throughout the ocean and would be difficult to link to any "specific" areas.

The most recent status reviews completed by our Northwest Fisheries Science Center (NWFSC 2015) indicate that all PS Chinook salmon populations continue to be well below the Puget Sound Technical Recovery Team (PSTRT) planning ranges for recovery escapement levels. Most populations are also consistently below the spawner-recruit levels identified by the PSTRT as consistent with recovery. Across the ESU, most populations have declined in abundance since the last status review (NWFSC 2015), and this decline has been persistent over the past seven to ten years. Productivity remains low in most populations. According to the Status Update (NWFSC 2015), hatchery-origin spawners are present in high fractions in most populations outside the Skagit River watershed, and in many watersheds the fraction of spawner abundances that are natural origin have declined over time. Many of the limiting factors for this species are associated with spawning habitat quality. The action area does not extend into freshwater river systems.

BP Facility Wastewater and Puget Sound Chinook

Section 2.3.5 presents information on the current wastewater discharge at the BP facility. Petroleum-based Polycyclic Aromatic Hydrocarbons (PAHs) and heavy metals affect fish by uptake directly through their gills, and through dietary exposure (Karrow et al. 1999; Lee and Dobbs 1972; McCain et al. 1990; Meador et al. 2006; Neff 1982; Varanasi et al. 1993). Direct exposure to pollutants can cause effects in exposed fish that range from avoidance behaviors, to reduced growth, altered immune function, and immediate mortality in exposed individuals. The intensity of effects depends largely on the pollutant, its concentration, and/or the duration of exposure (Beitinger and Freeman 1983; Brette et al. 2014; Feist et al. 2011; Gobel et al. 2007; Incardona et al. 2004, 2005, and 2006; Mcintyre et al. 2012; Meadore et al. 2006; Sandahl et al. 2007; Spromberg et al. 2015).

Beitinger and Freeman (1983) report that fish possess acute chemical discrimination abilities and that very low levels of some water-borne contaminants can trigger strong avoidance behaviors. Exposure to PAHs can cause reduced growth, increased susceptibility to infection, and increased mortality in juvenile salmonids (Meador et al. 2006; Varanasi et al. 1993). Zinc can bind to fish gills and cause suffocation (WDOE 2008). In freshwater, exposure to dissolved copper at concentrations between 0.3 to 3.2 µg/L above background levels has been shown to cause avoidance of an area, to reduce salmonid olfaction, and to induce behaviors that increase juvenile salmon’s vulnerability to predators (Giattina et al. 1982; Hecht et al. 2007; McIntyre et al. 2012; Sommers et al. 2016; Tierney et al. 2010). However, dissolved copper’s olfactory toxicity in salmon diminishes quickly with increased salinity. Baldwin (2015) reports no toxicity at copper concentrations below 50 µg/L in estuarine waters with a salinity of 10 parts per thousand, and Sommers et al. (2016) report no copper-related impairment of olfactory function in salmon in saltwater.

Contaminants that settle to the bottom are biologically available in the receiving waters into the foreseeable future. Amphipods and copepods uptake PAHs from contaminated sediments (Landrum and Scavia 1983; Landrum et al. 1984; Neff 1982), and pass them to juvenile Chinook salmon and other fish through the food web. Varanasi et al. (1993) found high levels of PAHs in the stomach contents of juvenile Chinook salmon in the contaminated Duwamish Waterway. They also reported reduced growth, suppressed immune competence, as well as increased mortality in juvenile Chinook salmon that was likely caused by the dietary exposure to PAHs.

Meador et al. (2006) demonstrated that dietary exposure to PAHs caused “toxicant-induced starvation” with reduced growth and reduced lipid stores in juvenile Chinook salmon. The authors surmised that these impacts could severely impact the odds of survival in affected juvenile Chinook salmon.

Based on information presented in Section 2.3.5 indicating that contaminant levels are very low, it is likely that a small number of PS Chinook salmon, relative to the respective populations that transit through the Cherry Point area, likely pick up very low levels of contaminants (sublethal levels) of contaminant through direct and indirect food web exposure. It is highly doubtful that PS Chinook suffer lethal exposures with very few among those exposed having reduced growth or survival rates.

Puget Sound Chinook Critical Habitat and Wastewater

The ongoing discharge of treated wastewater by BP adversely affects the water quality and prey availability PBFs of PS Chinook salmon to a spatially small degree with very low levels of contaminants (Section 2.3.5). Water quality as a PBF in designated critical habitat of Puget Sound is likely to be slightly, but chronically, diminished by the contribution of a range of contaminants in the immediate vicinity of the mixing zone. Prey availability may also be diminished to a small degree in the immediate Cherry Point region through food web interactions, potentially with low level disruption of herring spawning success from low level PAH exposure as previously discussed above.

2.3.17 Baseline Conditions Puget Sound Steelhead

No critical habitat has been designated in the marine waters of Puget Sound or Georgia Strait and therefore none occurs in the action area except for spatially limited estuarine areas as the mouths of some rivers. No critical habitat occurs in the Cherry Point area at the BP facility. All of the Puget Sound steelhead populations transit through the action area on their way to and from sea. Steelhead productivity has been variable for most populations since the mid-1980s. In the NWFSC status review update, natural productivity was measured as the intrinsic rate of natural increase (r), which has been well below replacement for at least six of the steelhead DIPs (NWFSC 2015). These six steelhead populations include, the Stillaguamish River winter-run in the Northern Cascade MPG, the North Lake Washington and Lake Sammamish, Puyallup River/Carbon River and Nisqually winter-run populations in the Central and South Puget Sound MPG, and the Dungeness and Elwha winter-run populations in the Hood Canal and Strait of Juan de Fuca MPG. Productivity has fluctuated around replacement for the remainder of Puget Sound steelhead populations, but the majority have predominantly been below replacement since around 2000 (NWFSC 2015). Some steelhead populations are also showing signs of productivity that has been above replacement in some years. Steelhead populations with productivity estimates above replacement in some years include the Tolt River summer-run, Pilchuck River winter-run, and Nooksack River winter-run in the Northern Cascades MPG, the White River winter-run in the Central and South Puget Sound MPG, and the East Hood Canal Tributaries and Strait of Juan de Fuca Tributaries winter-run steelhead populations in the Hood Canal and Strait of Juan de Fuca MPG.

The Skagit and Nooksack rivers, which discharge into the general vicinity of Cherry Point, support populations of native steelhead. Juvenile steelhead move rapidly out of freshwater and into offshore marine areas and recent studies in steelhead migratory behavior suggest that juveniles spend very little time in nearshore areas (Moore et al., 2010a, Moore et al., 2010b; Romer, 2010 as cited in 78 FR 2726). The nearshore benthic survey conducted by the Lummi Nation found few steelhead juveniles in their extensive beach seining sampling during the 2008 to 2009 survey effort (Dolphin et al 2010). In addition to the limited occurrence of steelhead documented in the vicinity of the BP Marine Terminal, this species also migrates through the Strait of Juan de Fuca enroute to spawning tributaries throughout Washington's north coast. Similar to PS Chinook salmon, PS steelhead face uncertainty from climate change and poor water quality in the Salish Sea.

Puget Sound Steelhead and Wastewater

Based on information presented in Section 2.3.5 and because PS steelhead head out to sea quickly after leaving their natal rivers, any exposure to treated wastewater and potential low level food web bioaccumulation is likely very low and inconsequential to this species. Critical habitat is not designated in the Cherry Point area, therefore the wastewater has no effect on PS steelhead critical habitat.

2.3.18 Baseline Conditions Hood Canal Summer Chum

The range of summer chum salmon is highly restricted and extends only to discrete portions of the eastern portion of the Olympic Peninsula and south into Hood Canal. These include spawning adults returning to Snow Creek (Discovery Bay), Chimicum Creek (near Port Townsend) and many drainages in Hood Canal.

Critical habitat has been designated within the action area for the Strait of Juan de Fuca from the line of extreme high tide to a depth of 30 meters (98 feet). Vessels calling at the BP Marine Terminal would likely pass through areas designated as chum salmon critical habitat. Adult chum could migrate through the action area enroute to spawning tributaries.

Summer Chum and Facility Wastewater

Based on information presented in Section 2.3.5 and because the facility is located a far distance from Hood Canal, any exposure to treated wastewater and potential low-level food web bioaccumulation is likely very low and inconsequential to this species. Critical habitat is not designated in the Cherry Point area, therefore the wastewater has no effect on Hood Canal summer chum critical habitat.

2.3.19 Baseline Conditions Eulachon

Outside of the Columbia River Basin, eulachon have been occasionally reported from other coastal Washington rivers including Willapa Bay, Grays Harbor, and at the mouth of various small streams of the coast (Swan 1881 as cited in Moody 2008). Spawning runs outside the Columbia River Basin have been documented at Willapa Bay (North, Naselle, Nemah, Bear, and Willapa rivers), Grays Harbor (Humptulips, Chehalis, Aberdeen, and Wynoochee rivers), and the

Copalis, Moclips, Quinault, Queets, and Bogachiel rivers (WDFW and ODFW 2001 and Willson et al. 2006).

Within the action area, Shaffer et al. (2007) reported on the capture of 58 adult eulachon in the Elwha River on Washington's Olympic Peninsula between March 18 and June 28, 2005. This was the first formal documentation of eulachon in the Elwha River, although anecdotal observations suggest that eulachon "were a regular, predictable feature in the Elwha until the mid-1970s" (Shaffer et al. 2007). Other Olympic Peninsula rivers draining into the Strait of Juan de Fuca have been extensively surveyed over many years for salmonid migrations; however, eulachon have not been observed in any of these other systems (Shaffer et al. 2007).

A WDFW technical report entitled "Marine Forage Fishes in Puget Sound" (Pentilla 2007) presents detailed data on the biology and status and trends of surf smelt and longfin smelt in Puget Sound, but states that "there is virtually no life history information within the Puget Sound Basin" available for eulachon. Similarly, detailed notes provided by WDFW and ODFW as part of this review, do not provide evidence of spawning stocks of eulachon in Puget Sound rivers. Monaco et al. (1990) described eulachon as "rare" in Skagit Bay and, in addition to a personal communication, cited Miller and Borton (1980) as a supporting reference. Miller and Borton (1980) report on a total of 20 eulachon specimens collected in the San Juan Islands, southern Strait of Georgia, and Strait of Juan de Fuca and recorded in boat logs and museum collection records; however, samples from Skagit Bay were not included in this list. Eulachon has been incidentally caught by the Puget Sound non-spot shrimp trawl fishery within the inland waters (NMFS 2012b) Since 2011, eulachon have been found in small numbers throughout Puget Sound and in several watersheds including the Deschutes River, Dungeness River, Elwha River, Goldsborough Creek (Mason Co.), Nisqually River, and Salmon Creek (Jefferson Co.) (NMFS APPS database; https://apps.nmfs.noaa.gov/).

The Nooksack River has frequently been listed as supporting a run of eulachon (WDFW and ODFW 2001, Wydoski and Whitney 2003, Willson et al. 2006; Moody 2008); however, there seems to be some confusion as to the exact species encountered. The Nooksack River is known to support a run of longfin smelt [*Spirinchus thaleichthys*], which are sometimes mistaken for eulachon. The run of longfin smelt into the Nooksack occurs in November, which is outside the normal spawning time for eulachon. Additionally, midwater trawl surveys thought the Strait of Juan de Fuca routinely collected longfin smelt juveniles, while eulachon were rarely encountered (Anchor Environmental 2003).

Freshwater critical habitat is designated in the Elwha River on the Olympic Peninsula (Figure 45). This river drains to the Strait of Juan de Fuca in the action area.

Figure 45. Critical habitat for southern DPS of eulachon occurs within the Elwha River. Critical habitat in the Columbia is outside of the action area.

Facility Wastewater and Eulachon

Based on information presented in Section 2.3.5, the rarity of this species in the Cherry Point area, and because the facility is located a far distance from designated critical habitat of this species, any exposure to treated wastewater and potential low-level food web bioaccumulation is likely very low and inconsequential to this species. Critical habitat is not designated in the Cherry Point area, therefore the wastewater has no effect on critical habitat.

2.3.20 Baseline Conditions Green Sturgeon (Southern DPS)

Southern DPS green sturgeon were first documented in Oregon and Washington waters in the late 1950s when tagged San Pablo Bay green sturgeon were recovered in the Columbia River estuary (CDFG 2002). A few individual green sturgeon have been recovered in Puget Sound as incidental harvest from trawl fishers although this species is not known to spawn, rear, or feed in coastal Washington or Puget Sound (Adams et al. 2002). The presence of green sturgeon in

Puget Sound is rare (Lindley et al. 2011), but the species could occur in the action area. Critical habitat for Southern DPS green sturgeon is designated in the action area and includes waters in the Strait of Juan de Fuca and a portion of Rosario Strait (Figure 46; 74 FR 52300). Puget Sound has been excluded from designation because the economic benefits of exclusion outweigh the benefits of inclusion and exclusion will not result in extinction of the species. Vessels calling at the BP Marine Terminal transit through the Strait of Juan de Fuca in the shipping lanes that are located north of the areas designated as green sturgeon critical habitat.

Figure 46. Designated Critical Habitat for Southern DPS Green Sturgeon in the Action Area.

Facility Wastewater and Green Sturgeon

Based on information presented in Section 2.3.5, the rarity of this species in the Cherry Point area, and because the facility is located a far distance from designated critical habitat of this species, any exposure to treated wastewater and potential low-level food web bioaccumulation is likely very low and inconsequential to this species. Critical habitat is not designated in the Cherry Point area, therefore the wastewater has no effect on critical habitat.

2.3.21 Baseline Conditions Rockfish (Bocaccio Rockfish and Yelloweye Rockfish)

The WDFW considers the north Puget Sound area to be one of the most productive areas for groundfish. This area extends from the Canadian border to Deception Pass out to the center of the Strait of Juan de Fuca, including all of the San Juan Islands. Within this area, production data in the vicinity of Cherry Point are not kept distinct.

Information on actual distribution of these two listed rockfish species in the vicinity of the Cherry Point facility is vague at best. Rockfish adults tend to prefer rocky, deeper water habitats of the kind that are not common in the vicinity of the BP Marine Terminal facility (Figure 47). Bocaccio has been found to occur in Central Puget Sound, Tacoma Narrows, Ports Gardner and

Susan, and along the Strait of Juan de Fuca, with the most common occurrences recorded south of the Tacoma Narrows (Drake et al., 2010). Detection of adult yelloweye rockfish indicate they do occur in the broader vicinity of the San Juan Islands near suitable habitat, but have not been observed near Cherry Point (Figure 48). Yelloweye rockfish have been reported by anglers to occur off Middle Bank in Haro Strait, Waldron Island, Hood Canal, Foulweather Bluff, Jefferson Head, Mukilteo, and Bainbridge Island (Washington 1977, Palsson et al. 2009). A 2011 study (Greene and Godersky 2012) of larval rockfish presence in Puget Sound surface waters indicate there is a difference in densities between deepwater and nearshore sites. Based on this preliminary study, the highest relative abundance of rockfish larva would be expected to occur in the action area during August and September.

Final critical habitat for rockfish in the action area includes waters east of Port Angeles north to the BP Marine Terminal (79 FR 68041) (Figure 49). Vessels calling at the BP Marine Terminal would pass through areas designated as rockfish critical habitat and the terminal is located in nearshore critical habitat. There is a kelp bed along the shoreline between the wings of the terminal and the shoreline. Bocaccio are known to utilize kelp for their early life history (Love et al. 2002), and general research shows that areas with floating and submerged kelp species support the highest densities of most juvenile rockfish (Carr 1983; Halderson and Richards 1987; Hayden-Spear 2006; Matthews 1989). General research shows that areas with floating and submerged kelp species support the highest densities of most juvenile rockfish (Carr 1983; Halderson and Richards 1987; Hayden-Spear 2006; Matthews 1989).

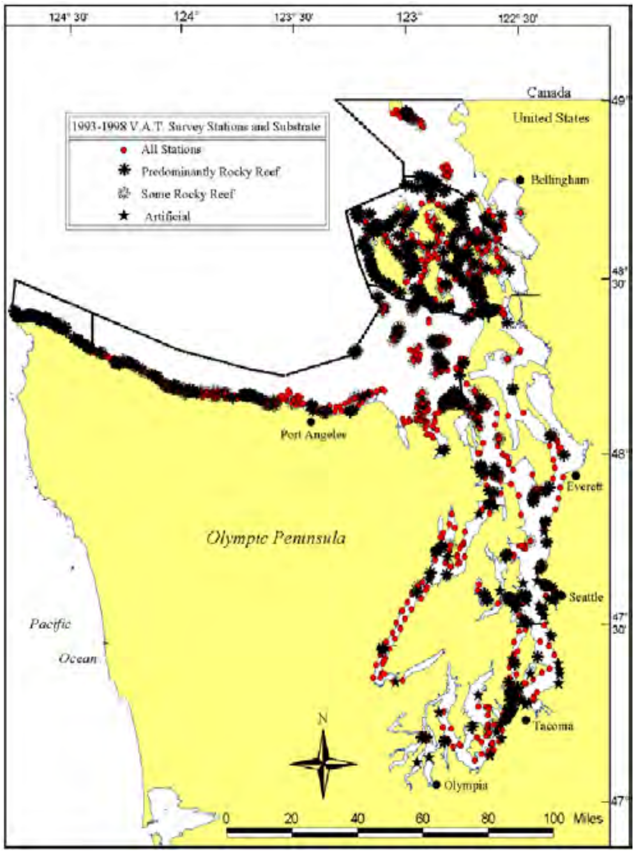

Figure 47. Distribution of Nearshore Rocky Habitats in Puget Sound.

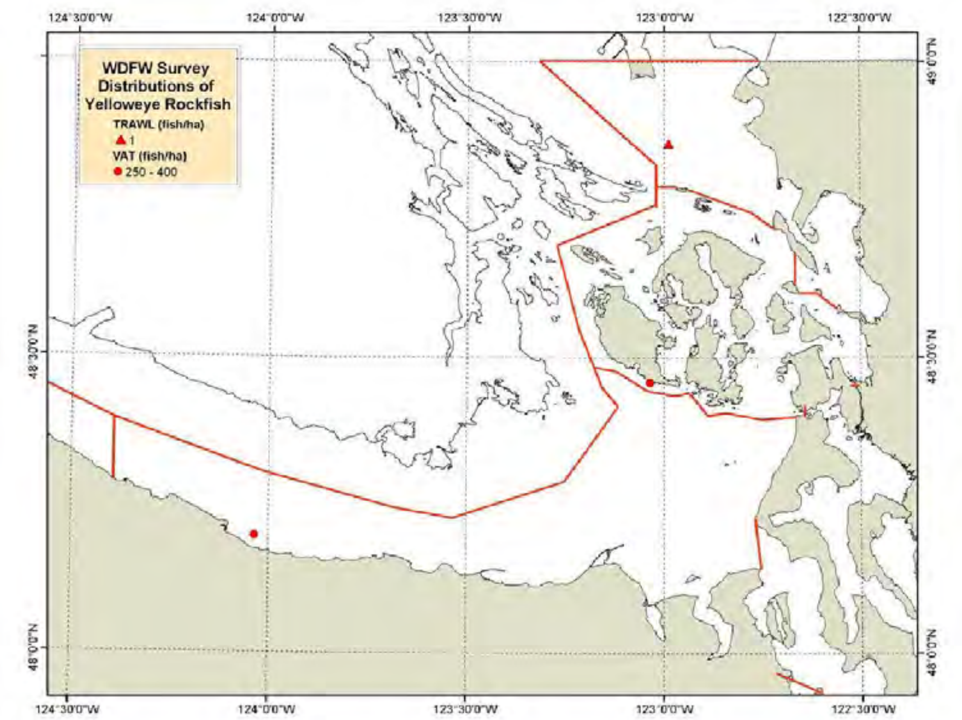

Figure 48. Distribution of Yelloweye Rockfish in North Puget Sound determined from Trawl, Video, and Scuba Surveys

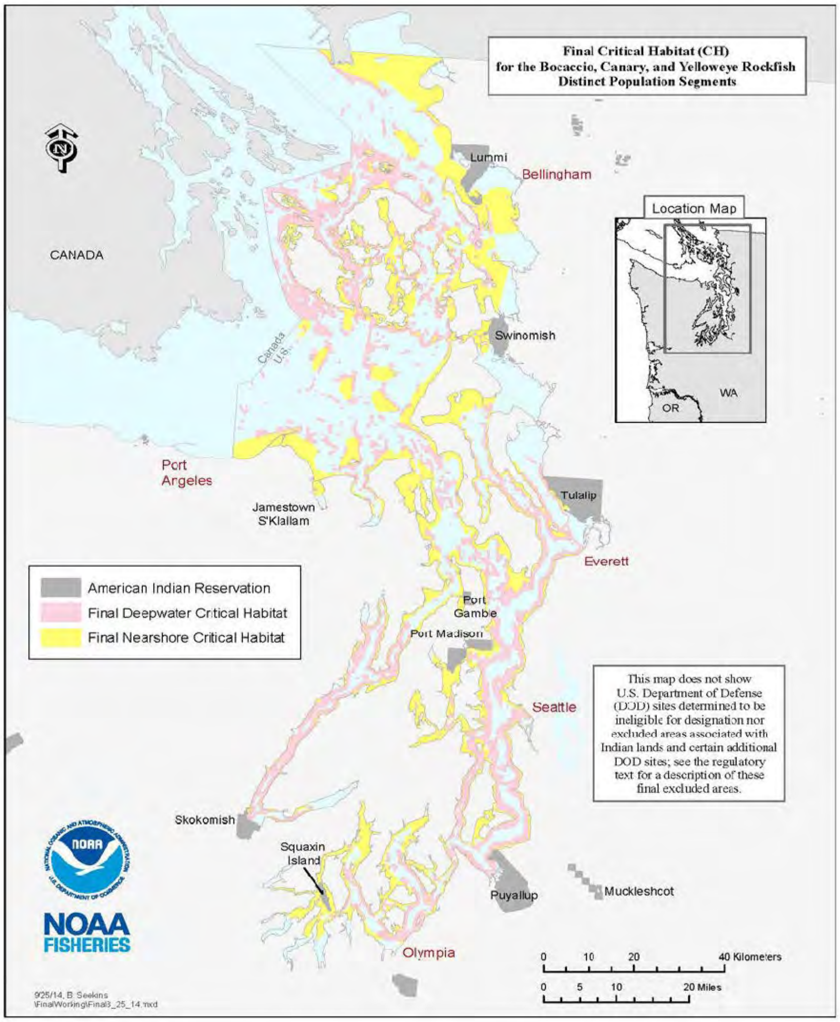

Figure 49. Critical Habitat for the Bocaccio and Yelloweye Rockfish Distinct Population Segments (note that the figure includes canary rockfish- this species is no longer listed).

Most of the benthic deepwater (e.g., deeper than 90 feet (27.4 m) habitats of Puget Sound proper consist of unconsolidated sediments such as sand, mud, and cobbles. The vast majority of the rocky-bottom areas of Puget Sound occur within the San Juan Basin, with the remaining portions spread among the rest of Puget Sound proper (Palsson et al. 2009). Depths in the Puget Sound extend to over 920 feet (280 meters).

Benthic habitats within Puget Sound have been influenced by a number of factors. The degradation of some rocky habitat, loss of eelgrass and kelp, introduction of non-natural-origin species that modify habitat, and degradation of water quality are threats to marine habitat in Puget Sound (Drake et al. 2010; Palsson et al. 2009). Some benthic habitats have been impacted by derelict fishing gear that include lost fishing nets, and shrimp and crab pots (Good et al. 2010).

Over the last century, human activities have introduced a variety of contaminants into the Georgia Basin at levels that can affect adult and juvenile rockfish habitat and/or the prey that support them. Toxic pollutants in Puget Sound include oil and grease, polychlorinated biphenyls (PCBs), phthalates, PBDEs, and heavy metals that include zinc, copper, and lead. Several urban embayments in Puget Sound have high levels of heavy metals and organic compounds (Palsson et al. 2009). There are no studies to date that define specific adverse health effects thresholds for specific toxicants in any rockfish species; however, it is likely that PCBs pose a risk to rockfish 84 health and fitness (Palsson et al. 2009). About 32 percent of the sediments in the Puget Sound region are considered to be moderately or highly contaminated (PSAT 2007), though some areas are undergoing clean-up operations that have improved benthic habitats (Sanga 2015).

Washington State has a variety of marine protected areas managed by 11 Federal, state, and local agencies (Van Cleve et al. 2009), though some of these areas are outside of the range of the rockfish DPSs. The WDFW has established 25 marine reserves within the DPSs' boundary, and 16 host rockfish (Palsson et al. 2009), though most of these reserves are within waters shallower than those typically used by adult yelloweye rockfish or bocaccio. The WDFW reserves total 2,120.7 acres of intertidal and subtidal habitat. The total percentage of the Puget Sound region within reserve status is unknown, though Van Cleve et al. (2009) estimate that one percent of the subtidal habitats of Puget Sound are designated as a reserve. Compared to fished areas, studies have found higher fish densities, sizes, or reproductive activity in the assessed WDFW marine reserves (Eisenhardt 2001; Palsson 1998; Palsson et al. 2004; Palsson and Pacunski 1995). These reserves were established over several decades with unique and somewhat unrelated ecological goals, and encompass relatively small areas (average of 23 acres).

We cannot quantify the effects of degraded habitat on the listed rockfish because these effects are poorly understood. However, there is sufficient evidence to indicate that ESA-listed rockfish productivity may be negatively impacted by the habitat structure and water quality stressors discussed above (Drake et al. 2010).

At the BP Cherry Point facility, nearshore critical habitat is designated along the shoreline. There is also a narrow band of deepwater critical habitat just offshore of Cherry Point (Figure 49). Adult yelloweye rockfish and bocaccio typically occupy waters deeper than 120 feet (Love et al., 2002), while the pier is located in depths of 49 to 69 feet. However, the pier itself creates structure in relatively deep water, which may attract rockfish to the pier. Therefore, we conclude that it is likely that very low numbers of bocaccio and yelloweye rockfish occur in the immediate vicinity of the pier.

Existing Risk of Oil Spill to Rockfish

The rockfish Recovery Plan identifies the threat of oil spill as a threat among "other natural or manmade factors affecting its continued existence" and is listed as a "high" threat across all of Puget Sound/Strait of Georgia, which is the Salish Sea including Canadian waters. The Recovery Plan acknowledges that, "There are numerous parallel efforts underway, independent from rockfish recovery, to protect and restore the Puget Sound ecosystem. Such efforts include oil spill prevention measures, contaminated sediment clean-up projects, and other important projects. These efforts will provide benefits to listed rockfish and habitats and prey base and are thus highlighted in the plan." The plan further states that response and prevention are already conducted in the range of the DPSs and the plan stresses their importance to a "healthy ecosystem that supports listed rockfish."

Facility Wastewater and Bocaccio and Yelloweye Rockfish

Based on the information presented in Section 2.3.5 and Section 2.3.15 above for wastewater and PS Chinook, and the numbers and distribution of these rockfish species, the existing wastewater discharge likely affects very small numbers of bocaccio and yelloweye rockfish in both the nearshore and deepwater habitat near the BP Cherry Point facility. The nearshore habitat contains kelp beds which may attract juvenile bocaccio where they would be exposed to low level contaminants. Because rockfish are long lived, adult fish in the deepwater habitat near the facility may experience chronic, low level exposure to the contaminants in the wastewater. This may reduce the fitness and survival of very small numbers of bocaccio and yelloweye rockfish relative to their respective populations in the Salish Sea. The treated wastewater likely has ongoing low level and spatially limited adverse effects to the water quality and prey PBFs of these species.

2.4 Effects of the Action on Species

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).

For this consultation, we consider the effects of fossil fuel burning in general insofar as we consider effects of on-going climate change as part of the baseline and cumulative effects in the action area. We do not consider impacts from the burning of fuels shipped from the facility, including the production of greenhouse gases (GHGs), separately as an indirect effect of the action. This is because we cannot show a causal connection between the emissions of GHGs from the proposed agency action and specific localized climate change as it impacts listed species or critical habitat with reasonable certainty. The ultimate fate of the refined petroleum products shipped from the facility is unknown and could be used anywhere in the world after production. Due to this high degree of uncertainty, we cannot identify any specific effect from the burning or processing of these fuels that is reasonably certain to occur and the requisite causal connections cannot be made between the emissions of GHGs somewhere in the world and specific localized climate change as it impacts the listed species or critical habitat.[30]

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[30] May 14, 2008, Memorandum from Mark Meyers (USGS) to the US Fish and Wildlife Service Director ("The Challenges of Linking Carbon Emissions, Atmospheric Greenhouse Gas Concentrations, Global Warming, and Consequential Impacts"), which cites several findings of the Intergovernmental Panel on Climate Change (2007) Fourth Assessment Synthesis Report. In particular, the IPCC noted difficulties in simulating and attributing observed temperature changes at smaller than continental scales, because it is a fundamental property of atmospheric CO_2 that it is considered to be "well-mixed", i.e., its residence time in the troposphere is long enough that it becomes homogeneous both vertically and horizontally (i.e., distributed world-wide) and because at smaller than

Additionally, even if we make the unlikely assumptions that all of the exported refined petroleum products are burned to produce energy, and this creates a causal link to a change in temperature in the area where listed species occur, the magnitude of that effect pathway is likely to be too small to constitute an effect on the listed species or critical habitat that can be drawn to the proposed action.[31] However, it should be noted that the overall effects of burning of fossil fuels, including those which could theoretically be linked to this facility, are considered as part of our cumulative effects analysis, and in this way factored into our conclusions.

No new construction will occur with the proposed action. If this proposal were for a new pier, we would consider the potential effects of future construction (temporary disturbance to the environment) and the long-term effects that a new structure and its operations would have on the environment (future consequences to species and habitat). Because no new construction will occur with the action, we consider the past construction-related effects to be part of the baseline. Because the No Action in the DEIS is to revoke the permit for the North Wing, which would require removing it, we *do not* consider the long-term continuous existence of the North Wing to be a part of the environmental baseline[32] (See Table 2) (Cardno and USACE 2014). However, we *do* consider, in our analysis of effects of the action, the ongoing effects of the North Wing on listed species and habitat. That is, we describe the effects of the newer North Wing as "new" or additive effects of the proposed action.

The effects of the action considered in this opinion fall into two categories- those that are based on risk of an accident occurring (oil spill, transfer errors, ship strikes, contaminated ballast water) and those with tangible effects (ship noise, the physical presence of the pier, wastewater). Large/catastrophic oil spills are an ever-present danger in the Salish Sea and the overall risk accumulates over time, yet the probability of a catastrophic spill is very small. A large oil spill is considered a low probability, but potentially high consequence event to species in the action area. Therefore, we analyze the incremental increase in risk as an effect of the action (the increase in risk is reasonably certain to occur; the risk is perceivable, measurable, and partially mitigatable). We consider this increased risk, together with the potential consequences of an actual spill to the species to inform our jeopardy analysis. This is not to say that we consider an actual oil spill to be reasonably certain to occur as a consequence of the proposed action. Rather, we consider the additive risk of the proposed action, in light of the existing risks to the species

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continental scales there are spatially heterogeneous forcings, such as those arising from changes in aerosol loadings and land use patterns, which may have large impacts on regional climate.

[31] Letter from Robert J. Meyers, Principal Deputy Assistant Administrator, Office of Air and Radiation, EPA, to H. Dale Hall, Director, U.S. Fish and Wildlife Service, and James Lecky, Director of Protected Resources, National Marine Fisheries Service, on "Endangered Species Act and GHG Emitting Activities" (October 3, 2008). This EPA analysis determined that a coal plant emitting 14.1 million metric tons of CO_2 per year would raise average global temperatures 0.00022-0.00035 °C after 50 years. Based on the EPA Greenhouse Gas Equivalencies Calculator (http://www.epa.gov/cleanenergy/energy-resources/calculator.html), this amount of CO_2 would be equivalent to that generated by consuming 32.8 million barrels of oil per year. Although the number of barrels of oil shipped per year annually from this facility will likely double what was analyzed by the EPA, the effect of the additional CO2 emissions would cause a miniscule increase in global temperature.

[32] 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 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 C.F.R. § 402.02).

and the degree of the potential consequences to the species, to inform the jeopardy analysis. We also recognize that with a rolling average number of ships, BP will contribute incrementally less risk in some years when operations involve fewer total ship calls and/or fewer crude oil-specific deliveries.

Likewise, in the case of ship strikes, we analyze the incremental increase in risk associated with increased ship numbers in some years over baseline as an effect of the action, but this is not to say that we consider an actual ship strike to be reasonably certain to occur as a consequence of the proposed action. We know that large whales are infrequently struck by ships in the action area, but we cannot reasonably predict that an incremental increase in risk from the proposed action will result in an actual ship strike of an animal. For ship strikes, we consider the incremental increase in risk associated with the proposed action in the action area to each species of whale and turtle in relation to the numbers of animals in the action area and their susceptibility to ship strike to inform our jeopardy analysis. We also recognize that with a rolling average number of ships, BP will contribute incrementally less risk in some years when operations involve fewer total ship calls.

In contrast, transfer errors/small spills occur with regularity (one per year on average), so we consider ongoing transfer error spills- not just the risk- to be an effect of the action. In the case of ballast water, we consider industry best practices to mitigate the risk of introducing invasive species to be adequate to the point that an accidental introduction of non-native species is not reasonably certain to occur.

2.4.1 Risk of Oil Spill

Oil spills from commercial vessels are considered in general terms to be “low probability/high consequence events” (WDOE 2015). Particularly for Southern Resident killer whales, the consequence of a large oil spill could be severe and lead to extinction (NMFS 2008a).

There is also the inherent risk of transiting through the action area where an accident could be caused by a multitude of factors from mechanical failure, human error, bad weather, or an unfortunate chain of events. Risk mitigation measures i.e., best management practices (BMPs), industry standards, traffic separation schemes, mechanical inspections, etc., partially reduce overall risk among all vessel traffic in the Salish Sea (WDOE 2015). The various traffic studies presented in this opinion attempt to quantify existing and future risks using statistics and probability theory in mathematical models. The results of these models can help us to perceive relative levels of risk, which provide the industry and regulators information to refine risk mitigation measures. No amount of risk mitigation can reduce the risk of oil spill to zero, and the models cannot predict the future. Each of the models have to be viewed in light of the assumptions made about future conditions, statistical methods, and data inputs. For oil spill risk, ships that carry crude oil present a higher degree of risk associated with the volume of crude that could be spilled. Non-crude oil ships still present risk associated with leaking their cargo and bunker fuel, but the environmental consequences would be much less severe. Refined products dissipate and evaporate relatively rapidly.

The Glosten Associates Vessel Traffic Analysis[33] (TGA VTA). The USACE commissioned this project-specific vessel traffic analysis by The Glosten Associates (TGA), a marine sciences and engineering company. The TGA VTA used a statistical model (known as a Monte Carlo simulation) to analyze incremental potential accident and oil outflow at the maximum projected vessel calling volume at the BP Cherry Point facility (TGA 2014). The report is summarized in Chapter 6 of the USACE's final draft EIS and the full report is attached as Appendix D to the final draft EIS (http://www.nws.usace.army.mil/Missions/Civil-Works/Regulatory/News-and-Updates/) (Cardno and USACE 2014). The TGA VTA found an increase in the potential for accidents and oil spills may occur at future traffic levels (assumes increases in traffic from other facilities in addition to BP) at the upper limit of vessel traffic projected for operation of the BP Cherry Point facility (up to 420 calls per year) (TGA VTA).

The forecast year in the future scenarios is 2030. Vessel traffic was calculated for two time periods: 2010 represents current conditions and 2030 represents future conditions. The 2010 time period was used as a baseline to take advantage of the most recent year in which data from all three of the chosen sources were available. The forecast for 2030 is chosen to provide a 20-year future time period for analysis. The vessel traffic includes the following traffic components:

- BP Traffic – BP-calling tankers and tugs escorting and docking the BP-calling tankers.

- General Traffic – General traffic includes existing tankers, tank barges, bulk carriers, general cargo carriers, tugboats, and passenger/fishing vessels. Future general traffic includes forecasted changes in the existing traffic transiting the study area (i.e. continued traffic increases to and from existing facilities as a baseline condition).

- ·Cumulative Traffic – Cumulative traffic includes tankers, tank barges, bulk carriers, general cargo carriers, tugboats, and passenger/fishing vessels that are likely to be generated by terminals or other facilities that do not yet exist. General and Cumulative traffic are referred to as Non-BP traffic. Four projects were considered reasonably foreseeable by the study team and are included in forecasting cumulative traffic:

- New oil production from the Alaska Outer Continental Shelf beginning in 2024.
- ·Shale oil production from the Alaska North Slope with substantial volumes online by 2016.
- Expansion of Canada's Trans Mountain pipeline to export oil to Asia in 2016 (note- as of April 2019, this project has been approved by the Canadian government, but it is being appealed and is not yet in service) [note- approximately 30-50 oil tankers per year transit through the action area to existing facilities in Canada. If the Trans Mountain Pipeline is

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[33] We note here that this discussion includes both existing and future scenarios. This study includes ongoing traffic that increases over time to the existing facility, defined as "Future General" traffic by the authors- this is similar to describing the baseline as including increasing traffic over time) and what the authors call "Cumulative" traffic, which includes potential new or expanded facilities. The "Cumulative" traffic in the study does not necessarily align with how we would define cumulative under the ESA. Nevertheless, we have included a summary of the study in one place here, rather than try and split up the discussion and put some of the information under the Cumulative Effects Section of this opinion. The study as a whole helps to inform current and future risk. We have kept this discussion in one place under the Baseline Section of this opinion rather than to split up the information and present some of it in the Cumulative Effects Section for readability and logic flow.

completed, this number would increase to approximately 400 crude oil tankers per year of exported crude oil].

- Bulk carrier and tug traffic calling at the Gateway Pacific Terminal (GPT) with up to 487 ships per year (dry goods) by 2030 [note-this project is no longer proposed, so the Cumulative traffic forecast is likely overstated for the 20 year time horizon].

Representative risk statistics for the seven analysis cases are given in Table 25. The average is presented for the number of incidents and number of spills. Median and 95th percentiles are presented for annual spill volume. These are the statistics of 10,000 attempts to predict the number of incidents, spills, and spill volumes in gallons; they should not be interpreted as certain events. They are generated using historical incident and traffic data, supplemented by national and international data, assumptions, and simplifications, which do not affect the incremental risk between cases. The 95th percentile spill volumes show that of the predicted spills, 95 percent would be at or below that spill volume. This means that 5 percent of the spills are predicted to be larger. This model used BP's old calculated maximum number of ships calls at a one-winged pier of 335. BP has updated its calculation of maximum number of ships calls at a one-winged pier to 385 ships per year (Table 1 and 2). Therefore, these model results are not directly representative of the proposed action. The model is still useful in showing how risk can change with potential future increases in traffic or it could be viewed as showing the potential range in risk over time.

Table 25. Table 8 from **TGA VTA** (Cardno and USACE 2014).

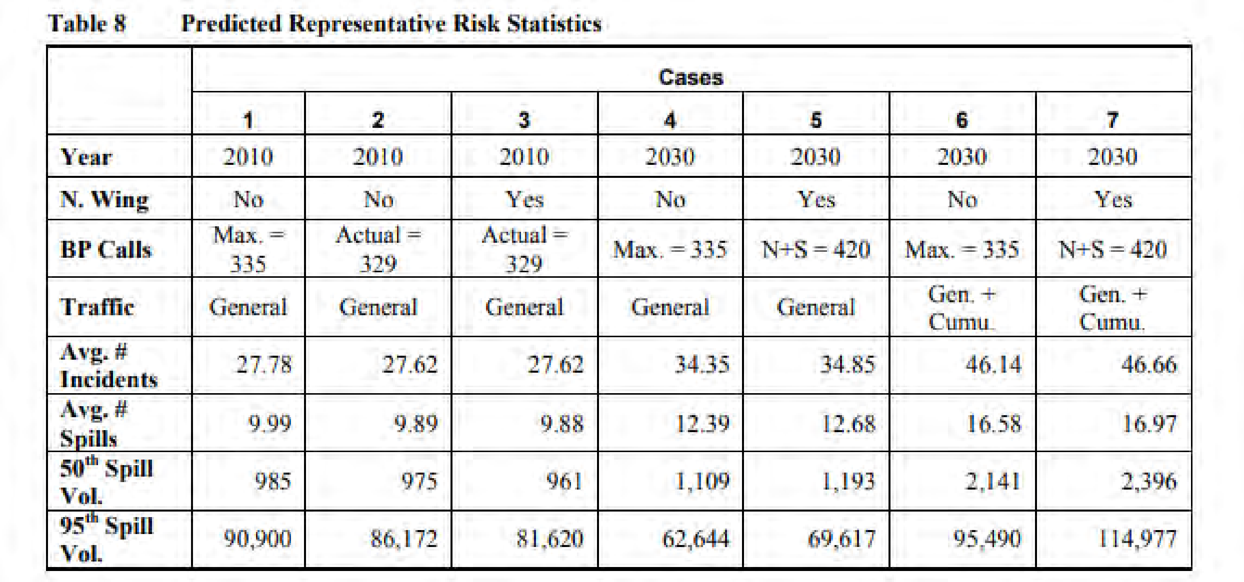


Table 8 Predicted Representative Risk Statistics

	Cases						
	1	2	3	4	5	6	7
Year	2010	2010	2010	2030	2030	2030	2030
N. Wing	No	No	Yes	No	Yes	No	Yes
BP Calls	Max. = 335	Actual = 329	Actual = 329	Max. = 335	N+S = 420	Max. = 335	N+S = 420
Traffic	General	General	General	General	General	Gen. + Cumu.	Gen. + Cumu.
Avg. # Incidents	27.78	27.62	27.62	34.35	34.85	46.14	46.66
Avg. # Spills	9.99	9.89	9.88	12.39	12.68	16.58	16.97
50th Spill Vol.	985	975	961	1,109	1,193	2,141	2,396
95th Spill Vol.	90,900	86,172	81,620	62,644	69,617	95,490	114,977

Case 1 shows the risk profile of operating a one-winged pier with a maximum number of ship calls of 335 per year. Note that BP has updated its estimation of maximum use at a one-winged facility of up to 385 ships per year, so case 1 likely understates the theoretical base year risk.

The modeled results of adding the BP North Wing with 329 calls per year is isolated by comparing Cases 2 and 3, for which the number of BP calls and General traffic remain the same (329 ships was a number chosen by the modelers as an input-the actual average calls was 317 between 2000 and 2014). The model shows a slight reduction in risk by adding the second wing. The slight reduction in the number of spills, and thus the change in annual spill volume, is negligible due to the addition of the second wing, as shown in Table 26. The very small decrease in risk profile is likely from decreased tanker wait time in the system with the addition of a second wing, however the tanker wait time is a small percentage of the total vessel risk exposure in the system (Cardno and USACE 2014).). This finding differs from the GWU VTRA study that showed a greater reduction in risk profile to safer conditions with two wings operating at 335 total ships (although the studies are not directly comparable).

Table 26. Table 9 from **TGA VTA.**

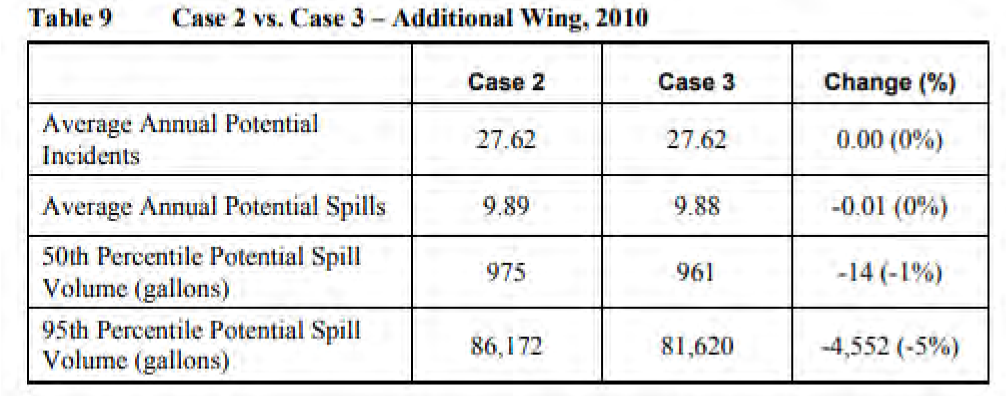


Table 9 Case 2 vs. Case 3 – Additional Wing, 2010

	Case 2	Case 3	Change (%)
Average Annual Potential Incidents	27.62	27.62	0.00 (0%)
Average Annual Potential Spills	9.89	9.88	-0.01 (0%)
50th Percentile Potential Spill Volume (gallons)	975	961	-14 (-1%)
95th Percentile Potential Spill Volume (gallons)	86,172	81,620	-4,552 (-5%)

The modeled results of adding the BP North Wing and operating at the maximum use of 420 calls per year (reduced tanker wait time with two wings and increased maximum number of calls), are isolated by comparing Cases 4 and 5 (Table 27). This is illustrative of the potential effect associated with the No Action in the EIS of removing the North Wing and operating with 335 vessel calls per year at a one-winged facility (BP now estimates that they would actually handle up to 385 ships per year at a one-winged facility) vs permitting the North Wing without restrictions on number of calls and operating consistently at the calculated maximum 420 calls per year. Within the model assumption, there are eighty-five additional calls to BP in Case 5 at the BP “High” forecast as compared to the Single Wing Max of 335. Within the model General Traffic in the year 2030 is increased as a baseline condition- the model assumes all traffic at existing facilities increases over time. The reduction in BP tanker anchoring time with an increase in the number of tankers and tugs underway, maneuvering, and at berth time leads to a small increase in risk in Case 5 vs 4. The change in number of incidents is small. With a small increase in the number of spills, there is a larger increase in annual spill volume. The fiftieth and ninety-fifth percentile spill volume increases from 8 to 11 percent with the increase in total traffic and higher traffic level at the BP facility. The changes in potential spill volume at the fiftieth percentile spill size were small (84-gallon increase).

Table 27. Table 10 from **TGA VTA.**

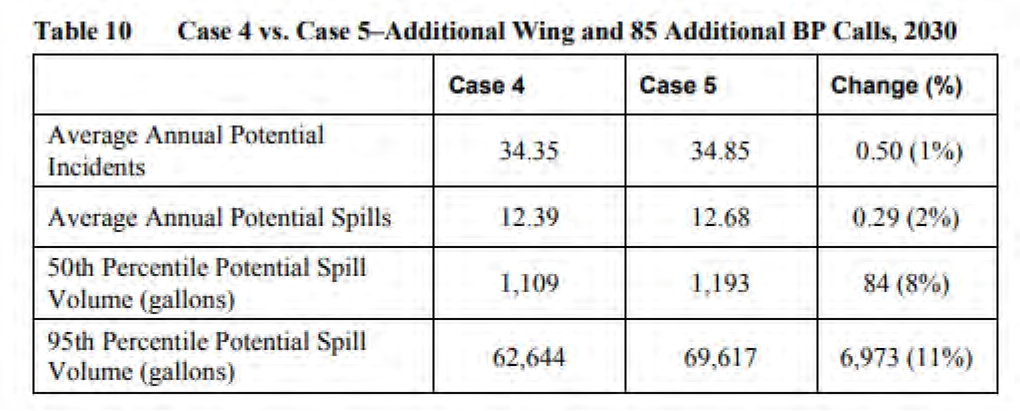


Table 10 Case 4 vs. Case 5–Additional Wing and 85 Additional BP Calls, 2030

	Case 4	Case 5	Change (%)
Average Annual Potential Incidents	34.35	34.85	0.50 (1%)
Average Annual Potential Spills	12.39	12.68	0.29 (2%)
50th Percentile Potential Spill Volume (gallons)	1,109	1,193	84 (8%)
95th Percentile Potential Spill Volume (gallons)	62,644	69,617	6,973 (11%)

The effect of adding Cumulative Traffic to the General Traffic is isolated by comparing Cases 5 and 7 in Table 28. The increase in risk statistics is large enough to be considered significant and attributable to additional vessel traffic days. Although these numbers are likely overstated because they include GPT traffic at Cherry Point (487 ships per year) and that project has since been denied by the USACE. It is also not known if the Canadian Trans Mountain Pipeline project will move forward and add approximately 350 oil tanker traffic to the action area. Therefore, Case 5 and Case 7 can be viewed as theoretical "worse-case" scenarios.

Table 28. Table 11 from **TGA VTA**

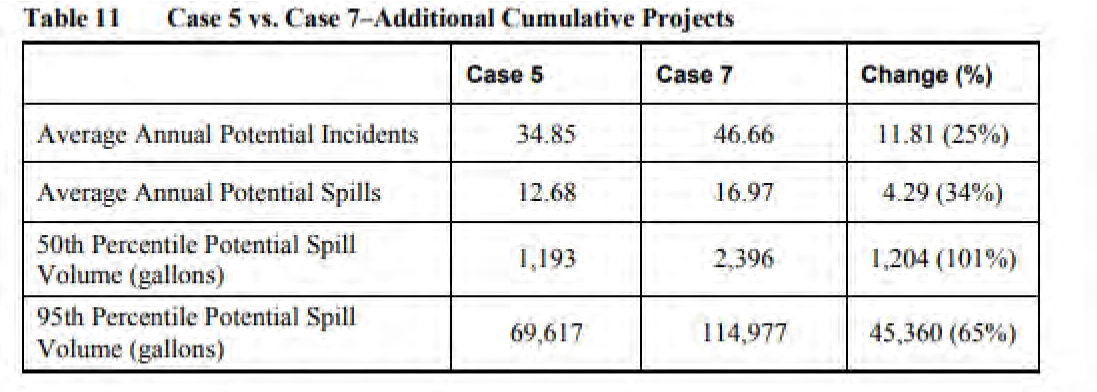
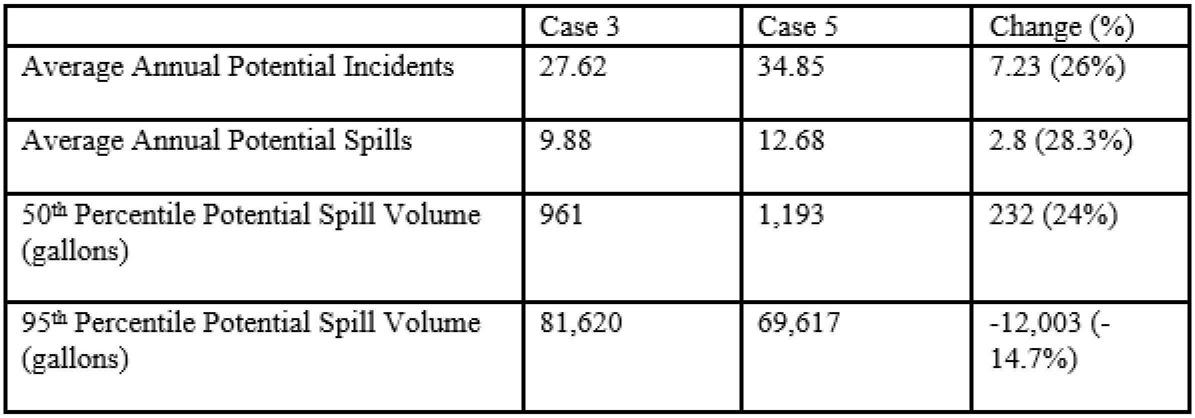


Table 11 Case 5 vs. Case 7–Additional Cumulative Projects

	Case 5	Case 7	Change (%)
Average Annual Potential Incidents	34.85	46.66	11.81 (25%)
Average Annual Potential Spills	12.68	16.97	4.29 (34%)
50th Percentile Potential Spill Volume (gallons)	1,193	2,396	1,204 (101%)
95th Percentile Potential Spill Volume (gallons)	69,617	114,977	45,360 (65%)

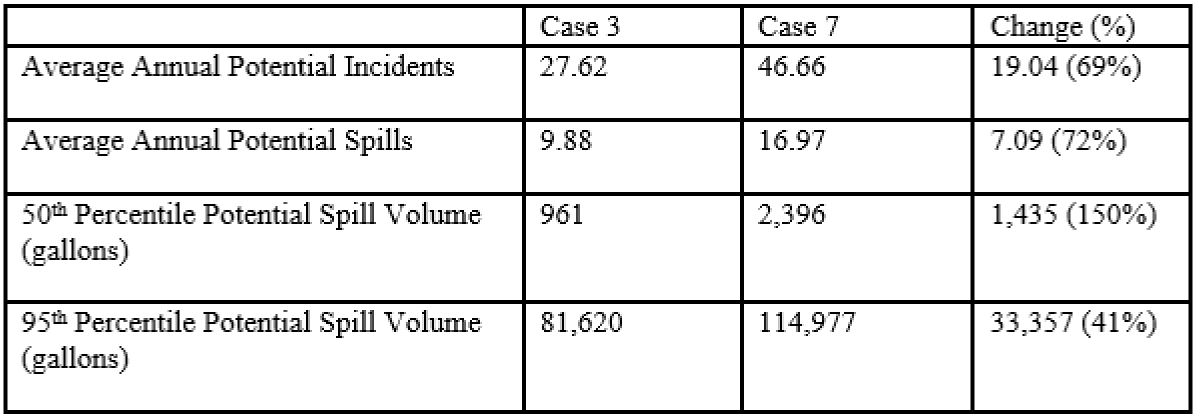
Comparing Case 3 to Case 5 and Case 3 to Case 7 isolates the effect of increasing the number of ships at the existing two-winged facility together with overall traffic increases as a baseline condition (Case 5) and the effect of adding new facilities to the region (General plus Cumulative Traffic (Case 7)). These two comparisons show that increasing traffic leads to increasing numbers of incidents and spill volumes (using future projects that are not certain), except for a decrease in spill volume of 12,003 gallons in the Case 3 vs Case 5 example.

Table 29. Case 3 vs Case 5.



	Case 3	Case 5	Change (%)
Average Annual Potential Incidents	27.62	34.85	7.23 (26%)
Average Annual Potential Spills	9.88	12.68	2.8 (28.3%)
50th Percentile Potential Spill Volume (gallons)	961	1,193	232 (24%)
95th Percentile Potential Spill Volume (gallons)	81,620	69,617	-12,003 (-14.7%)

Table 30. Case 3 vs Case 7



	Case 3	Case 7	Change (%)
Average Annual Potential Incidents	27.62	46.66	19.04 (69%)
Average Annual Potential Spills	9.88	16.97	7.09 (72%)
50th Percentile Potential Spill Volume (gallons)	961	2,396	1,435 (150%)
95th Percentile Potential Spill Volume (gallons)	81,620	114,977	33,357 (41%)

The various comparisons show that in general, as traffic increases, the number of potential incidents increases. Although Case 5 shows a slight decrease in oil outflow at the 95th percentile, with a spill volume of 69,617 gallons.

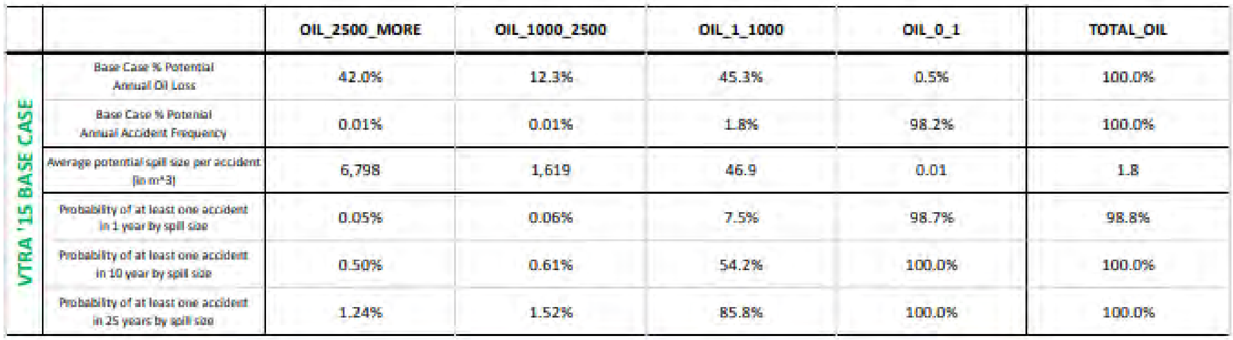
The 95th percentile spill volumes show that of the model-predicted spills, 95 percent would be at or below that spill volume. This means that 5 percent of the spills are predicted to be larger. Case 6 shows that over time risk increases occur as a baseline and cumulative condition because all traffic is predicted to increase over time within the model, although the GPT request for authorization from the USACE at Cherry Point for a new bulk carrier terminal was denied so these results may be overstated, yet the Canadian Trans Mountain Pipeline project is still a possibility.

2015 Vessel Traffic Risk Assessment (2015 VRTA)

BP's ships are part of the overall traffic scheme in the action area. WDOE's 2015 VTRA modeled the potential for high consequence spill events across the entire traffic system in the Salish Sea (described below). The model also shows how risk accumulates over time.

As shown in WDOE's 2015 VTRA, for the base case [overall baseline oil spill risk in the action area-not specific to, but including BP], the potential chance in this model of one or more spills occurring in one year for a large spill (1.8 million gallons average – 2500 cubic meter or more category) is 0.05 percent [note about probabilities- a probability of 1 equals 100 percent chance- therefore a 0.05 percent chance equates to a probability of 0.0005]. A spill size of 1000 to 2500 cubic meters (average spill size of 430,000 gallons) has 0.06 percent chance (probability of 0.0006) in one year. The smaller modeled spill of 1 to 1000 cubic meters (12,000-gallon average) has a 7.5 percent chance in one year (probability of .075). Reading the columns of the figure vertically shows how risk accumulates over time. Observe from each column that the probability of at least one accident over a specified time period mathematically increases with the length of that time period (cumulative probability). For example, focusing on the first column for the biggest spills, while a 0.05 percent probability (0.0005 probability) is shown for at least one accident within that potential oil spill category in a 1-year period, there is a 0.5 percent (0.005 probability) in a 10-year period, and it increases further to a 1.24 percent probability (0.0124 probability) in a 25-year period.

Table 31. Figure 2-20 copied from WDOE's 2015 VTRA. Oil values are reported in cubic meters (2500 cubic meters equals 660,430 million gallons- the average spill size in this category is 1.8 million gallons, 1000 cubic meters equals 264,172 gallons- the average spill volume in this category is 12,000 gallons, 1 cubic meter equals 264 gallons).



		OIL_2500_MORE	OIL_1000_2500	OIL_1_1000	OIL_0_1	TOTAL_OIL
VTRA '15 BASE CASE	Base Case % Potential Annual Oil Loss	42.0%	12.3%	45.3%	0.5%	100.0%
	Base Case % Potenial Annual Accident Frequency	0.01%	0.01%	1.8%	98.2%	100.0%
	Average potential spill size per accident [in m^3]	6,798	1,619	46.9	0.01	1.8
	Probability of at least one accident in 1 year by spill size	0.05%	0.06%	7.5%	98.7%	98.8%
	Probability of at least one accident in 10 year by spill size	0.50%	0.61%	54.2%	100.0%	100.0%
	Probability of at least one accident in 25 years by spill size	1.24%	1.52%	85.8%	100.0%	100.0%

Figure 2-20. VTRA 2015 summary of risk metrics for the Base Case 2015 analysis

For scale, the Exxon Valdez accident resulted in a spill of 11 million gallons (USEPA online). That volume of oil outflow occurred after the accident because the ship was single-hulled and in a remote location, making accident response measures extremely difficult. An accident of that size is extremely unlikely in Puget Sound because ships are double-hulled and accident response efforts are likely to be more effective in Puget Sound because of the response measures that are in place in the Northwest Response Plan. The Deepwater Horizon oil spill in the Gulf of Mexico spilled an estimated 134 million gallons. That scale of accident occurred because the spill occurred from a blow-out at the sea floor, not from a ship, and response efforts were very difficult and slow because of the challenge of working in deep water off the coast.

Qualitative Discussion of Risk- NMFS Interpretation of Model Results with Revised Baseline Ship Numbers and Approach for Analysis of Effects for Low Probability – High Consequence Events

Given BP's revised single-wing estimate of 385 ships per year and their commitment to holding their average annual vessel calls at the two-winged pier to 385 on a 5-year rolling average, not to exceed 420 ships in any one year, the TGA VTA Case 3, Case 5, and Case 7 could be viewed as showing the range of risk in operations under the proposed action, with overall traffic in the action area increasing over time as a baseline condition (Case 5) , and highest risk presumption with Cumulative Traffic shown in Case 7 (includes potential new facilities in the region). NMFS assumes that TGA VTA is generally representative of risk associated with the proposed action, but we recognize that the results must be viewed in terms of the model inputs, that is, the model is a tool and the results are not definite. In addition, the model cannot predict the future, the GPT is no longer proposed at Cherry Point which would have added 487 ships per year, the Canadian Trans Mountain Pipeline project is still being challenged in Canadian Court, and BP and the industry engage in many risk reduction measures. The USCG also has an active adaptive management approach for the traffic scheme in the action area that helps to manage oil spill risk in the action area (Cardno 2017). Other factors that reduce the chances of a very large oil spill are industry standards for risk management such as the requirement of ships to be double-hulled and piloted through the Salish Sea by a local pilot (WDOE 2015). The Northwest Response Plan is also a robust collaboration between industry and government agencies.

The most basic assumption that NMFS is making regarding risk in this opinion is that more crude oil ships per year above the baseline maximum of 140 ships carrying crude oil equates to more risk associated with the proposed action. Each additional ship transiting the action area contributes to an incremental increase in the risk profile of BP individually and in the overall traffic scheme in the action area. By incremental, we mean a small change in the overall risk profile attributable to the proposed action including BP Cherry Point-specific ships and a very small change in the overall risk profile among all traffic (which also includes BP ships). For example, the difference in risk associated with 140 versus 100 or 145 versus 185 crude oil vessels in any one year will vary "incrementally." Therefore, a consequence of the action is that crude oil spill risk will be incrementally higher in some years over baseline risk (191 is the highest recorded number of crude oil vessels received by BP in one year), and incrementally lower in some years, yet risk will also incrementally increase over time as a baseline condition because all traffic in the action area is predicted to go up over time at existing facilities. In addition, cumulative risk will increase if new facilities are built, particularly the Canadian Trans Mountain Pipeline, and risk accumulates over time through cumulative probability. The TGA VTA is illustrative of the risk directly attributable to the BP facility and the WDOE 2015 VTRA is illustrative of the overall risk profile in the Salish Sea, which includes BP as part of the overall traffic scheme. The TGA VTA also illustrates how risk accumulates over time (cumulative probability). Therefore, with the proposed action, it is reasonably certain that oil spill risk will continue as a baseline condition and it will incrementally increase in some years and over time (cumulative risk) as a result of the proposed action in proportion to the actual number of crude oil ship calls and total ship calls, putting listed species at an incrementally greater risk of exposure to spilled crude oil in the action area. We also acknowledge, for example, that the TGA VTA and the GWU VTRA indicate that operations at the two-winged facility are safer (less risk of oil spill at the facility) than a one-winged facility when operating in the range of 329 to 335 total ships calls per year in part because of reduced wait times (staging) of ships with two wings and separation of operations that specialize in either crude oil or refined oil transfer. We also recognize that BP will likely operate at less than 385 total ships per year, and the total number of crude oil ship calls will also be fewer in some years.

Because it is impossible to predict an actual spill (note- transfer errors/very small spills at BPs facility are addressed in Section 2.4.2), we do not consider an actual large oil spill an effect of the action, rather we consider the increased risk as the effect of the action (the risk is perceivable, measurable, and can be partially reduced with industry best practices). We also understand that there is not a direct linear relationship between number of ships and risk, and there are many factors and assumptions that go into calculating probabilities. Based on the oil spill risk models and the inherent danger associated with shipping crude oil, we conclude that all of the listed species and critical habitat in the action area are adversely affected by BP's incremental increase in risk of oil spill in the action area in some years, with each species having a different degree of vulnerability to an actual spill. Because this risk cannot be translated into an actual predicted spill, we consider whether or not the incremental increase in risk of oil spill with the proposed action translates to a significant threat to the species or a significant change in the existing threat level or overall extinction risk of the species. We do this analysis by considering the species vulnerability to oil spill, its status in the action area, its range, abundance, life history characteristics, trajectory for recovery, key limiting factors, etc., faced by each species and in consideration of the potential consequences to the species from an actual large spill in the action area (i.e. the degree of vulnerability and resilience; another way of viewing this is "risk tolerance" – i.e. how much risk can a species assume considering the potential consequences of a low probability/high consequence event).

The following sections describe, in a general way, how a large oil spill might affect each listed species and critical habitat. This is not a comprehensive analysis of how an oil spill would affect the Salish Sea and all of the living resources within it, nor does this analysis attempt to quantify how long it would take to fully recover from an oil spill. In the event of a large oil spill, oil spill response activities would attempt to limit the spread of oil, remove oil, and limit the extent of ecosystem damage. Laws and processes are in place that would deal with recovering ecosystem function post spill. The Natural Resource Damage Assessment (NRDA) is the legal process that federal agencies including NOAA, together with the states and Indian tribes, use to evaluate the impacts of oil spills, hazardous waste sites, and ship groundings on natural resources both along the nation's coast and throughout its interior. NOAA and these partners, referred to collectively as natural resource trustees, work together to identify the extent of natural resource injuries, the best methods for restoring them, and the type and amount of restoration required. In addition to studying impacts to the environment, the NRDA process includes assessing and restoring the public's lost use of injured natural resources. This opinion in no way interferes with any post-spill process or mitigation. WDOE (2019, Publication 19-08-002) provides this context:

> 'There has not been a major oil spill in the Salish Sea from collisions or groundings for over 20 years (Van Dorp & Merrick, 2016). This impressive record is a result of a comprehensive safety regime that includes international, federal, and state standards. Other contributing factors include regional collaborative efforts by government, tribes,

> and stakeholders through forums such as the Puget Sound Harbor Safety Committee (PSHSC), and proactive and voluntary measures taken by industry associations and responsible marine operators. At the same time, the unique ecosystem and resources of the Salish Sea, including declining populations of Southern Resident Killer Whales (SRKWs), are vulnerable to the damage an oil spill could cause.
>
> As recent history has shown nationally and internationally, the low probability but high consequence of a major oil spill demands well-thought-out, continuing efforts to prevent a spill from occurring and to protect these sensitive areas."

The following discussion is pertinent only to the USACE's permitting action under this consultation and forms the basis of our biological and conference opinions. The discussion focuses on the inherent vulnerability of individuals and populations of each species given their numbers, distribution, and unique life history characteristics, their level of resiliency to exposure, and the likelihood of eventually recovering populations after exposure. The Washington Department of Ecology's website provides more information on oil spill prevention, response, damage assessment, and risk analyses (https://ecology.wa.gov/Spills-Cleanup/Spills).

2.4.1.1 Risk of Oil Spill to Southern Resident Killer Whale

Of the whale species addressed in this opinion, Southern Resident killer whales are the most vulnerable to oil spill because the action area overlaps a significant portion of their critical habitat, particularly their core summer range in the San Juan Islands region. Oil spills in Puget Sound were identified in the SR killer whale listing (70 FR 69903) as an ongoing threat to the survival of the population and the SR killer whale Recovery Plan also includes oil spill as an ongoing threat that could be catastrophic to killer whales and their environment. Recognizing this oil spill is a major threat to SR killer whales, the Northwest Area Contingency Plan (NWACP), the Puget Sound Region's oil spill response plan (https://www.rrt10nwac.com/NWACP/Default.aspx) includes response guidelines to protect killer whales. NOAA Fisheries has worked closely with cooperating agencies and industry to develop hazing methods to deter killer whales from entering spilled oil (https://response.restoration.noaa.gov/sites/default/files/Hazing-Implementation-Plan.pdf) provides guidance for killer whale monitoring and hazing activities.

NMFS recognizes that a major oil spill in the action area, particularly in the San Juan Islands region of the Salish Sea, would be devastating to the Southern Resident killer whales, from either direct acute exposure or over time through indirect effects to their food resources and prolonged exposure to pollutants. What we are analyzing here is the incremental increase in risk associated with the proposed action in some years from additional oil tankers transiting the Salish Sea, and whether or not the incremental increase significantly changes the baseline risk to the population of whales.

Consequences of a Spill: In marine mammals, acute exposure to petroleum products can cause changes in behavior and reduced activity, inflammation of mucous membranes, lung congestion, pneumonia, liver disorders and neurological damage (Geraci and St. Aubin 1990). The Exxon Valdez oil spill was identified as a potential source of mortality for resident and transient killer whales in Prince William Sound, Alaska, and has raised concerns about potential implications for Southern Residents, particularly if the entire population is together in the vicinity of a spill. All three pods that comprise the Southern Residents periodically gather together in a “super pod” as they did in September 2018 off Victoria, BC, which increases the population’s vulnerability to a catastrophic event.

In the event of a spill, killer whales appear to not have the wherewithal to avoid oiled waters. Matkin et al. (1994) reported that killer whales did not attempt to avoid oil-sheened waters following the Exxon Valdez oil spill in Alaska. After the Exxon Valdez oil spill in 1989, six of the 36 members of the northeastern Pacific AB pod were missing within one week of the spill after being seen in heavily oiled waters and eight more disappeared within two years. These absences were followed by the deaths of two orphaned calves in the winter of 1993-1994, as well as two adult males (including one fairly young individual) in 1994 and 1997 whose dorsal fins collapsed soon after the spill, indicating stress or ill health. AT1 pod lost eight of its 22 members by 1990 and two others by 1992. These mortality rates are unprecedented for the northeastern Pacific (NMFS 2008a). Following the BP Deepwater Horizon oil spill of 130 million gallons in the Gulf of Mexico in April 2010, 122 cetaceans stranded or were reported dead within 5 months following the spill (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). In addition, oil spills have the potential to adversely impact habitat and prey populations, and, therefore, may adversely affect Southern Residents by reducing food availability. While many measures are in place to reduce the probability of major oil spills, the effects of such spills are potentially catastrophic to the Southern Resident population. Despite many improvements in spill prevention since the late 1980s, much of the region inhabited by the Southern Residents remains at risk from major spills because of its heavy volume of shipping traffic and its role as a leading petroleum refining center (WDOE 2015).

In Lacy et al., (2017), the Population Viability Assessment (PVA) model for Southern Resident killer whales used assumptions from the Canadian Trans Mountain Pipeline study for oil spill risk. The modeled oil spill defined a large oil spill as >104,000 bbl (4.348 million gallons) with a 0.21 percent chance per year (probability of 0.0021) and a smaller oil spill as >52,000 bbl (2.184 million gallons) with a 1.08 percent chance per year (probability of 0.0108). These oil spill projections include the presumed added oil tanker traffic from the Canadian Trans Mountain Pipeline construction, so these probabilities represent potential future conditions with as many as 350 more oil tankers transiting the action area in the future. Note that these probabilities are higher than WDOE’s 2015 VTRA, likely as a result of different assumptions about future traffic and risk mitigation measures. To compare to actual spills in the region, Table 20 in this document summarizes the actual 15 oil spills in the region of 100,000 gallons or more, with the largest being 2.3 million gallons. These actual spill volumes are within the range of the smaller modeled spill used in the Lacy et al. (2017) PVA of 2.184 million gallons. For the modeled spill of 2.184 million gallons, the authors estimated that 12.5 percent of the Southern Resident killer whale population could be killed by direct exposure to oil. The authors estimated this mortality percentage by overlaying oil spill spread and critical habitat, and then estimating how many animals could be exposed.

WDOE’s 2015 VTRA model resulted in an average spill size of 1.8 million gallons as a high-end prediction for their “base case”. The base case represents current conditions without the addition of potential future traffic such as from the Canadian Trans Mountain Pipeline. The key factor to consider in a potential oil spill is not the absolute volume of the spill, but the potential exposure of SRKWs to oiled waters. Recall that Krahn et al.'s (2004) model shows that at 100 individual carrying capacity, with 1994-2003 survival estimates (poor survival period), the probability of quasi-extinction (defined as less than or equal to 10 males or females) in 100 years with *no* catastrophes is 40 percent. Adding a catastrophe with a 1 percent (0.01 probability) annual chance that kills 10 percent of the population (i.e. 90 percent of killer whales survive the event), the quasi-extinction probability rises to 47 percent in 100 years. In short, Krahn et al.'s (2004) model shows that a threat with a 1 percent annual chance could have catastrophic consequences to the population.

Comparing studies and probabilities: This line of reasoning was used to inform our opinion on oil spill risk with respect to SR killer whales and the proposed action. Lacy et.al. (2017), showed that a spill on the order of 2.184 million gallons in the San Juan region could directly expose/kill approximately 12.5 percent of the SR killer whale population from direct exposure to oil from a spill that has a 1.08 percent chance (0.0108 probability) with future traffic projects (worse-case scenario- e.g. including new oil tanker exports from the Canadian Trans Mountain Pipeline). We interpret these model results to show that it would take quite a large oil spill within critical habitat (summer core range in the San Juan Islands region) to expose slightly more than 10 percent of the animals. For this reason, we consider this scale of spill as a catastrophic event for SR killer whales because it could cause a sudden loss of more than 10 percent of the animals. Recall that under Krahn's population viability analysis (PVA) a catastrophic event for the population is a sudden loss of 10 percent of the animals at a population carrying capacity of 100 animals. Although, under Krahn's model, a catastrophic event was input with a 1 percent (0.01 probability) annual chance. Under current conditions (base case) in WDOE's 2015 VTRA, a spill of 1.8 million gallons has a probability of 0.05 percent chance in one year (0.0005 probability). This 0.05 percent chance spill is orders of magnitude less than the 1 percent catastrophe input in Krahn's study. With WDOE's 2015 VTRA the risk of a 1.8 million-gallon spill is on the order of 1.24 percent (0.0124 probability) over a 25-year period, which is also orders of magnitude less than 1 percent per year catastrophe input in the PVA. If we look at the WDOE's 2015 VTRA, the spill category that exceeds 1 percent annual chance is the 12,000-gallon average spill (1- 1000 cubic meters/264,172 gallons spill range). This spill category has a 7.5 percent probability in one year (0.075 probability). Recall that the TGA VTA for BP showed models spills in the range of 62,644 to 114,997 gallons for the 95th percentile spill (meaning of 10,000 model attempts, 95 percent of modeled spills were less than that number) and between 961 to 2,396 gallons for the 50th percentile for various assumptions in BP ship numbers, number of pier wings, and general and cumulative traffic scenarios. Given this line of reasoning, NMFS does not perceive BP's potential incremental increase in oil spill risk associated with the proposed action for large oil spill to be of a magnitude that would substantially change the existing risk profile of the species because the more probable spills are orders of magnitude less than what Lacy's study indicates would be catastrophic for this species, and the largest spills that would approach the 1.8 million gallon level in Lacy's study have a very low probability. Given this very slight increase in risk of a spill attributable to the proposed action, we cannot determine that the consequence of a spill, the take of any individual whales resulting incidentally from the proposed action, can be expected to occur. This conclusion includes the incremental and varying increase in risk from the proposed action with a rolling average number of 385 total ships, with some years having more crude oil ships calls over the baseline of 140 and some years having total ship numbers above 385, but not exceeding 420, and considering the risk mitigation measures employed by BP and the industry, together with the Northwest Response Plan, while also recognizing that some years will have lesser risk when BP operates with fewer shipments.

2.4.1.2 Risk of Oil Spill to Large Whales

Oil spills within the inland waters of the action area present a threat to large whales that occur within these waters because of the narrow straits, limited mixing of water, and low dispersion rates making acute toxic exposure more likely in the inland waters compared to spill on the outer coast or open ocean. A large spill on the outer coast could disperse over many, many miles, which could expose more individual whales to spilled oil, but potentially avoid acute toxic exposure because the oil and vapors would rapidly dilute. When oil is spilled in the ocean, it initially spreads primarily on the surface, depending on its relative density and composition. Some of the oil may evaporate. An oil slick may remain cohesive, or may break up in rough seas. Waves, currents, and wind can push oil into coastal areas and affect marine and terrestrial habitats in the path of the drift. Over time, oil waste weathers (deteriorates) and disintegrates by means of photolysis and biodegradation. The rate of biodegradation depends on the availability of nutrients, oxygen, and microorganisms, as well as temperature.

Geraci and St. Aubin (1990) found that cetaceans in the open ocean are more likely to encounter weathered oil that contains little of the toxic hydrocarbon fractions. However, they note that a whale trapped in an oil slick for the first few hours after a spill may be exposed to concentrations of toxic vapors in sufficient concentration to cause harm to the animal (Geraci and St. Aubin 1990). With the exception of the sperm whale, the large whale species in the action area feed with baleen plates. Jarvela-Rosenberger et al (2017) reviewed the risk of oil spill to 21 species in British Columbia and determined that baleen whales are highly vulnerable due to blowhole breathing, surface filter feeding with baleen plates, and invertebrate prey. Baleen has the potential to become fouled after physical contact with oil. The surface “skim” feeding behavior of right whales makes this species most vulnerable to baleen fouling. In contrast, blue, fin, and humpback whales typically “gulp” feed at depth. The indirect consequences of oil on listed cetaceans include the effects of oil on prey resources and habitats. Oil may temporarily decrease the biomass of and reproduction and feeding in zooplankton. The large whale species are at much less risk from an oil spill in the action area compared to the SR killer whale population because the action area is only a small portion of the range of large whales and large whales do not occur in proportionately large numbers in the action area, with very few individuals that enter the inland waters of the Salish Sea.

2.4.1.3 Oil Spill Risk Humpback Whales

Humpback whale use of the Salish Sea has been increasing since 2012. Large numbers of humpback whales are present along the outer coast and into the Strait of Juan de Fuca during the summer feeding months with groups as large as 80 individuals reported (Calambokidis et al. 2017; Miller, 2020). This area represents a biological important area for humpback whales (Calambokidis et al. 2015). Humpback whales do venture into the rest of the Salish Sea but in smaller groups of two or three individuals or as single animals. NMFS estimates that nine percent are from the endangered Central America DPS and 28 percent are from the Mexico DPS, with the remaining 63 percent from the non-listed Hawaii DPSs (NMFS 2021). A spill in the inland waters would affect individuals that were present and we would expect that the risk to the endangered Central America DPS and threatened Mexico DPS to be proportionate to their respective presence in the action area (Table 5). On the outer coast, humpback whales occur in larger numbers. A spill on the outer coast could disburse over many miles, but acute toxicity would be less likely. However, oil spread on the outer coast could indirectly affect multiple individuals over time through reduced food resources and contaminants. Jarvela-Rosenberger et al. (2017) determined that humpback whales are at a medium to high risk from oil exposure if they encounter oil because of their surface feeding techniques, potential for oil adhesion on tubercles, use of baleen plates, and diet reliance on euphausiids.

Central America DPS Humpback Whale For the Central America DPS, the 2015 Status Review (NOAA 2015) discusses threats from oil spill in the context of offshore oil and gas exploration, not from ship traffic. The BRT concluded that the potential for new offshore oil rigs is low for a number of reasons such as industry focus on alternative energy sources (wind, solar) and there are no current proposals, making this threat "low and stable." The proposed action does not include oil or gas exploration and therefore does not increase the specific threat called out in the Status Review. Within this context and in consideration of the potential consequences of an actual spill, NMFS concludes that the incremental increase of oil spill risk in the action area in some years associated with the proposed action poses very little risk to the species. This conclusion does not mean that in the event of a spill that individuals would not be affected, rather that the incremental increase in risk in some years does not present a significant threat to the population. In the event of a spill, very few individuals relative to the population could be directly adversely affected by direct contact with oil or through reduced food resources and increased contaminants. Because the action area is at the far northern part of the species range, the number of individuals affected would be a very small proportion of the population and although this population is endangered, this species growth rate would likely not be significantly affected.

Mexico DPS Humpback Whale Humpback whales from the Mexico DPS are more common in the action area on the outer coast, making up approximately 28 percent of the humpbacks that occur seasonally in the offshore feeding grounds off the Washington coast. A number of these whales may enter the Salish Sea seasonally. Similar to the Central America DPS, the BRT considered the threat of oil spill in the context of offshore energy exploration and development that could lead to new deep-water drills, and they did not specifically identify oil spill from ships as a noted threat. The BRT concluded that:

> "There are currently numerous active oil and energy leases and offshore oil rigs off the U.S. west coast. Offshore LNG terminals have been proposed for California and Baja California. The feeding grounds for this population are therefore an active area with regard to energy exploration and development. However, there are no plans at present to open the West Coast to further drilling. Alternative energies, such as wind and wave energy, may be developed in the future in this region. Currently, the threat posed to this population by energy exploration and development is low, and is considered stable."

The proposed action does *not* include oil or gas exploration so it does not increase this specific threat identified by the BRT. The BRT did not identify oil spills from shipping as a specific threat. Within this context, NMFS concludes that the incremental increase of oil spill risk in some years in the action area associated with the proposed action poses little additional risk to this DPS. This conclusion does not mean that in the event of a spill that individuals would not be affected, rather that the incremental increase in risk does not present a significant threat to the population of whales because the consequences of a large spill would not be severe enough to cause population level effects. In the event of a spill, some individuals could be directly adversely affected through contact with oil, while more individuals could be affected over time through reduced food resources and exposure to contaminants. Because these animals are wide ranging and the action area is a small portion of their range, the number of animals affected would be a small proportion of the population. The general trend in the population growth rate would likely not be altered.

2.4.1.4 Oil Spill Risk Blue Whale

Blue whales are not known to enter the Salish Sea and are common to the south, outside of the action area, along the coast of Oregon and California (Figure 39). In the event of a spill on the outer coast of Washington, the risk to any one individual blue whale would be very small for direct exposure and not likely to affect more than a very small number of individuals from contaminant exposure or reduced food sources. The blue whale Recovery Plan does not identify oil spills as a factor impeding recovery of blue whales because blue whales have a "broad distribution and wide-ranging movements, which would be expected to lessen the population-, subspecies-, or species-level impact of such spills." For these reasons, we conclude that the incremental increase in oil spill risk in some years associated with the proposed action poses little risk to this species.

2.4.1.5 Oil Spill Risk Fin Whale

Fin whales rarely occur within the Salish Sea so that an oil spill in the inland waters would likely only affect one or very few individuals. On the outer coast, fin whales occur more to the south of the action area and would therefore be at low risk from direct exposure to a spill in the action area on the outer coaster. The Final Recovery Plan for the Fin Whale (NOAA 2010) discusses oil spill threat in the context of exposure to contaminants and pollution. The plan describes the threat from contaminants and pollutants as "occurring at a low severity and there is a medium level of uncertainty. Thus, the relative impact to recovery of fin whales due to contaminants and pollution is ranked as low." The 5-year Status Review does not address oil spill. Given fin whales infrequent use of the action area and the low threat level posed by oil spill in the action area, the incremental increase in oil spill risk in some years associated with the proposed action poses little risk to the fin whale population.

2.4.1.6 Oil Spill Risk Gray Whale

The Eastern North Pacific gray whale, the non-listed species, is common in the Salish Sea. These whales occur seasonally by the dozens and often feed in very shallow delta areas within the inland waters. The entire population consists of approximately 20,000 animals (Calambokidis *et* *al.* 1998). The Eastern North Pacific stock was delisted from the ESA in 1993, therefore we are not analyzing the Eastern North Pacific stock in this opinion. In contrast, the listed WNP gray whales are rare, with population estimates of only 200 individuals. Information from tagging, photo-identification, and genetic studies show that WNP gray whales have been observed migrating in the winter and spring to the eastern North Pacific off the outer coast of North America from Vancouver, B.C to Mexico (Lang 2010, Mate *et al.* 2011, Weller *et al.* 2012, Urban *et al.* 2013). Although there is potential for WNP gray whales to occur along the Washington coast and to enter the Salish Sea, available data indicate that occurrence is likely to be very rare in the action area. Therefore, the WNP gray whale would be at very low risk of exposure to an oil spill in the action area because their numbers are so few, they occur very rarely in the action area, and the action area is a very small portion of their range. Therefore, the incremental increase in oil spill risk in some years associated with the proposed action poses little risk to this population.

2.4.1.7 Oil Spill Risk North Pacific Right Whale

The North Pacific right whale population is very small, likely in the low 100s, and most sightings in the Pacific have been of single whales, though small groups have been sighted. North Pacific Right whales may pass through the action area on the outer coast of Washington as they migrate from summer feeding grounds in North Pacific and Bering Sea to warmer waters as far south as central Baja California. Since 1996, right whales have been observed repeatedly in their critical habitat (outside of the action area) in the southeastern Bering Sea during the summer months. Migration patterns of the North Pacific right whale are unknown, although it is thought the whales spend the summer in far northern feeding grounds and migrate south to warmer waters, such as southern California, during the winter. From 1965 to 1999, there were only 82 sightings of right whales in the entire eastern North Pacific, with the majority of those occurring in the Bering Sea and nearby areas of the Aleutian Islands. In the action area, right whales are extremely rare with one whale was sighted off Washington in 1992, while none have been sighted off of Oregon as of 2001 (Brownell *et al*. 2001). In more recent years, there have been two sightings of single right whales in the waters of British Columbia. The first was observed off Haida Gwaii on 9 June 2013 and the second, a large adult, was seen in the Strait of Juan de Fuca on 25 October 2013. Two right whale calls were detected on a bottom-mounted hydrophone off the Washington Coast on 29 June 2013 (Širović et al. 2015). No right whale calls were detected in previous years at this site. It is likely that right whales were never common off the coast of Oregon and Washington (Scarff 1986, 1991).

The North Pacific right whale Recovery Plan identifies energy development in the Gulf of Alaska and Bering Sea regions to be a potential threat to this species, with offshore oil and gas exploration and associated seismic surveys being a threat to this species within its critical habitat range. The Recovery Plan for this species ranks the relative threat of contaminants and pollution associated with oil spill as unknown because so little data exists on this species at all. The 5-Year Status Review also discusses the threat from oil and gas development activities in this species critical habitat range. For the proposed action, individual North Pacific right whales are at very low risk of exposure to an oil spill in the action area because North Pacific right whale occurrence in the action area is so rare and the action area is a very small portion of their range in the Pacific Ocean. If a spill were to occur in the action area, it is likely that no individual North

Pacific right whales would be exposed either directly or indirectly. For these reasons, NMFS concludes that the incremental increase in oil spill risk in some years associated with the proposed action poses little risk to the North Pacific right whale population.

2.4.1.8 Oil Spill Risk Sperm Whale

Whitehead (2002) estimated sperm whale abundance to be approximately 300,000–450,000 worldwide, growing at about one percent per year. Abundance in the Pacific is approximately 152,000–226,000 using Whitehead's 2002 methods. The abundance estimates for sperm whales off California, Oregon, and Washington, out to 300 nautical miles (nm) ranged from 2,000 to 3,000 animals (Moore and Barlow 2014). Sperm whales are very rare in the inland waters portion of the action area with just one recent sperm whale sighting in the Salish Sea near the San Juan Islands in Haro Strait in March 2018.

The Final Recovery Plan for the Sperm Whale (NOAA 2010a) lists oil and gas exploration (seismic exploration of ocean bottoms) among the potential threats to this species. The threat from contaminants and pollution associated with oil spills is ranked as "unknown severity and there is high level of uncertainty." The 5-Year Status Review for sperm whale discusses direct and indirect effects to sperm whales following the Deepwater Horizon oil spill in the Gulf of Mexico in 2010 from the oil itself and the chemical dispersants used after the spill (see Section 2.1.3.7). The actual number of sperm whales that may have been impacted by that spill is unknown, but likely higher than what was directly observed. The Status Review concludes that the magnitude of various threats including contaminants and pollutants are highly uncertain, and some may intensify in the future.

Within the action area, an oil spill within the inland waters would present very little risk to this species because direct exposure of more than one individual, if any, would be unlikely. Indirect effects through contaminants would also likely not be measurable in this population because the inland waters are so rarely used by this species. Acoustic detections of sperm whales in the offshore waters of the outer Washington coast occurred in all months of the year, with peak occurrence April to August. Acoustic detection inshore from April to November were generally faint enough to suggest that the whales were offshore (Oleson et al. 2009). An oil spill on the outer coast of Washington would present a small risk to individual animals, but would likely not have any population level effects because the action area is a very small portion of the overall range of these animals along the coast. Therefore, the incremental increase in oil spill risk in some years in the action area poses little risk to the species, although a small number, relative to the population, of individual animals could be harmed in the event of an actual spill.

2.4.1.9 Oil Spill Risk Leatherback Turtles

Leatherback turtles regularly occur off the coast of Washington, especially off the mouth of the Columbia River (to the south, outside of the action area) during the summer and fall when large aggregations of jellyfish form (WDFW 2012b). Observations, telemetry data, and gillnet captures of leatherbacks off the Washington coast, identified turtles south of Cape Flattery and in deeper offshore water (WDFW 2012b). Leatherback turtles occur in the action area, more commonly on the outer coast, with rare occurrences in the inland waters of the Salish Sea.

Because all sea turtles must spend time at the surface to breathe, rest, bask, and feed, these fundamental behaviors put turtles at continuous and repeated risk of exposure if they occur within the vicinity of an oil spill (DWH Trustees 2016). Based on veterinary assessments of oiled juvenile turtles collected during the Deepwater Horizon spill, physical fouling in heavy surface oil was the most readily apparent, immediately harmful result of oil exposure (Stacy 2012). Turtles that were heavily fouled were considered unlikely to survive without human intervention (Stacy 2012). Studies of the toxic effects of oil exposure on other vertebrate taxa indicated that less extensive exposure could also lead to chronic or sublethal effects (Mitchelmore et al. 2017).

An oil spill in the inland waters of the action area is unlikely to expose more than one or very few individuals to acute exposure to spilled oil because leatherbacks are rare within the Salish Sea. An oil spill on the outer coast could expose small numbers of leatherbacks from the local feeding group, relative to the total number in this feeding group (20-366 animals), because the action area is at the northernmost range of this feeding group. Following an oil spill on the outer coast, small numbers from this feeding group would likely experience long term adverse effects associated with reduced prey abundance and contaminants. Because the action area is at the northernmost extent of this species, a spill in the action area could affect the local feeding group abundance. Diverse foraging strategies likely would help to provide some resilience to oil spills, minimizing impacts on prey availability (NMFS and USFWS 2020). A spill in the action area would not affect nesting beaches, which are not located in the action area. Although, any loss of mature females would be concerning because the larger eastern Pacific nesting group is declining and perhaps on the verge of extirpation (*e.g.*, Spotila *et al.* 1996; Spotila *et al.*, 2000). Yet, oil spill is not the driving factor for this extirpation. Other environmental factors, particularly in nesting areas, are the main threats to the eastern Pacific breeding group as well as fishery bycatch. Therefore, although oil spill is a concern for this species in the action area, incremental increase in oil spill risk in some years associated with the proposed action presents a very small risk to the globally listed species, even though a small number of individual turtles, relative to the population, could be harmed in the event of an actual spill.

2.4.1.10 Oil Spill Risk Listed Fish

Logan et al. (2015) provides a good summary of the acute toxic effects of oil to fish. The components of oil that are acutely toxic include low molecular weight alkanes, benzene, toluene, ethylbenzene, xylenes (BTEX), and naphthalene because these compounds are sufficiently water soluble to partition from the non-aqueous phase liquid (NAPL) to the water and reach lethal concentrations. These compounds pass through juvenile and adult fish gill cell membranes, concentrate in the lipid fraction of organs and cause narcosis for days or longer. Since low molecular weight organic compounds are volatile and biodegradable, their aqueous concentration decreases rapidly and acute effects depend on a steady source of oil, such as a pipeline leak, to sustain high aqueous phase concentrations.

Tjeerdema et al. (2007) exposed Chinook salmon smolts for 96 hours to various concentrations of Prudhoe Bay crude oil in seawater such that the concentration of crude oil decreased from the initial concentration to zero over 8 hours to simulate dilution and dispersion. The average 96-hour LC50 s was 7.46 milligram per liter. Muscle and liver samples from surviving fish revealed metabolic changes at concentrations significantly lower than the LC50 and concluded that exposure to crude oil could possibly delay smolt development.

Kazlauskiene et al. (2008) performed a four day and a 14-day crude oil toxicity tests on juvenile and adult rainbow trout by exposing them to 0.87 and 1.73 grams crude oil per liter (1.73 g/L consisted of 28.2 mg/L of dissolved constituents and a dispersed NAPL). They found these doses to not be lethal to juveniles or adults although that both concentrations increased heart rate and gill ventilation frequency. The most obvious difference in these tests is that Tjeerdema tested in closed tanks and simulated mixing by diluting with clean seawater and Kazlauskiene tested in open tanks so that volatile compounds could be removed by evaporation. It may be that the volatile compounds evaporated from the Kazlauskiene test faster than they were diluted in the Tjeerdema test. Kazlauskiene concluded that fish kills are usually caused by large amounts of oil that become trapped in shallow waters and that it is unlikely that large numbers of fish inhabiting large bodies of flowing water would be acutely killed by the toxic effects of petroleum.

Exposure to crude oil can have sublethal effects to fish that may not be immediately apparent, but can have a negative effect on fitness and survival. Scientists from the NOAA Northwest Fisheries Science Center and Alaska Fisheries Science Center temporarily exposed embryonic salmon and herring to low levels of crude oil from the North Slope of Alaska and found that both absorbed chemicals at similar concentrations in their tissues (Incardona et al., 2015.) The embryos were then transferred to clean seawater and raised as juvenile fish for seven to eight months. The study found that few of the embryos or larvae looked abnormal, but over the course of months, juvenile salmon exposed to oil grew more slowly, with those exposed to the highest concentrations growing the slowest. For salmon, early survival in the ocean is strongly influenced by juvenile growth, with smaller fish suffering higher loss to predators. The study also found that exposure to oil as embryos altered the structural development of the hearts of juvenile fish, potentially reducing their fitness and swimming ability. Poor swimming and cardiac fitness is also a factor in disease resistance. Incardona et al., (2015) found that even very low-level petroleum exposure causes lethal heart failure or, in fish that survive, permanent changes in heart form and function.

In November 2007, the container ship Cosco Busan released 54,000 gallons of bunker fuel oil into San Francisco Bay. The accident oiled shoreline near spawning habitats for the largest population of Pacific herring on the west coast of the continental United States. Herring are an important forage fish for salmonids and marine mammals. Incardona et al., (2012) assessed the health and viability of herring embryos from oiled and unoiled locations that were either deposited by natural spawning or incubated in subtidal cages. Three months after the spill, caged embryos at oiled sites showed sublethal cardiac toxicity from exposure to aromatic compounds (PACs) from the oil spill. Embryos from the adjacent and shallower intertidal zone showed high rates of tissue necrosis and lethality unrelated to cardiotoxicity. No toxicity was observed in embryos from unoiled sites. Embryos sampled two years later from oiled sites showed modest sublethal cardiotoxicity but no elevated necrosis or mortality. The authors were not able to separate out the acute and longer-term effects of the oil spill versus the background contamination that characterizes this urbanized coastal estuary.

A large oil spill in Puget Sound would likely affect the fish species considered in this opinion to varying degrees depending on location, size, timing of a spill, and the unique life history characteristics of each species. The various oil spill risk models cannot predict when or where a spill might occur, but the models show higher probability locations in the Cherry Point region and the narrow passages through the Salish Sea (e.g. Haro and Rosario Straits and Guemes Channel). The trajectory for recovery of the listed fish species is decades long. For example, the Puget Sound Chinook salmon Recovery Plan has a 50-year timeline and the PS Steelhead Recovery Plan acknowledges that it may take up to 100 years before full protection and restoration efforts would lead to recovery. In the two decades since the listing, Puget Sound Chinook salmon remain threatened with most populations far from reaching recovery targets. Population level effects to PS Chinook and PS steelhead at the ESU and DPS level are less likely to occur even with a large oil spill in the Puget Sound because their life history traits make them resilient to environmental disasters as some research following the Exxon Valdez spill indicates.

The 1989 Exxon Valdez oil spill exposed embryos of pink salmon and Pacific herring to crude oil in shoreline spawning habitats throughout Prince William Sound, Alaska. The herring fishery collapsed four years later. Incardona et al.'s (2015) research shows that exposure thresholds for developmental cardiotoxicity (heart deformation) are very low, suggesting the scale of the Exxon Valdez impact in shoreline spawning habitats was significant and likely caused irreversible loss of cardiac fitness and consequent increases in delayed mortality in oil-exposed cohorts. This adverse exposure may have been an important contributor to the delayed decline of pink salmon and herring stocks in Prince William Sound. Ward et al., (2017) also studied the long-term effects of the *Exxon Valdez* oil spill. Pacific herring (*Clupea pallasii*) and some wild Pacific salmon populations (*Oncorhynchus spp*.) in Prince William Sound that declined in the early 1990s have not returned to the population sizes observed in the pre-spill 1980s. Scientists have found it difficult to distinguish between the stochastic effects of the oil spill versus ongoing effects of short term environmental variability, longer term climate change, fishery management (hatcheries and fishing industry), and predation pressure from increasing numbers of marine mammals. Using data pre- and post-spill, the authors applied time-series methods to evaluate support for whether and how herring and salmon productivity has been affected by each of five drivers: (1) density dependence, (2) the oil spill event, (3) changing environmental conditions, (4) interspecific competition on juvenile fish, and (5) predation and competition from adult fish or, in the case of herring, predation from humpback whales. The results showed support for intraspecific density-dependent effects in herring, sockeye, and Chinook salmon, with little overall support for an oil spill effect. Of the salmon species, the largest driver was the negative impact of adult pink salmon returns on sockeye salmon productivity. Herring productivity was most strongly affected by changing environmental conditions; specifically, freshwater discharge into the Gulf of Alaska was linked to a series of recruitment failures that occurred before, during, and after the oil spill.

Salmonids may be affected by spilled oil during each stage in their life cycle. Adults are probably the least likely to be directly affected by oil and also the least sensitive to its effects. Juveniles/smolts are also relatively insensitive to the toxic effects of oil, but because they reside in nearshore coastal and estuarine habitats they may be more likely to encounter it, as oil may collect and persist in these areas. Salmonid larvae, or alevins, may be the most sensitive to oil, but would not be exposed in their freshwater river environments which are not in the action area (the action area does not include the rivers and streams that flow into Puget Sound/Salish Sea, except for the estuarine areas when tides could carry oil upstream). Floating and emergent plants in the nearshore community that serve as habitat for salmon and their prey may be affected temporarily (weeks to months or years) by oil contamination. Copepods are an important prey item to salmonids; however, observations of up to 30 days have shown them to be relatively insensitive to oil contamination. Amphipods represent an important prey item to some life stages of salmon. Dauvin and Gentil (1990) reported heavy mortalities of amphipods immediately following a spill in 1979. The authors noted that most of those populations had recovered within 10 years of the spill. However, depending on the period of time, reductions in abundance of important prey species are likely to have significant adverse impacts to salmonids. Seagrasses and kelp appear to be less vulnerable to the effects of oil. The main impacts of oil are associated with the fauna that use these habitats (NOAA 1992).

Puget Sound Chinook salmon, Puget Sound Steelhead, Hood Canal Summer Chum

For salmonid species, populations at ESU and DPS level are likely to be resilient in the long term to a large oil spill in the Salish Sea because the species are widespread, have short life cycles, and use the Salish Sea for only a portion of their life cycle. In the case of PS steelhead, juveniles move quickly out of the inland waters and into the open ocean when they are 2 to 3 years old, highly mobile, and are not nearshore dependent (NWFSC 2015). Juvenile steelhead forage for one to four years before emigrating to sea as smolts. Smoltification and seaward migration occur principally from April to mid-May. The nearshore migration pattern of Puget Sound steelhead is not well understood, but it is generally thought that smolts move quickly offshore, bypassing the extended estuary transition stage which many other salmonids need (Hartt and Dell, 1986). Steelhead oceanic migration patterns are also poorly understood. Evidence from tagging and genetic studies indicates that Puget Sound steelhead travel to the central North Pacific Ocean (Hartt and Dell 1986; Burgner et al., 1992). Puget Sound steelhead feed in the ocean for one to three years before returning to their natal stream to spawn. They typically spend two years in the ocean. Puget Sound steelhead recovery is dependent on freshwater habitat improvement and they remain vulnerable to changing ocean conditions and climate change. In recent years, poor survival of PS steelhead in Puget Sound has been linked to increased predation from growing numbers of pinnipeds (seals and sea lions). The ESA listing for the species and critical habitat, as well as the Recovery Plan, and 2016 Status Review do no specifically call out oil spills as a threat or limiting factor (3/24/99 64 FR 14308, 9/02/05 70 FR 52630, NMFS 2006a, NMFS 2017c). However, a large oil spill in Puget Sound could certainly affect the recovery trajectory of this species by delaying the recovery of one or more subpopulations depending on where a spill occurred by affecting the local populations within the area of a spill. Because the species is widely distributed throughout Puget Sound, the DPS as a whole would likely be resilient to such an event given time and human intervention following a spill. Based on this information, the NMFS concludes that the incremental increase in oil spill risk in some years associated with the proposed action presents very little risk to the listed Puget Sound steelhead DPS.

For PS Chinook, the effects of an oil spill in the inland waters may have greater consequences to the local subpopulations within the area affected by a spill. PS Chinook salmon are highly dependent on estuary and nearshore habitat, which could affect local abundance more sharply. Depending on location and timing, a large oil spill in the Salish Sea could cause acute exposure to anywhere from very few individual fish to large numbers of fish from a given cohort. The longer-term effects of oil spill to affected subpopulations from indirect food web impacts could have negative effects on successive cohorts, but given time, we would expect that these populations could rebuild to pre-spill levels. Subpopulation abundance in affected areas could be depressed for decades and this would negatively affect the timeline for recovery. Human intervention would likely be necessary to rebuild affected populations. Given this information, the NMFS concludes that the incremental increase in oil spill risk in some years associated with the proposed action poses a small risk to this species. The PS Chinook Recovery Plan discusses oil spill as a threat to this species in terms of general water quality in Puget Sound and as a threat to the function of nearshore and marine habitat. The plan recognizes oil spill prevention, planning, and response efforts of the State of Washington, industry, and partners as a means to reduce the threat level.

For Hood Canal summer chum, the waters of Hood Canal would be unlikely to be affected by a spill outside of the canal because there is limited mixing of water between the canal and the rest of the Salish Sea. There are no oil refineries in Hood Canal. This species could be adversely affected by a spill in the Strait of Juan de Fuca, but similar to the other salmon species, would likely recover to pre-spill numbers in time and with human intervention. Given this information, the NMFS concludes that the ~~ongoing and~~ incremental increase in oil spill risk in some years associated with the proposed action poses a small risk to this species.

Eulachon

Because eulachon are infrequently found in the U.S. portions of the Salish Sea, the risk of exposure to an oil spill is small. The primary range of the Southern DPS is the Columbia River, to the south and outside of the action area, however the Fraser River is another important spawning ground. Oil spill is not mentioned as a threat in the Recovery Plan (NMFS 2017f). The main driver for this population may be ocean and Columbia River estuary conditions and fishery bycatch. The estuary and river habitat in the Columbia basin is heavily influenced by the system of dams. In the Salish Sea, the Elwha River is designated as critical habitat. If an oil spill were to occur in the Strait of Juan de Fuca near the mouth of the Elwha River, there could be more direct consequences to this species. Otherwise, the risk to the species from an oil spill in the Salish Sea is very small because these fish are infrequently found in the action area and spend the majority of their lives in the ocean, outside of the action area. Therefore, the incremental increase in oil spill risk in some years associated with the proposed action poses little risk to this species.

The Southern DPS of North American Green Sturgeon

The Recovery Plan for the southern DPS (sDPS) North American green sturgeon acknowledges that the recovery of the species is likely to be a long process. Restoring freshwater spawning and rearing habitat (outside of the action area) by providing adequate water flow and temperature and addressing migration barriers is likely to take ten years or more. Due to green sturgeon slow maturation and low recruitment rate, increases in abundance may not be observed for three to four generations following habitat improvement. Given a generation time for green sturgeon of approximately 22 years, a substantial increase in adult abundance in response to habitat-based recovery actions may not be observed for 66-88 years (NMFS 2018e). With this long recovery trajectory, an oil spill could significantly delay recovery depending on the location of the spill and the number of fish affected. However, this species is rare in the Salish Sea (Lindley et al. 2011). This species is likely more common in the action area off the coast of Washington, but not in high concentrations. Adult and subadult fish from this DPS of green sturgeon occur in relatively large concentrations from late spring to autumn within coastal bays and estuaries to the south of the action area including the Columbia River estuary, Willapa Bay, Grays Harbor and the Umpqua River estuary, with peaks in abundance in summer and autumn. Within the Salish Sea, critical habitat is designated along a narrow band on the south side of the Strait of Juan de Fuca and in Rosario Strait. The Recovery Plan (NMFS 2018e) identifies oil spill as a ``high" threat to adult and subadults in coastal bays and estuaries and a "medium threat" to adults and subadults in nearshore marine areas. Because this species rarely occurs in the action area and the action area, although containing critical habitat, does not contain concentrations of these fish, the incremental increased in probability of oil spill in some years associated with the proposed action in the action area presents a very low risk to individuals of this species and low risk to the population as a whole.

Bocaccio and Yelloweye rockfish

Prior to contemporary fishery removals, each of the major basins in the range of the bocaccio and yelloweye rockfish DPSs likely hosted relatively large populations, though their distribution was likely not uniform throughout the basins of Puget Sound (Moulton and Miller 1987; Washington 1977; Washington et al. 1978; Williams et al. 2010). Having a relatively wide geographic distribution within the Salish Sea enables each species to potentially exploit good habitat, which may be naturally limited in portions of Puget Sound, and protect them from potentially negative environmental fluctuations or conditions. These types of fluctuations may include change in prey abundance for various life stages and/or change in environmental conditions, such as temperature, that influence the number of annual recruits. Wide spatial distribution also provides a measure of protection from larger scale anthropogenic changes that damage habitat suitability, such as oil spills or hypoxia that can cause acute local or regional effects. Rockfish population resilience may be sensitive to changes in connectivity among various groups of fish (Hamilton 2008). However, the wide spatial distribution of these species can also make them vulnerable if their numbers are so scarce that sub populations become effectively isolated from one another. Yelloweye rockfish are the most susceptible to spatial structure impacts because of their sedentary nature. Localized losses of yelloweye rockfish are less likely to be replaced by roaming fish, compared to bocaccio, which are better able to recolonize habitats due to the propensity of some individuals to travel long distances. There is evidence that abundance for both species varies between regions within the DPS (Gertseva and Cope 2017).

Exchange of water masses between the basins of the Salish Sea and Puget Sound, in particular, is naturally restricted by relatively shallow sills located at Deception Pass, Admiralty Inlet, the Tacoma Narrows, and in Hood Canal (Burns 1985). This phenomenon influences larval transport and population connectivity (Drake et al. 2010), and would likely restrict the movement of crude oil from a large spill. These sills regulate water exchange from one basin to the next, and thus likely moderate the movement of rockfish larvae (Drake et al. 2010) and spilled oil. If a large oil spill were to occur within one basin it could reduce the local population abundance. When localized depletion of rockfish occurs, it can reduce resiliency of the entire DPS (Levin 1998; Hilborn et al. 2003; Hamilton 2008). The main threat to rockfish remains fishery bycatch, but the Recovery Plan does identify oil spill as an ongoing "high risk" threat to the "continued existence of these species."

Yelloweye rockfish spatial structure and connectivity has been reduced by the decline of fish within each basin. This reduction is likely most acute within the basins of Puget Sound proper. The severe decline of fish in these basins may eventually result in a contraction of the DPS' range (Drake et al. 2010). The Recovery Plan states that although yelloweye rockfish are probably most abundant within the San Juan Basin, the likelihood of juvenile recruitment from this basin to the adjacent basins of Puget Sound proper is likely naturally low because of the generally retentive water circulation patterns that occur within each of the major basins of Puget Sound proper. Combined with limited adult movement, yelloweye rockfish DPS viability may be highly influenced by the localized loss of populations within the DPS, which decreases spatial structure and connectivity. The San Juan Basin is also at higher risk than other areas of the Salish Sea for oil spills (WDOE 2015).

Bocaccio may have been historically more limited in their spatial distribution. They were likely historically most abundant in the Main Basin and South Sound (Drake et al. 2010; Williams et al. 2010) with no known documented occurrences in the San Juan Basin until 2008 (Pacunski et al. 2013). Spatial structure and connectivity in the DPS likely comes from the propensity of some adults and pelagic juveniles to migrate long distances, which could re-establish aggregations of fish in formerly occupied habitat (Drake et al. 2010). The apparent reduction of populations of bocaccio in the Main Basin and South Sound represents a further reduction in the historically limited distribution of bocaccio, and adds significant risk to the viability of the DPS. Bocaccio juveniles are also dependent on shallow, nearshore areas, particularly with kelp beds, making them susceptible to oil spills that foul shorelines.

Given that the rockfish Recovery Plan identifies oil spill as a significant threat to listed rockfish, we looked at how rockfish responded to the Exxon Valdez oil spill in Prince William Sound to gauge how rockfish might be affected and how the populations might respond afterward to inform our view of whether or not the incremental increase in risk in some years associated with the proposed action is significant to the species. Of course, this is not a direct comparison because the rockfish species in Prince William Sound were not listed as threatened or endangered making their baseline populations naturally more resilient to a catastrophe compared to the DPSs in the action area; although the scale of the Exxon Valdez spill of 11 million (11,000,000) gallons in Prince William Sound in Alaska was huge. That volume of oil outflow occurred after the accident because the ship was single-hulled and in a remote location, making accident response measures extremely difficult. An accident of that size is extremely unlikely in the Salish Sea because ships are double-hulled and accident response efforts are likely to be more effective in the Salish Sea. Nevertheless, the "base case" modeled spill in WDOE's 2015 VTRA has an average spill volume of 1.8 million gallons, which would be a substantial spill in the inland waters of the Salish Sea. This average spill volume has a 0.005 probability of occurring in a ten-year period (0.5 percent probability) with WDOE's model. The Exxon Valdez Oil Spill Trustee Council reports that dead rockfish were observed throughout Prince William Sound immediately following the 1989 spill, but the total number of dead fish was not documented. Necropsies of five fish indicated that oil ingestion was the cause of death. Additionally, hydrocarbon concentrations in dead fish from oiled areas were higher than those from unoiled areas. Between 1989 and 1991, higher petroleum hydrocarbon concentrations were measured in rockfish from oiled areas when compared to unoiled areas. The Council notes that interpretation of these data "is limited, however, because oil accumulation differs by species and by age of the fish, and these variables were not fixed across sites." Other studies on rockfish following the spill included, 1) an examination of larval growth of fish, (including rockfish) in 1989; 2) a genetics investigation designed to identify species of rockfish larvae and young in the Gulf of Alaska and 3) a microscopic examination of fish tissues to identify lesions associated with oil exposure. These studies were inconclusive as none of them directly linked exposure of Exxon Valdez oil to any of the endpoints that were measured (http://www.evostc.state.ak.us/index.cfm?FA=status.rockfish).

Ten years after the spill, data collected in 1999-2000 led the Council to conclude that it is unlikely that rockfish were being exposed to lingering oil because known pockets of lingering oil rarely occurred in their preferred habitat. Documented lingering bioavailable oil was in the subsurface sediments of the intertidal zone, and rockfish mostly occurred in different habitats of subtidal areas and in pelagic environments. The Council also reported that data collected by the Alaska Department of Fish and Game and the North Pacific Fisheries Management Council "in the years since the Spill indicate that the population is healthy in Prince William Sound and have shown no biomarkers of oil exposure. There have been no demonstrated differences in population or breeding success between oiled and unoiled areas (http://www.evostc.state.ak.us/index.cfm?FA=status.rockfish)." The Council considers rockfish to be very likely recovered from the Exxon Valdez oil spill in Prince William Sound.

Given the status of bocaccio and yelloweye rockfish in the Salish Sea with low numbers and scattered populations, these DPSs may not show similar resilience following a major oil spill in the action area. Following a large spill, it could take decades longer to rebuild populations because of the spatial structure and low numbers in these two DPSs; although it is encouraging to see that rockfish did recover in Prince William Sound. NMFS recognizes that a major oil spill in the action area could be devastating to the local sub-population of rockfish in the vicinity of a major spill. Recognizing that an actual spill cannot be predicted, we assess the effect to the threat level of incremental increases in oil spill risk in some years to bocaccio and yelloweye rockfish populations from BP ship traffic.

Given this line of reasoning, the NMFS perceives BP's potential incremental increase in oil spill risk in some years associated with the proposed action for a large oil spill to be of a magnitude that does not alter the existing threat level to the listed rockfish because the most likely spills are orders of magnitude less than what would likely be "catastrophic" to listed rockfish because the effects would be localized enough to likely not cause the complete loss of local subpopulations with the Salish Sea. Additionally, the largest spills that would approach the 1.8 million (among all traffic) have a very low probability of occurring. This conclusion regarding the risk posed by the proposed action includes the consideration of incremental and varying increase in risk from the proposed action with a rolling average number of 385 total ships, including some years having more crude oil ship calls over the baseline use of 140 (highest actual crude oil ships calls to date was 191 in 2007), and considering the risk mitigation measures employed by BP and the industry, together with the Northwest Response Plan. The Recovery Plan acknowledges that, "There are numerous parallel efforts underway, independent from rockfish recovery, to protect and restore the Puget Sound ecosystem. Such efforts include oil spill prevention measures, contaminated sediment clean-up projects, and other important projects. These efforts will provide benefits to listed rockfish and habitats and prey base and are thus highlighted in the plan." The plan further states that oil spill response and prevention are already conducted in the range of the DPSs and the plan stresses their importance to a "healthy ecosystem that supports listed rockfish." To this end, NMFS concludes that the incremental increase in oil spill risk in some years associated with the proposed in the action area presents low risk to individuals of this species and low risk to the population as a whole. The proposed action does not significantly exacerbate the existing extinction risk of these two species because the proposed action does not significantly change the existing oil spill risk profile in the action area. We also recognize that there will be years when BP operates with fewer shipments and there will be incrementally less risk in those years.

2.4.2 Risk of Small Oil Spills/Transfer Errors at the BP Cherry Point Facility

Ongoing operation and maintenance activities at the BP Marine Terminal could result in accidental releases of oil or other hazardous materials (e.g., hydraulic fluid).
Spill records at the facility for the period from 1990 through 2010 indicate that incidents typically average 3.5 spills per year. Many of the incidents reported were in quantities of drops or sheen on the water, with an average spill volume of 9.8 gallons. Between 2001 (when the North Wing became operational) and 2010, the average spill volume at the BP Marine Terminal decreased to 0.65 gallons. These small spills are likely to continue into the future and affect small numbers of fish in the immediate vicinity of the facility at Cherry Point. BP utilizes industry BMPs to contain spilled oil at the facility (booms, support boats) and BP cooperates with the Washington Department of Ecology on assessment and cleanup of small spills. Nevertheless, small quantities of oil (drops to gallons), may escape cleanup and affect the nearshore marine habitat and fish at Cherry Point, and will increase proportionally with added crude oil ship calls over 140 and total ship calls over 385 (not to exceed 420). We also recognize that adding the second wing adds some risk reduction measure by keeping the operations specialized to one type of transfer, and there will also be years in which BP operates with fewer shipments resulting in incrementally less risk.

Small Spills/Transfer Errors SRKW, Large Whales, and Leatherback Turtle

For SRKW, 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 (Geraci and St. Aubin 1990; 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). However, we do not anticipate that transfer errors would release oil in quantities that would expose SRKWs to acute toxicity because SRKWs infrequently occur in close proximity to Cherry Point, making the chance of direct exposure to transfer errors highly unlikely. Similarly, the other whale species and leatherbacks would likely not be exposed to transfer errors because of their rarity in the action area.

Small Spills/Transfer Errors and Listed Fish

PS Chinook Salmon, PS Steelhead, Rockfish Of the listed fish species addressed in the opinion, yelloweye rockfish, bocaccio, juvenile PS Chinook salmon, and juvenile steelhead are likely to be directly adversely affected by these small spills. These small spills will likely also have a periodic negative effect on forage fish spawning in the Cherry Point area. Many of the species addressed in this opinion depend on forage fish, although the effect to forage fish would be periodic and localized; and it is likely not possible to directly observe or quantify changes in local abundance and link those to periodic smalls spills. Nevertheless, Incardona et al. (2015) found that low level exposure of embryonic herring to PAHs may result in lasting physiological effects. Whether Incardona et al.'s (2015) results are applicable to larval and juvenile rockfish and the more advanced life stage of juvenile salmon is uncertain because the test species and developmental stages are different, nevertheless, we believe that direct exposure to spilled oil would cause adverse physiological effects. Very low numbers of juvenile PS Chinook salmon and juvenile steelhead, relative to their respective populations are likely to be exposed periodically from spilled oil as they outmigrate through Puget Sound.

Rockfish fertilize their eggs internally and the young are extruded as larvae. Rockfish larvae are pelagic, often occupying the upper portion of the water column near floating algae, detached seagrass, and kelp. Juvenile bocaccio settle onto shallow nearshore water in rocky or cobble substrate that support kelp at 3 to 6 months of age, and move to progressively deeper waters as they grow (Love et al., 1991, Love et al., 2002). There are extensive kelp beds in the Cherry Point region, making exposure of juvenile bocaccio to spilled oil likely. Juvenile yelloweye rockfish do not typically occupy intertidal waters and shallow habitats (Love et al., 1991), so this life stage is not likely to be exposed. Adult yelloweye rockfish and bocaccio typically occupy waters deeper than 120 feet (Love et al., 2002) and would therefore be unlikely to be exposed to floating surface oil.

Larval yelloweye rockfish and bocaccio could in the vicinity of pier, although they are readily dispersed by currents after they are born, making the concentration or probability of presence of larvae in any one location extremely small, which would make the risk of exposure to any one small spill event relatively small, but not discountable because small spills are likely to continue periodically so long as the BP facility is in operation.

Hood Canal Summer Chum, Eulachon, Sturgeon Transfer errors are unlikely to affect Hood Canal summer chum, eulachon, and sturgeon because they are not known to occur in the Cherry Point area or their occurrence would be extremely rare.

2.4.3 Risk of Vessel Collision on Marine Mammals and Sea Turtles

As discussed in the Rangewide Status of the Species and Environmental Baseline sections of this opinion, collisions with large ships remain a source of anthropogenic mortality or serious injury for both sea turtles and whales. The origin and destination of ships coming and going from the facility is likely to change over time based on many factors including market demand. It is therefore impossible to compare the precise overlap in shipping and whale or turtle density to precisely quantify the probability of collisions for BP-bound ships and general traffic in the action area. In spite of being one of the primary known sources of direct anthropogenic mortality to large whales, and to a lesser degree, sea turtles, vessel collisions remain relatively rare, stochastic events, particularly in the action area as described under the Rangewide Status of the Species and Baseline sections of this opinion for each whale and turtle species.

For vessel strikes, we assume the risk posed by a vessel is essentially the same among crude oil ships and refined product ships, although there may be some actual differences associated with specific routes or speeds, we do not have data to make that distinction. The proposed action includes receiving up to 420 ships in a year (35 above calculated baseline operational use/up to 70 additional trips in a year), within the proposed 5-year rolling average. Therefore, in some years, risk of ship strikes will be incrementally greater than baseline (we also recognize that some years will have incrementally less risk when BP operates with fewer shipments). We assume that the risk of a vessel collision is proportional to the number of animals and vessels trips, but likely not directly/linearly proportional. Defining the proportionality requires more information than is currently available at this scale. Nevertheless, we conclude that with the proposed action, the listed whales and turtle in the action area will continue to be at risk of ship strike risk, with BP generally maintaining its existing risk of vessel collisions on average, but with some years having incrementally higher risk when operating between 385 ships and 420 ships in any one year, and having incrementally lower risk in some years when operating below 385 ships.. Therefore, we look at the general co-occurrence of ships and animals and qualitatively consider the degree of additional risk posed to individuals in the action area and the potential consequences to the respective populations.

2.4.3.1 Southern Resident Killer Whale Vessel Collision

Vessel strikes on killer whales are rare, but do occur and can result in injury or mortality (Gaydos and Raverty 2007). Killer whale vessel strikes are more rare than larger whale strikes because killer whale swimming and social behavior is dolphin-like (killer whales are the largest animal in the dolphin family). Whereas large whales do not maneuver in the same manor, making them more susceptible to vessel strike. According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS West Coast Region, no human-caused killer whale mortality or serious injuries were reported from non-fisheries sources between 2007 and 2011 (Carretta et al. 2013). There was documentation of a whale-boat collision in Haro Strait in 2005 which resulted in a minor injury to a whale. In 2006, whale L98 (also known as Luna) was killed during a ship interaction. L98’s unique behavior may have contributed to this accident. L98 became separated from his pod at a young age and lived alone in Nootka Sound where he regularly interacted socially with boats, and was considered a nuisance by some. Both of these collisions were from small tankers, in contrast to the large ships likely to be transiting to and from the proposed facility. There have been several Southern Resident killer whale deaths between 2002 and 2017 that have been attributed to “trauma”, which could have been from ship or small boat collisions, but the findings are not conclusive. These deaths include L60, an adult female, in 2002; L112, a juvenile female with blunt force trauma to the head; J34, an adult male, in 2016 with blunt force trauma to the head (Stranding Network). Several dead transient killer whales have also been found with trauma as the cause of death in the Northwest during this same time period.

The vessels associated with BP’s operation move in predictable patterns in shipping lanes and do not seek out the whales as is the case with whale-watching vessels. No known vessel strikes have occurred among ships calling at the BP facility. We consider the additive risk of up to 35 additional ships (385 to 420) in a year to not meaningfully increase the possibility of BP-bound vessel collision, which is likely to be extremely small as a baseline condition to any one individual whale. Because the incremental increase in risk from the proposed action in some years is likely so small, we cannot reasonably predict that a whale from this DPS will be struck as a result of the proposed action. Therefore, the proposed action is not likely to contribute to population level effects to the species from the incremental increase in ship strike risk in some years, or result in the incidental taking of an individual.

2.4.3.2 Vessel Collision and Large Whales

The large whales in the action area are vulnerable to injury and death from vessel collisions (Vanderlaan and Taggart 2007). The occurrence and density is variable for the different species in the action area. In U.S. waters, ship strikes account for tens of large whale deaths per year (Con and Sibler 2013, Henry *et al.* 2012, Van der Hoop *et al.* 2012), and in the hundreds of deaths each year globally (Con and Sibler 2013, Laist *et al.* 2001, Jensen and Sibler 2003, Van Waerebeek *et al.* 2007). The documented number of vessel collisions is an underestimate of the actual number of collisions because vessel collisions have a low probability of detection (Laist *et al.* 2001, Con and Sibler 2013).

Ship strike injuries to whales include propeller wounds characterized by external gashes or severed tail stocks, blunt trauma injuries indicated by fractured skulls, jaws, and vertebrae (Laist *et al* 2001), and hemorrhaging that sometimes lacks external expression (Con and Sibler 2013). Collisions with smaller vessels may result in propeller wounds or no apparent injury, depending on the severity of the incident. A majority of vessel collisions seem to occur over or near the continental shelf, probably reflecting the concentration of vessel traffic and whales in these areas (Laist *et al.* 2001). Vessel size and speed are associated with the number and severity of vessel collisions with whales. In one study, of the known collisions that killed whales, at least 87 percent involved ships more than 250 feet long (Laist *et al.* 2001). There is a significant positive relationship between ship speed and the probability of a lethal injury (Conn and Sibler 2013). Vanderlaan and Taggart (2007) reported that the greatest probability of a lethal injury to a large whale occurs between vessel speeds of 8.6-15 knots. Limited data are available on whale behavior in the vicinity of an approaching vessel and the hydrodynamics of whale/vessel interactions.

2.4.3.3 Humpback Whales Vessel Collision

The 1991 Humpback Whale Recovery Plan identifies ship strike as a general threat. Of the humpback whales within the action area, NMFS presumes that 9 percent are from the Central America DPS and 28 percent are from the Mexico DPS. This does not mean that 9 percent and 28 percent of these populations occur in the action area, it means that, for example, if there are 20 humpbacks in the action area, 9 percent and 28 percent are presumed to be from the respective DPSs.

Along the entire West Coast range of this stock, the 2019 Humpback Whale Stock assessment identified 2.2 observed vessel collisions per year from 2013-2017 with total estimated vessel collisions per year of 22 (based on Rockwood el al. 2017). This estimate of 22 vessel collisions per year is for the combined CA/OR/WA stock across its range, of which the action area is a small portion and signals at a low reporting or observation rate of vessel strikes. Carretta et al.

(2018) estimates an additional 10.8 serious injuries/deaths per year during this same time period. The stock assessment report notes that the stock has shown a long-term increase in abundance from 1990 through approximately 2008, but more recent estimates through 2014 showed a leveling off.

The 2015 Status Review (NMFS 2015b), which assessed threats separately each of the new 14 DPSs, concludes that in general, “In the Pacific Ocean, all threats are considered likely to have no or minor impact on population size and/or the growth rate or are unknown, with the following exceptions. . . . Vessel collisions are considered likely to moderately reduce the population size or growth rate of the Central America [DPSs] . . .” The 2015 Status Review further states that vessel collisions and entanglement in fishing gear pose the “greatest threat” to the Central America DPS because of “especially high levels of large vessel traffic are found in this population’s range off Panama, southern California, and San Francisco.”

Overall, the 2015 Status Review (NMFS 2015b) concluded that vessel collisions were determined to pose a medium risk (level 2) to these populations primarily because of the small population size and the likelihood that shipping traffic will increase over time with global commerce. As described in the Baseline Section 2.3.5, Rockwood et al. (2017) estimated vessel collisions of humpback whales along the U.S. West Coast. Comparing across the study area (U.S. waters offshore from California, Oregon and Washington), the majority of strike mortality occurs in waters off California (outside of the action area), from Bodega Bay south and tends to be concentrated in a band approximately 24 Nm (44.5 km) offshore and in designated shipping lanes leading to and from major ports. Rockwood et al. (2017) and Nichol et al. (2017) also showed a hot spot for humpback whales extending offshore from the Strait of Juan Fuca in the action area. Miller (2020) found considerable overlap of humpback whale sighting locations with the shipping lanes, ferry routes, and large vessel tracks on the Washington outer coast and into the action area.

Taking this information into account and considering that the entire population size of the Central America DPS is in the 100’s of animals, with the primary range of this population far to the south of the action area along Southern California and to the south along Central America, NMFS concludes that small numbers of this DPS use the action area, making the probability of vessel collisions in the action area on individuals from this DPS extremely small, particularly within the inland waters. On the outer coast, ship strike risk would be proportionally higher because of higher concentrations of humpbacks in the offshore feeding grounds, but still extremely small for this DPS. Therefore, we conclude that the incremental increase in risk in some years from the proposed action poses an extremely small risk to any one individual from this population. Population-level effects are unlikely because the action area is at the far northern range of this DPS making this population’s occurrence in the action area rare. The already low probability of ship strike on any one particular animal would be even lower for BP-specific vessels. Therefore, the proposed action poses very little additional risk to individual whales from this population and extremely small additional risk to the population. Because the risk is likely so small, we cannot reasonably predict that a whale from this DPS will be struck as a result of the proposed action. Therefore, the proposed action is not likely to contribute to population level effects to the species from the incremental increase in ship strike risk in some years, or result in the incidental taking of an individual.

Humpbacks from the Mexico DSP are more common in the action area, making up an estimated 28 percent of the humpback whales in the action area. This does not mean that 28 percent of the population occurs in the action area. The primary range for this population is off Mexico and California, with many whales feeding off California and Oregon. For the CA/OR/WA stock that includes members of the Mexico DPS, the 2015 Status Review mentions ship strikes and an overall exceedance of PBR for the larger stock, but the Status Review does not call out ship strikes as a major threat. The 2015 Status Review indicates that the population of this DPS may be growing, but there is much uncertainty in the estimates, though it is unlikely that the population is declining. Rockwood et al. (2017), as discussed more fully in the Section 2.3.5 Baseline, shows that there is a hot spot for potential humpback whale vessel collisions in the action area on the outer coast in a fan that extends offshore from the Strait of Juan de Fuca. This is where shipping traffic co-occurs with an offshore feeding area (see Figures 34 and 35 in Section). Documented strandings of humpback whales from vessel collisions are more common to the south (outside of the action area) off California. Within Puget Sound/Salish Sea sightings of whales have been increasing, but whales are generally seen alone or in small groups.

In 2004, a humpback whale stranded dead in Washington with injuries consistent with those caused by a ship strike. In 2008, in Washington, two humpback whales stranded dead with injuries consistent with those caused by a ship strike. A humpback whale carcass was found near Neah Bay in 2018. A necropsy revealed injuries from a vessel strike. In 2019 and 2020, a Washington State ferry hit a humpback whale within the inland waters; both incidents were presumed to be fatal. Additionally, in 2020 a juvenile humpback whale carcass washed ashore on the Washington outer coast with injuries consistent with a vessel strike. As shown by Rockwood et al. (2017) many ship strikes go unreported or discovered due in part to the location of strikes and the fact that humpback whale carcasses exhibit negative buoyancy. Considering this information for known and modelled vessel collisions (Rockwood et al. 2017) in the action area, we conclude the proposed action will result in incrementally greater risk over baseline in some years, but the risk to any one individual from this population from the proposed action is extremely small. Because this population represents a small proportion of the whales using the action area, it is unlikely that the additional incremental risk in some years associated with the proposed action will result in population level effects. This population appears to be growing despite the level of existing vessel collisions in its *core* range off Mexico and California, where the number of whales is higher compared to the action area and the number of ship strikes are likely proportionally higher. Because the incremental increase in risk from the proposed action in some years is likely so small, we cannot reasonably predict that a whale from this DPS will be struck as a result of the proposed action. Therefore, the proposed action is not likely to contribute to population level effects to the species from the incremental increase in ship strike risk in some years, or result in the incidental taking of an individual.

2.4.3.4 Blue Whale Vessel Collision

Blue whales are extremely rare in the action area. The Eastern North Pacific population feeds off California in the summer and fall. Vessel surveys conducted in Washington waters in 1996 and 2001 did not find any blue whales (Carretta et al. 2013; Figure 39) however some groups and individuals have been sighted in recent years off the coasts of Oregon and Washington. As described more fully in the Section 2.3 Baseline Vessel collisions of blue whales are problematic off California in the California Current and likely exceed PBR. Rockwood et al. (2019) found mortality levels above the 90th percentile for blue whales were limited to the waters off of California. Because blue whales are extremely rare in the action area, the additional risk associated with the proposed action in some years is extremely small to individual blue whales and is likely inconsequential to the Eastern North Pacific population. Because the incremental increase in risk from the proposed action in some years is likely so small, we cannot reasonably predict that a whale from this DPS will be struck as a result of the proposed action. Therefore, the proposed action is not likely to contribute to population level effects to the species from the incremental increase in ship strike risk in some years, or result in the incidental taking of an individual.

2.4.3.5 Fin Whale Vessel Collisions

Fin whales rarely occur within Puget Sound, with one sighted in 2015 and one in 2016 by a whale-watching company. In the Salish Sea, including Canadian waters, Towers et al. (2017) found photographic evidence of at least 13 unique individuals during 43 encounters from 1999 to 2017, documenting live fin whales in Queen Charlotte, Johnstone, Georgia and Juan De Fuca Straits and the only confirmed sightings between Vancouver Island and continental North America since 1930. On the outer coast, fin whales are more common to the south of the action area off Oregon and California (Figure 40). An estimated 2,636 fin whales occur off the coasts of California, Oregon, and Washington during summer/fall based on shipboard surveys in 2001 and 2005 (NMFS 2010a) (Figure 40), with the concentrations of sightings decreasing through Oregon and becoming much less off Washington.

Fin whales typically feed well offshore along the continental slope. Fin whales have been reported struck and killed by large ships along the entire West Coast with an estimated 19 whales struck from 1998-2013 (WCR Stranding Database). Dead fin whales have been unknowingly brought into multiple ports on the bows of ships. In 2008, one fin whale was struck and brought into the port of Los Angeles on the bow of a ship. In 2009, a total of four fin whales were reported as struck: two were struck off of San Clemente Island in Southern California, one came in on the bow of a ship into Los Angeles Harbor, and one came in on a bow of a ship into Tacoma, Washington in the action area. In 2010, a fin whale came in on the bow of a ship in the port of Oakland, near San Francisco, CA. Between 2007 and 2011, the average observed annual mortality and serious injury due to vessel collisions was 1.6 fin whales per year (Carretta *et al.* 2014).

In the Salish Sea, Towers et al. (2017) reports 12 dead fin whales, all with evidence of vessel collisions between 1986 and 2017. The authors suggest that fin whales in the inland waters may be at greater risk to vessel collisions than in less confined waters further offshore. Although the precise locations of the mortality events could not always be determined (Douglas et al. 2008); the whales could have been carried into port from more open waters. The 2019 Stock Assessment for fin whales from the CA/OR/WA stock reports documented ship strikes at 1.6 per year and notes that total observed injuries from ship strikes (2.1) and fisheries (0.5) were less than PBR (81). However, many vessel collisions likely go undetected or unreported. Within US waters, the estimated vessel strike mortality is 43 whales per year or 0.5 percent of the stock. A worse-case estimate is 95 whales per year or 1percent of the stock.

The 2010 Fin Whale Recovery Plan identifies vessel collisions as a high threat with a "medium severity, but with high level of uncertainty, the relative impact to recovery of fin whales due to ship strikes is ranked as unknown but potentially high." Although fin whales have been struck in the action area, the main hot spots for fin whale ship strikes are off California (Figure 30). Considering that the primary range of fin whales is south of the action area and fin whales are still quite rare in the action area and considering modelled vessel collisions (Rockwood et al. 2017) in the action area, we conclude that the additional incremental risk in some years poses an extremely small risk to any one individual from this population. Further, this species is very rare within the Salish Sea and fin whales typically feed well offshore, making it unlikely that the additional incremental risk in some years associated with the proposed action would result in CA/OR/WA stock-level effects and would be inconsequential at the level of the global listing. Because the incremental increase in risk from the proposed action in some years is likely so small, we cannot reasonably predict that a whale from this DPS will be struck as a result of the proposed action. Therefore, the proposed action is not likely to contribute to population level effects to the species from the incremental increase in ship strike risk in some years, or result in the incidental taking of an individual.

2.4.3.6 Western North Pacific Gray Whale Vessel Collisions

Western North Pacific gray whales are rare, with population estimates of only 200 individuals. Information from tagging, photo-identification, and genetic studies show that WNP gray whales have been observed migrating in the winter to the eastern North Pacific off the outer coast of North America from Vancouver, B.C to Mexico (Lang 2010, Mate *et al.* 2011, Weller *et al.* 2012, Urban *et al.* 2013). Although there is potential for WNP gray whales to occur along the Washington coast and to enter the Salish Sea, available data indicate that occurrence is likely to be very rare in the action area. Given the extreme rarity of this species, the likelihood of a BP-bound ship striking an individual WNP gray whale is extremely remote and the incremental increase in risk from the proposed action is not likely to present risk at the population level because the action area is a very small portion of the species range and this species is extremely rare in the action area. Because the incremental increase in risk from the proposed action in some years is likely so small, we cannot reasonably predict that a whale from this DPS will be struck as a result of the proposed action. Therefore, the proposed action is not likely to contribute to population level effects to the species from the incremental increase in ship strike risk in some years, or result in the incidental taking of an individual.

2.4.3.7 North Pacific Right Whale Vessel Collisions

The North Pacific right whale population is very small, likely in the low 100s or as many as 400, between the two subpopulations, and most sightings have been of single whales, though small groups have been sighted. The eastern subpopulation that occurs in the action area may number as few as 30 individuals. These whales may pass through the action area on the outer coast of Washington as they migrate from summer feeding grounds in the North Pacific and Bering Sea to warmer waters as far south as central Baja California. Since 1996, right whales have been observed repeatedly in their critical habitat (outside of the action area) in the southeastern Bering Sea during the summer months.

Migration patterns of the North Pacific right whale are unknown, although it is thought the whales spend the summer in far northern feeding grounds and migrate south to warmer waters, such as southern California, during the winter. From 1965 to 1999, there were only 82 sightings of right whales in the entire eastern North Pacific, with the majority of those occurring in the Bering Sea and nearby areas of the Aleutian Islands. Five sightings were off California or Mexico and one off the coast of Washington. The one whale sighted off Washington was in 1992, while none have been sighted off of Oregon as of 2001 (Brownell *et al*. 2001). It is likely that right whales were never common off the coast of Oregon and Washington (Scarff 1986, 1991). Aboriginal and commercial whaling records indicate that right whales were not common off the west coast of North America even during the early stages of whaling (Townsend 1935, Scarff 1986, Mitchell and Reeves 2001).

Right whales are slow-moving animals and are susceptible to injury or mortality by ship strike. Vessel collisions are considered the primary source of human-caused mortality of right whales in the North Atlantic (Cole et al. 2005). For the West Coast, the 2019 Stock Assessment (NMFS 2019d) points out that there is currently no known direct human-caused mortality of these whales because their population is so small and scattered, yet any human-related mortality or serious injury from ship strikes is likely to have serious population level impact. The 5 Year Status review contradicts this conclusion saying, “Risks from entanglement and ship strikes may currently pose little direct threat to recovery of North Pacific right whales, although injury or mortality from any of these sources would be noteworthy due to the limited size of the population.” The Recovery Plan identifies ship strikes as an unknown threat and expresses concern for growing traffic in the Arctic region associated with melting sea ice. Individual North Pacific right whales are at extremely low risk of exposure to additional BP-bound ships because there are so few whales in this population, the action area is a small portion of their range, this species is rare in the action area, and they are not known to congregate off the Washington Coast. Therefore, the proposed action poses very little additional risk to this species. Because the incremental increase in risk from the proposed action in some years is likely so small, we cannot reasonably predict that a whale from this DPS will be struck as a result of the proposed action. Therefore, the proposed action is not likely to contribute to population level effects to the species from the incremental increase in ship strike risk in some years, or result in the incidental taking of an individual.

2.4.3.8 Sperm Whale Vessel Collisions

Whitehead (2002) estimated sperm whale abundance to be approximately 300,000–450,000 worldwide, growing at about 1 percent per year. Abundance in the Pacific is approximately 152,000–226,000 using Whitehead’s 2002 methods. Prior to whaling, the estimated North Pacific Ocean abundance was 1.26 million. The abundance estimates for sperm whales off California, Oregon, and Washington, out to 300 nautical miles (nm) ranged from 2,000 to 3,000 animals (Moore and Barlow 2014). Sperm whales are very rare in the inland waters portion of the action area with just one recent sperm whale sighting in the Salish Sea near the San Juan Islands in Haro Strait in March 2018. Acoustic detections of sperm whales in the offshore waters of the outer Washington coast occurred in all months of the year, with peak occurrence April to August. Acoustic detection inshore from April to November were generally faint enough to suggest that the whales were offshore (Oleson et al. 2009).

The 2019 Stock Assessment for the California to Washington states that, including annual mortality and serious injury rate of ≥ 0.64 per year, which is less than the calculated PBR (2.5) for this stock, but this is likely underestimated due to incomplete detection of carcasses. Total human-caused mortality is greater than 10 percent of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The 2010 Sperm Whale Recovery Plan identifies vessel strike as one of several main threats to species recovery. Sperm whales spend long periods of time "rafting" and socializing at the surface after deep dives, typically up to 10 minutes at a time, making them vulnerable to ship strikes. In hot spots in the Atlantic Ocean for right whale strikes, NMFS has established ship speed restrictions with USCG and recommended shipping routes to reduce the risk in those waters, which also may reduce risk to sperm whales.

From 1998-2013, the total estimated number of observed or assumed mortality and serious injury attributed to vessel collisions off the U.S. West Coast is approximately four sperm whales (WCR Stranding Database). Sperm whale interactions with large ships are rarely reported along the entire West Coast, although they are likely vulnerable to vessel collisions. Carcasses that do not drift ashore may go unreported, and those that do strand may show no obvious signs of having been struck by a ship. Two whales described as "possibly sperm whales" are known to have died in U.S. waters in 1990, after being struck by a ship (Barlow *et al.* 1997). In 2007, in Florence, OR, a calf stranded dead with obvious signs of propeller trauma, a deep gash on its dorsal side, and the caudal end of the body cut off at the peduncle. In 2009, a sperm whale carcass washed ashore at Point Reyes, California with severe bruising and hemorrhaging along the dorsum, consistent with injuries likely to have been caused from a ship strike. From 2001-13, the total number of observed or assumed mortality and serious injury (M/SI) attributed to vessel collisions is 3.0, resulting in an annual average of 0.23 sperm whales. Again, this is considered a minimum estimate since animals struck by ships may not be realized or reported.

The 2010 Recovery Plan concludes that, "While there have been some reports of sperm whales struck by ships, it does not appear that ship strikes are a significant threat to sperm whales (Whitehead 2003 [as cited in the 2010 Recovery Plan]). However, accurately quantifying the effects of ship strikes in the U.S. is not possible, at this time." Given all of this information and the fact that the action area is a small portion of the sperm whale range, we conclude that the proposed action poses very small additional risk of vessel collision in some years to individual sperm whales in the action area. The risk is very small to individual sperm whales because sperm whale abundance is relatively low in the coastal waters and extremely rare in the inland waters. Although the 2017 Stock Assessment identifies PBR as being exceeded for the local stock, the global population appears to be increasing at a steady one percent rate. Because the incremental increase in risk from the proposed action in some years is likely so small, we cannot reasonably predict that a whale from this DPS will be struck as a result of the proposed action. Therefore, the proposed action is not likely to contribute to population level effects to the species from the incremental increase in ship strike risk in some years, or result in the incidental taking of an individual.

2.4.3.9 Leatherback Turtles Vessel Collisions

Leatherback sea turtles regularly occur off the coast of Washington, especially off the mouth of the Columbia River (to the south- outside of the action area) during the summer and fall when large aggregations of jellyfish form (WDFW 2012b). Observations, telemetry data, and gillnet captures of leatherbacks off the Washington coast, identified turtles south of Cape Flattery and in deeper offshore water (WDFW 2012b). Leatherback turtles occur in the action area, more commonly on the outer coast, with rare occurrence in the inland waters of the Salish Sea. Because all sea turtles must spend time at the surface to breathe, rest, bask, and feed, these fundamental behaviors make turtles vulnerable to ship strikes. Sea turtle stranding data for the U.S. Gulf of Mexico and Atlantic coasts, Puerto Rico, and the U.S. Virgin Islands show that between 1986 and 1993, about 9 percent of living and dead stranded sea turtles had propeller or other boat strike injuries (Lutcavage *et al.* 1997). A study of sea turtle strandings in Florida estimated an annual death rate of 4 to 6 leatherback turtles a year from 2000 to 2014 (Foley et al. 2019). A recent study estimated that approximately 93 percent of turtles stranded in Florida with vessel strike wounds were killed by those injuries (Foley et al. 2019). Vessels strikes pose a threat to the West Pacific DPS. Of leatherback strandings documented in central California between 1981 and 2016, 11 were determined to be the result of vessel strikes (7.3 percent of total; NMFS unpublished data).

Between 2000 and 2005, there were three reported boat collisions with leatherbacks off the coast of California, and the fate of these turtles is unknown (SWR stranding database). Two of the reports documented damage to the carapace, head, or flippers. In 2008, there was another boat collision reported off Cayucos Point, California and the turtle was observed dead (SWR stranding database). Vessel collisions likely go largely unreported, and may pose a threat to leatherbacks in foraging areas like the Gulf of the Farallones (outside of the action area) (Benson *et al.* 2007b). This number underestimates the actual number of boat strikes that occur since not every boat-struck turtle will strand, every stranded turtle will not be found, and many stranded turtles are too decomposed to determine whether the turtle was struck by a boat. It should be noted, however, that it is not known whether all boat strikes were the cause of death or whether they occurred post-mortem (NMFS 2001).

Information is lacking on the type or speed of ships involved in sea turtle vessel collisions; however, there does appear to be a correlation between the number of vessel-struck turtles and the level of recreational boat traffic (NRC 1990). Sea turtles have been reported with injuries consistent with propeller wounds, which are likely from interactions with small, fast moving vessels, such as recreational boats. Based on telemetry data for leatherback turtles (n=15) on the northeastern U.S. shelf, leatherback turtles spent over 60 percent of their time in the top 10 m of the water column and over 70 percent of their time in the top 15 m (Dodge et al. 2014). The prolonged use of the upper waters increases the risk of vessel strike.

Although little is known about a sea turtle’s reaction to ship traffic, sea turtles are thought to be able to avoid injury from slower-moving ships (under 2 knots) since the turtle has more time to maneuver and avoid the ship (Hazel *et al.* 2007). BP-bound ships will travel faster than 2 knots in the action area, therefore there is a high likelihood that sea turtles will not be able to avoid an approaching ship and will incur injury or death from a collision. Therefore, we conclude that with the proposed action, leatherback turtles will continue to be at risk of vessel strikes from BP-bound ships, with the risk incrementally increasing and decreasing in some years in proportion to actual ship calls. Although leatherbacks are known to feed off the Washington Coast, the main feeding areas are off California and in the Columbia River plume, south of the action area.

Based on satellite tracking data from leatherbacks nesting on western Pacific beaches or foraging off California, some leatherbacks will move into U.S. coastal waters as early as the spring, often coming directly from foraging areas in the eastern equatorial Pacific (Benson *et al.* 2011). Leatherbacks will move into areas of high abundance and density of gelatinous prey, *e.g.*, *Chrysaora fuscescens* and *Aurelia spp.*, along the West Coast when upwelling relaxes and sea surface temperatures increase and retention areas develop (Benson *et al.* 2011). These coastal foraging areas are primarily upwelling “shadows,” regions where larval fish, crabs, and jellyfish are retained in the upper water column during relaxation of upwelling. Three main areas of foraging have been documented on the U.S. West Coast: in California over the coastal shelf in waters of 14-16° C, particularly off of central CA; along the continental shelf and slope off of Oregon and Washington, particularly off the Columbia River plume; and offshore of central and northern California at sea surface temperature fronts in deep offshore areas, although this area was not regularly used (Benson *et al.* 2011).

Researchers estimated an average of 178 leatherbacks were present between the coast and roughly the 50-fathom isobath off California (Benson *et al.* 2007b). Abundance over the study period was variable between years, ranging from an estimated 20 leatherbacks (1995) to 366 leatherbacks (1990) (Benson *et al.* 2007b). Along the coast of Washington, past and present population status is difficult to quantify, but research using satellite telemetry indicates that the state’s outer coast (especially the area near the Columbia River plume) is an important foraging area for the species (Benson et al. 2011). This suggests that an unknown number of the turtles annually visit Washington. The Washington Department of Fish and Wildlife reports that for many years, commercial and sport fishermen have noted occasional sightings of single individuals or small groups of leatherbacks off the coast of Washington (Stinson 1984 as quoted in WDFW 2017; E. Holman pers. comm. 2016 as quoted in WDFW 2017). There were 78 documented occurrences from a variety of sources from 1975 to 2013, with records extending from the mouth of the Columbia River north to Cape Flattery. In aerial surveys conducted off the coasts of California, Oregon, and Washington between 1989 and 1992, Bowlby et al. (1994) noted that 14 of 19 leatherbacks (74 percent) counted during the survey were sighted in Washington waters. At-sea sightings (documented or otherwise), strandings, and a limited number of aerial surveys cannot provide an accurate or complete representation of population status or explain fluctuations, since the data provided are limited by survey effort and reliance on incidental reporting. Nevertheless, WDFW (2017) concludes that the number of western Pacific leatherbacks in Washington is likely decreasing over time, based on the strong declines in the nesting population in Indonesia.

Based on population estimates from California in a known feeding area of between 20 and 366 animals (Benson et al. 2007) and the limited sightings in Washington (WDFW 2017), we conclude that the incrementally increased risk in some year to any one individual turtle in the action area from is likely very small because very few animals are likely to occur in the action area and the total number of animals seasonally in the action area is likely very small proportion of the Pacific breeding population, making the odds of encountering additional BP ships extremely small. However, with such a small increase in risk to individual animals, BP ship interactions are not likely to significantly affect the local feeding population and likely pose very little threat to the Pacific breeding population. The threat from additional BP-bound ships is likely inconsequential to the listed population. Because the incremental increase in risk from the proposed action in some years is likely so small, we cannot reasonably predict that a turtle from this DPS will be struck as a result of the proposed action. Therefore, the proposed action is not likely to contribute to population level effects to the species from the incremental increase in ship strike risk in some years, or result in the incidental taking of an individual.

2.4.4 Ship Noise

Measurements of vessel noise generated by specific ships calling at BP's Cherry Point facility are not available. NMFS expects the general type of vessels and existing noise contribution to continue and increase in some years with the proposed action, with the frequency of ships varying by year. In some years BP-bound ships will contribute more noise over their baseline contribution by adding up to 35 additional ships to the overall noise profile in Puget Sound/Salish Sea.

When anthropogenic disturbances elicit responses from marine mammals, it is not always clear whether they are responding to visual stimuli, the physical presence of humans or manmade structures, or acoustic stimuli. Because sound travels well underwater, it is reasonable to assume that, in many conditions, marine organisms would be able to detect sounds from anthropogenic activities before receiving visual stimuli. As such, exploring the specific effects of sound on marine mammal and sea turtle behavior provides a reasonable and conservative estimate of the magnitude of disturbance caused by vessel traffic.

Marine organisms rely on sound to communicate with conspecifics and derive information about their environment. There is growing concern about the effect of increasing ocean noise levels due to anthropogenic sources on marine organisms, particularly marine mammals. Effects of noise exposure on marine organisms can be characterized by the following range of physical and behavioral responses (Richardson *et al.* 1995):

1. Behavioral reactions—Range from brief startle responses, to changes or interruptions in feeding, diving, or respiratory patterns, to cessation of vocalizations, to temporary or permanent displacement from habitat.
2. Masking—Reduction in ability to detect communication or other relevant sound signals due to elevated levels of background noise.
3. Temporary threshold shift—Temporary, fully recoverable reduction in hearing sensitivity caused by exposure to sound.
4. Permanent threshold shift—Permanent, irreversible reduction in hearing sensitivity due to damage or injury to ear structures caused by prolonged exposure to sound or temporary exposure to very intense sound.
5. Non-auditory physiological effects—Effects of sound exposure on tissues in non-auditory systems either through direct exposure or as a consequence of changes in behavior, (*e.g.*, resonance of respiratory cavities or growth of gas bubbles in body fluids).

2.4.4.1 Southern Resident Killer Whales and Vessel Noise

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 percent 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 percent 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 main concern for SRKWs in the inland waters is from commercial and recreational whale watching boats that seek out and follow the whales, particularly in the summer core feeding area in the San Juan Islands. However, as described in the Baseline Section 2.3.6, large ships in Puget Sound/Salish Sea have been shown to generate sound that is within the hearing range of SRKW. More recently, researchers are expanding their scope to assess the effects of noise from large ships that transit through the Salish Sea, but that do not specifically target the whales. Viers et al., 2015, found that noise from large ships extends into frequencies used by Southern Residents for echolocation. This means vessels not seeking out the whales can still cause disturbance and impair the whales' ability to find food and interact with each other.

The researchers measured underwater sound pressure levels for 1,582 unique ships that transited the core critical habitat of the Southern Resident killer whales during 28 months between March, 2011, and October, 2013. Median received spectrum levels of noise from 2,809 isolated transits were found to be elevated relative to median background levels not only at low frequencies (20–30 dB re 1 μPa^2/Hz from 100 to 1,000 Hz), but also at high frequencies (5–13 dB from 10,000 to 96,000 Hz). Thus, noise received from ships at ranges less than 3 km extended to frequencies used by odontocetes (toothed whales, including Southern Resident killer whales). The researchers found that most ship classes show a linear relationship between source level and vessel speed with a slope near +2 dB per m/s (+1 dB/knot). Mean ship speeds during measurements were 7.3 ± 2.0 m/s (14.1 ± 3.9 knots).

Although the hearing range of killer whales and other mid-frequency odontocetes (e.g. sperm whales) is believed to extend between 150 and 160,000 Hz, their peak sensitivity is between about 15,000 and 20,000 Hz, and acoustic sensitivity falls off sharply below 600 Hz and above 114,000 Hz (Branstetter *et al.* 2017). Thus, tanker-related noise has the potential to result in some type of behavioral disturbance or harassment, including displacement, site abandonment (Gard 1974; Reeves 1977; Bryant *et al.*1984), and masking (Richardson *et al.* 1995). These disturbances could cause minor, short-term displacement and avoidance, alteration of diving or breathing patterns, and less responsiveness when feeding. The concern for vessel noise is the potential to cause acoustically-induced stress (Miksis *et al.* 2001 in NRC 2003) which can cause changes in heart rate, blood pressure, and gastrointestinal activity. Stress can also involve activation of the pituitary-adrenal axis, which stimulates the release of more adrenal corticoid hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg 1987, Rivest and Rivier 1995) and altered metabolism (Elasser *et al.* 2000), immune competence (Blecha 2000) and behavior. However, we do not expect that BP's increased tanker traffic in some years would cause stress to the point of adverse physiological effects because any disturbance from increased numbers of BP-bound ships is expected to be short-term and transitory when whale presence overlaps with ship presence. This is because BP ships stay in shipping lanes within the inland waters and do not target/follow the whales. On the outer coast, the overlap of BP ships and SRKWs becomes much less likely because of the vast open water, so that although the numbers will increase in some years and they would be louder proportionally to increased speed in open water, the likelihood of disturbing SRKW feeding and communication is likely negligible on the outer coast. None of the noise from BP ships is not expected to cause direct physical injury (i.e. eardrum damage). Given this information, NMFS concludes that the proposed action will result in ongoing low-level disturbance of SRKW periodically in the action area, with some years having slightly increased levels of noise associated with additional ship traffic of up to 35 additional ships in some years. None of the noise from BP ships is expected to cause direct physical injury (i.e. eardrum damage) and the periodic disturbance and periodically increased noise contribution from additional ships in some years are not expected to cause harm or rise to the level of harassment.

2.4.4.2 Humpback Whales and Vessel Noise

The periodically increased tanker-related noise from the proposed action has the potential to result in slightly increased behavioral disturbance of humpback whales in the inland waters. We do not expect that additional BP ships would cause significant behavioral effects because disturbance from BP-bound ships is expected to be short-term and transitory when whale presence overlaps with ship presence. This is because BP ships stay in shipping lanes within the inland waters and do not target/follow whales. On the outer coast, the overlap of BP ships and large whales becomes much less likely because of the vast open water, so that although the ships would become louder proportionally to increased speed in open water, the likelihood of increasing disturbance of whale feeding and communication is likely negligible on the outer coast. None of the noise from BP ships is expected to cause direct physical injury (i.e. eardrum damage).

Central America DPS Because whales from this DPS are rare in the action area, very few whales from this DPS are likely to be exposed to increased noise from the additional BP traffic and those that are exposed would likely experience low level behavioral or physiological effects. These effects are not likely to appreciably reduce an individual's likelihood of survival or reproduction, and not likely to affect the population

Mexico DPS For this DPS, noise in feeding areas off Mexico and California in the California current are a concern because of the overlap of heavy shipping traffic with core feeding area. While this action area does contain a biologically important feeding area off the outer coast (Calambokidis et al. 2015), the relative numbers of whales from this DPS that travel to the action area to feed is small. Therefore, while the proposed action will periodically increase noise levels from added shipping traffic, the added noise will be dispersed on the outer coast and not likely to affect many individuals. Any affected individuals would likely experience low level behavioral or physiological effects. These effects are not likely to appreciably reduce an individual's likelihood of survival or reproduction, and not likely to affect the population.

2.4.4.3 Blue Whale and Vessel Noise

Because blue whales are extremely rare in the action area, additional noise from BP ships in some years is not likely to have an effect on this population and disturbance to any one individual whale on the outer coast would be a rare and likely inconsequential occurrence.

2.4.4.4 Fin Whale and Vessel Noise

Fin whales do not frequently use the inland waters in the action area, making exposure to increased noise in some years from BP ships rare and transitory. The additional ship traffic is not likely to cause enough additional noise to result in significant behavioral or physiological effects among exposed individuals. These effects are not likely to appreciably reduce an individual's likelihood of survival or reproduction, and not likely to affect the population.

2.4.4.5 Western North Pacific Gray Whale and Vessel Noise

Western North Pacific gray whales are extremely rare in the action area. The primary range of WNP gray whales is along the east coast of the Asia continent in the Western North Pacific Ocean. Ocean noise is likely a threat to this population, but these animals are so rare in the action area and the action area is not within their primary, making any additional noise from BP ships in the action area likely inconsequential to individual whales and to the population. Any behavioral or physiological responses are likely to be low level and transitory. These effects are not likely to appreciably reduce an individual's likelihood of survival or reproduction, and not likely to affect the population.

2.4.4.6 North Pacific Right Whale and Vessel Noise

North Pacific right whales are extremely rare with a population likely in the low 100s (Wade et al. 2011a). Ocean noise is among the potential threats identified for this species. The eastern North Pacific stock is estimated at a minimum abundance of 26 to 31 individuals (Wade et al. 2011a) and is in high danger of being extirpated (LeDuc et al. 2012 as cited in the 2018 Stock Assessment). The Recovery plan links the threat of anthropogenic noise to energy development in the Arctic and commercial vessel traffic increases in the Arctic because of increased sea ice melting. The severity of the threat of ship noise to right whales in unknown and uncertainty is high. Nevertheless, because North Pacific right whales are so rare and the action area is a small portion of their range, it is unlikely that increased BP ship traffic would significantly disturb any right whales because the chance of encounters is so rare.

2.4.4.7 Sperm Whale and Vessel Noise

Sperm whales are rare in the action area, although one sperm whale was sighted in the action area in Haro Strait in March 2018. Like the other whale species that are rare in the action area, additional BP ships are not likely to encounter sperm whales often, making the additional chance of disturbance from BP ships very small. With the available information on these large whales and ship noise, and the high degree of uncertainty about the threat level of noise in general to these populations, we remain concerned about anthropogenic noise disturbance to these large whales, however the action area is a very small portion of the range of these animals, making exposure to increased BP-specific vessel noise infrequent and likely inconsequential to the exposed whales. These effects are not likely to appreciably reduce an individual's likelihood of survival or reproduction, and not likely to affect the population. Any physiological or behavioral response would likely be low level and transitory.

2.4.4.8 Leatherback Turtles and Vessel Noise

Sea turtles are thought to be far less sensitive to sound than marine mammals. A single individual's exposure to increased ship noise from added BP traffic is likely to be transient, as all of the turtles in the action area are migratory and occur seasonally. With the proposed action, very small numbers, relative to the population of leatherback sea turtles, will rarely be exposed and experience low level behavioral effects from increased BP ship traffic. Exposed animals may experience temporary behavioral changes and acoustically-induced stress from the transient noise output. Temporary, short-term behavioral effects, such as decreased ability to monitor its acoustic environment, cause habituation, or sensitization (decreases or increases in behavioral response) (Dow *et al.* 2012) are likely, although these effects are not likely to appreciably reduce an individual's likelihood of survival or reproduction, and not likely to affect the population of leatherback turtles in the Pacific.

2.4.4.9 Listed Fish and Vessel Noise

Vessel noise is addressed below under Section 2.4.5.

2.4.5 Physical Presence of the North Wing in the Marine Environment

The general configuration of the BP facility is shown in Figure 1 (Figure 50 has a close-up view of the North Wing). The figure shows a "Y" shaped facility with the North and South Wings located approximately 2,150 feet offshore where water depths are approximately 49 to 69 feet mean sea level (msl). The existing trestle connecting both wings of the facility is approximately 1,800 feet long and includes a 16-foot wide roadway and piping. The total width of the trestle with the piping is approximately 35 feet. Each wing consists of a single vessel berth, a loading platform, and a connecting trestle.

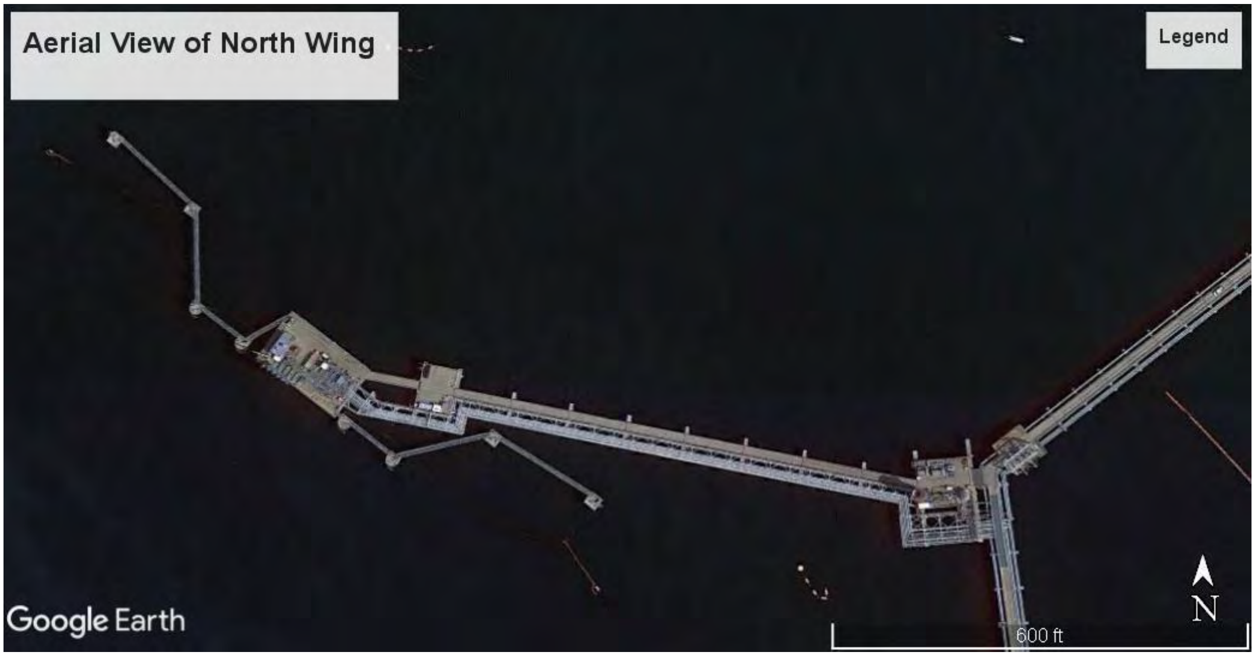


Figure 50. Close up of the North Wing.

The loading platform for the North Wing is 192.48 feet long and 90 feet wide. It is positioned at the center of the 971-foot long berth, which has mooring positions that allow for both tankers and barges to call at the BP Marine Terminal for unloading and loading operations. Water depth at the loading platform is 60 feet mean sea level (msl) (Cardno 2018). The connecting trestle between the main pier trestle and the North Wing berth 951 feet long and includes a platform for vehicle maneuvering, oil spill response equipment, two hoists for support vessels (workboats/oil spill response vessels), a 12-foot wide roadway, and grated catwalks for walking. The total area of the North Wing above the water (not solid coverage) is approximately 70,000 square feet/1.6 acres as measured on Google Earth.

For this consultation, we consider the physical effects of the North Wing in the marine environment as effects of the proposed action to re-authorize the North Wing. We do not consider on-going effects of the main pier access trestle and the South Wing because these structures are existing, not subject to the proposed action, and will persist whether or not the proposed action occurs.

2.4.5.1 Physical Presence of the Pier and Effects on Whales and Turtles

The critical habitat designation for SRKW identifies water greater than 20 feet deep relative to extreme high water as areas that are “occupied” by SRKW. The north wing occurs within waters that would otherwise be available to SRKW for foraging and passage. The physical presence of the North Wing may force SRKWs to swim farther around the facility, perhaps altering their preferred trajectory or interrupting feeding. Because SRKWs are infrequent in the Cherry Point region (Figure 32), we conclude that the physical presence of the North Wing structure likely does not present a passage barrier and is fairly inconsequential to the whales. The whale sightings in the vicinity of Cherry Point are few relative to the number of sightings around the San Juan Islands.

For the other whale species and leatherback turtles, the physical presence of the pier is likely inconsequential because of the rarity or absence of these species in the Cherry Point area.

2.4.5.2. Physical Presence of the Pier and Fish Species

PS Chinook, PS Steelhead, Bocaccio and Yelloweye Rockfish

In- and overwater structures influence habitat functions and processes for the duration of the time they are present in habitat areas. The effects include altered predator/prey dynamics related to the structure, disrupted migration, and other habitat related effects from the structure such as artificial lighting, noise, ship activity, and water quality. These effects are chronic, persistent, and co-extensive with the design life of the structure. For this action, the main trestle/pier that runs from the shoreline to the North and South Wing is considered as an existing baseline feature, as is the South Wing. Therefore, effects of the main access trestle in the shallow nearshore and the South Wing are not considered in this opinion. The North Wing is located more than 1,800 feet offshore in deep water (49 to 69 feet deep). The North Wing is located at the far edge of what is considered PS Chinook nearshore critical habitat and close to deepwater critical habitat for rockfish. The nearshore area for PS Chinook is considered to extend from extreme high water (Highest Astronomical Tide Line) out to a depth no greater than 30 meters (approximately 98 feet) relative to mean lower low water. The North Wing is located beyond the bands of eelgrass and kelp that occur in shallower water along the shoreline. Kelp is present to about -30 feet mean lower low water at Cherry Point and eelgrass occurs in shallower water closer to the shoreline. The North Wing is situated above unconsolidated subtidal sediments (sands, gravels). Therefore, the North Wing does not shade-out nearshore submerged aquatic vegetation.

In the marine nearshore, there is substantial evidence that overwater structures impede the nearshore movements of juvenile salmonids (Heiser and Finn 1970; Able et al. 1998; Simenstad 1999; Southard et al. 2006; Toft et al. 2007). In the Puget Sound nearshore, 35 millimeter to 45 millimeter juvenile chum and pink salmon were reluctant to pass under docks (Heiser and Finn 1970). Southard et al. (2006) snorkeled underneath ferry terminals and found that juvenile salmon were not underneath the terminals at high tides when the water was closer to the structure, but only moved underneath the terminals at low tides when there was more light penetrating the edges. These findings show that overwater-structures can disrupt juvenile migration in the Puget Sound nearshore.

An implication of juvenile salmon avoiding over water structure is that some of them will swim around the structure (Nightingale and Simenstad 2001). This behavioral modification will cause them to temporarily utilize deeper habitat, thereby exposing them to increased piscivorous predation. Hesitating upon first encountering the structure, also exposes salmonids to avian predators that may use the overwater structures as perches. Typical piscivorous juvenile salmonid predators, such as flatfish, sculpin, and larger juvenile salmonids, being larger than their prey, generally avoid the shallowest nearshore waters that outmigrant juvenile salmonids prefer—especially in the earliest periods of their marine residency. When juvenile salmonids temporarily leave the relative safety of the shallow water, their risk to being preyed upon by other fish increases. This has been shown in the marine environment where juvenile salmonid consumption by piscivorous predators increased fivefold when juvenile pink salmon were forced to leave the shallow nearshore (Willette 2001). Swimming around over water structures also lengthens the salmonid migration route, which has been shown to be correlated to increased mortality. Migratory travel distance rather than travel time or migration velocity has been shown to have the greatest influence on survival of juvenile spring Chinook salmon migrating through the Snake River (Anderson et al. 2005).

For the extended existence of the North Wing, if juvenile salmon swim all the way around the structure, rather than crossing under the access trestle closer to shore, the migratory pathway around the pier is extended by about 3,000 feet. The reluctance of juvenile salmon to pass under piers is related to the shadow cast by the pier (Celedonia *et al*. 2008a and b; Kemp *et al*. 2005; Moore *et al*. 2013; Munsch *et al*. 2014; Nightingale and Simenstad 2001; Ono *et al*. 2010; Southard *et al*. 2006). The eyes of salmonids are slow to adjust to changes in light. Some studies have shown that migrating juvenile salmon will pass under piers at lower tides when the shade cast by the pier is more diffuse or the hesitation is less on cloudy/rainy days. The intensity of the effect increases with proximity of the structure to the water and the increased contrast between light and dark areas. Celedonia *et al*. (2008a) report that two thirds of the juvenile Chinook salmon tracked during their study experienced a detectable delay in their migration under the SR 520 Bridge over Lake Washington, where there is no option to go around. One-third of the fish experienced an average delay of 15-minutes. One-third experienced delays of under 1 minute, and one-third showed no delay. Although the SR-520 Bridge is an imperfect analog for the North Wing, the authors' findings support the understanding that at least some of the juvenile PS Chinook salmon that migrate past the project site would swim around the pier to avoid its shadow. Others may swim some travel distance offshore into deeper water before crossing under the main trestle and so would not encounter or be delayed by the North Wing.

Swimming around overwater structures increases the migratory distance, which is positively correlated with increased mortality in juvenile Chinook salmon (Anderson *et al*. 2005). The degree to which shade-related altered migration would affect individual juvenile PS Chinook salmon is uncertain, but swimming around the shadow would increase the energetic cost for affected fish. The pathway around the North Wing is approximately 3,000 feet in deep water where foraging is likely to have higher energetic costs than shallow shoreline waters (Heerhartz and Toft 2015). Therefore, juvenile PS Chinook salmon that swim around the structure are likely to experience reduced fitness due to increased energetic costs.

Predatory fish such as flatfish, sculpin, and larger salmonids typically occur in waters deeper than the shallow shoreline waters preferred by shoreline-obligated juvenile salmonids. Swimming away from shore to avoid the pier's shadow forces juvenile salmon into deeper water. It also increases their migratory distance (discussed above), which increases the time spent in higher-risk conditions. Willette (2001) found that marine piscivorous predation of juvenile salmon increased fivefold when juvenile salmon left shallow nearshore habitats.

Therefore, over the life of the North Wing, some juvenile PS Chinook salmon are likely to experience mortality that would be attributable to the pier's shadow. Additionally, individuals that escape predatory attacks would experience reduced fitness due to increased energetic costs and stress-related effects related to their avoidance behaviors, which may reduce their overall likelihood of survival. NMFS assumes that the increase in migratory path length from swimming around the structure, as well as the increased exposure to piscivorous predators (birds and predatory fish) in deeper water, likely will result in proportionally increased juvenile PS Chinook mortality in the vicinity of the North Wing.

Steelhead are not nearshore dependent because they outmigrate as older, larger juveniles. Because steelhead are larger, we expect that the increased predation pressure will be minor, but still occur because the structure occurs in deep water increasing the likelihood that steelhead would encounter the pier and alter their movements around it or be exposed to increased predation if they do not avoid the pier.

The scale of the effect on the PS Chinook and PS steelhead populations is likely to be very small. The closest natal river is the Nooksack more than 15 miles south of Cherry Point. The Lummi Hatchery is 9 miles south and there are some independent, small drainages 5 to 10 miles to the north of Cherry Point, such as California and Dakota Creeks near Blaine. Juvenile PS Chinook from these locations would likely be fairly well developed and losing their nearshore dependence by the time that they have traveled to Cherry Point. However, the pier does provide perching sites for cormorants. These birds likely have greater feeding success around the pier, which would cause increased mortality of juvenile PS Chinook salmon and PS steelhead at the pier. The increased predation pressure is not possible to precisely quantify at this time, but it is likely not significant to the overall population abundances of the respective subpopulations.

Structure-related Altered Lighting:

Structure-related altered lighting is likely to adversely affect PS Chinook salmon, PS steelhead, and bocaccio and yelloweye rockfish. The type and intensity of the lighting are unspecified, but likely increase the nighttime in-water illumination immediately around the pier and moored ships (measured in tens of feet). Artificial lighting attracts fish (positive phototaxis) and often shifts nocturnal behaviors toward more daylight-like behaviors. It may also affect light-mediated behaviors such as migration timing. In lacustrine environments, sub yearling Chinook, coho, and sockeye salmon exhibit strong nocturnal phototaxic behavior toward incandescent light bulbs, with phototaxis positively correlated with light intensity (Tabor *et al*. 2017). Becker *et al*. (2013) found that the abundance of fish increased in artificially illuminated estuarine waters. Ina *et al*. (2017) reported strong positive phototaxis in juvenile Pacific bluefin tuna. Celedonia and Tabor (2015) reported that attraction to artificial lights can delay the onset of early morning migration by up to 25 minutes for juvenile Chinook salmon in freshwater, but didn’t alter migration timing in the evening.

The available information to describe the effects of artificial lighting on predator/prey relationships suggests that light-based predatory success in piscivorous fish is probably offset by similar improvements in predator avoidance by juvenile salmonids (Mazur and Beauchamp 2003; Tabor *et al*. 1998).

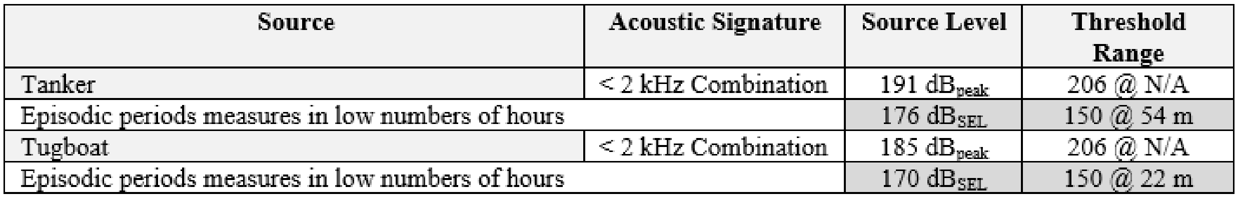
The BA did not describe the lightscape in the action area. However, based on the relatively low level of shoreline development in the area, and the high density of the trees along most to the shoreline in the area, ambient nighttime illumination is likely very low. Therefore, it is likely that the artificial illumination from the pier and moored ships would be detectable by fish in the area immediately around the applicant's pier. Exposed fish would likely experience some level of nocturnal phototaxis, and may experience other altered behaviors, such as delayed resumption of migration in the morning. Over the life of the applicant's pier, some of the exposed PS Chinook salmon, PS steelhead, and bocaccio and yelloweye rockfish would experience reduced fitness and/or altered behaviors that are likely to reduce their overall likelihood of survival.

In summary, structure-related altered lighting would cause a combination of altered behaviors that would reduce fitness and/or cause mortality for some PS Chinook salmon. PS steelhead, bocaccio and yelloweye rockfish. The annual numbers of individuals that would be impacted by this stressor is unquantifiable with any degree of certainty. However, the affected individuals would represent such small subsets of their respective cohorts that the numbers of exposed fish would be too low to cause detectable population-level effects.

Structure-related Noise:

Structure-related noise would cause adverse effects on PS Chinook salmon, PS steelhead, and bocaccio and yelloweye rockfish. Vessel operations typically consist of episodic brief periods of relatively low-speed operations by tugboats that may last a couple hours while the tugs maneuver the larger vessels. The tankers' auxiliary systems would also cause continuous in-water noises while they are moored at the pier. Because vessel operations at the pier may occur at any time during the year, this assessment assumes continuous, year-round vessel operations at the pier. Numerous sources describe the source levels for ocean-going ships and tugboats operating at transit speeds (Blackwell and Greene 2006; McKenna *et al*. 2012; Reine *et al*. 2014; Richardson *et al*. 1995). Table 32 summarizes the expected sound levels for those vessels, with ranges to applicable effects thresholds.

Table 32. Estimated in-water dB_{peak} and dB_{SEL} Source Levels for tankers and tugboats operating at typical transit speeds, and ranges to effects thresholds for fish.



Source	Acoustic Signature	Source Level	Threshold Range
Tanker	< 2 kHz Combination	191 dB_{peak}	206 @ N/A
Episodic periods measures in low numbers of hours		176 dB_{SEL}	150 @ 54 m
Tugboat	< 2 kHz Combination	185 dB_{peak}	206 @ N/A
Episodic periods measures in low numbers of hours		170 dB_{SEL}	150 @ 22 m

It is extremely unlikely that tankers would operate at anything above minimal speeds when near the pier. However, tugs would briefly use high power settings while maneuvering the tankers, and some of the tankers' auxiliary systems are very loud and operate continuously while moored. To be conservative, NMFS estimates that noise levels approaching that of tugboat operations may be present at the applicant's pier anytime ships are present. Based on the available information, no sound sources would exceed the exposure threshold for peak sound levels. However, the 150 dB_{SEL} isopleth may extend as far as 72 feet (22 m) around the pier, and any listed fish that are within that isopleth would likely experience behavioral disturbance, such as acoustic masking, startle responses, altered swimming patterns, avoidance, and increased risk of predation. The intensity of these effects would increase with increased proximity to the source and/or duration of exposure.

Vessel activity affects ESA-listed fish in a number of ways. The physical presence of ship hulls may disturb or displace nearby fishes (Mueller 1980). Vessel activity can cause physiological harm to fish. Graham and Cooke (2008) studied the effects of three small boat noise disturbances (canoe paddling, trolling motor, and combustion engine (9.9 hp) on the cardiac physiology of largemouth bass (*Micropterus salmoides*). They found that exposure to each of the treatments resulted in an increase in cardiac output in all fish, associated with a dramatic increase in heart rate and a slight decrease in stroke volume, with the most extreme response being to that of the combustion engine treatment. Recovery times were the least with canoe paddling (15 minutes) and the longest with the power engine (40 minutes). They postulate that this demonstrates that fish experienced sublethal physiological disturbances in response to the noise propagated from recreational boating activities. Directly, engine noise, prop movement, and the physical presence of a boat hull will likely disrupt or displace nearby fishes (Mueller 1980). The NMFS assumes that these effects would also occur in the vicinity of the Cherry Point facility from the large ships and the smaller support boats that operate at the facility. Listed fish present during operations at the facility are likely experience incrementally increased instances of the adverse effects described above in years that BP receives more than 385 ships in one year.

The annual numbers of individual fish that would be affected by this stressor is unquantifiable with any degree of certainty. However, the affected individuals would represent such small subsets of their respective cohorts that the numbers of exposed fish would be too low to cause detectable population-level effects.

Structure-related Propeller Wash:

Structure-related propeller wash is likely to adversely affect juvenile PS Chinook salmon, juvenile PS steelhead, and bocaccio and yelloweye rockfish (larvae and bocaccio juveniles). Annually over the life of the pier, rockfish larvae or fish in close proximity to the pier may be exposed to spinning propellers and propeller wash from tankers and tugboats while they maneuver. Exposed individuals may be injured or killed by the propeller blades, or exposure to propeller wash may cause displacement that could cause some combination of increased energetic costs, reduced feeding success, and increased vulnerability to predators. This effect will increase proportionally in years when BP receives greater than 385 ships in one year.

Although the likelihood of this interaction is very low for any individual fish, it is likely that over the life of the pier, some individuals would experience reduced fitness or mortality from exposure to spinning propellers and/or propeller wash at the site. The annual number of individuals that may be impacted by this stressor is unquantifiable with any degree of certainty. However, the affected individuals would represent such small subsets of their respective cohorts that the numbers of exposed fish would be too low to cause detectable population-level effects.

Facility Wastewater Discharge

Information on the existing wastewater discharge at the BP facility is presented under Section 2.3.5 and under the baseline sections for each species. Because the North Wing exists and because it represents a tiny portion of the total facility's spatial area, it is not practicable to separate out the additive effects of the North Wing from the existing discharge in a precise manner. Nevertheless, we consider the North Wing to contribute a slight incremental increase in contaminant loading in the immediate vicinity of Cherry Point. Small numbers, relative to their respective population of Puget Sound Chinook salmon, PS steelhead, and bocaccio and yelloweye rockfish likely are exposed to very slight additional contaminant loading from the additional treated wastewater associated with the North Wing. Among those exposed, a small subset may experience reduced fitness, particularly any adult rockfish that may reside near the pier.

Hood Canal Summer Chum, Eulachon, Green Sturgeon

The various potential impacts to species associated with the continued physical presence of the pier is likely inconsequential to Hood canal summer chum, eulachon, and sturgeon, as these fish are either not present in the vicinity of Cherry Point or their occurrence would be extremely rare and transitory in the action area.

2.4.6 Ballast Water Risk

Based on information presented in the Section 2.3.6, including the findings of the 2012 Biological Opinion with the Coast Guard on their ballast water regulations and the fact that no ballast water has been received at the BP terminal since early 2001, we consider the additional risk associated with the North Wing's contribution to added use for the entire facility (385 baseline maximum to proposed action maximum of 420) to not meaningful increase the existing baseline risk in those years when ship calls exceed 385 within the proposed 5-year rolling average. The baseline risk is likely extremely low and the proposed action does not meaningfully increase this risk.

2.5 Critical Habitat

Critical habitat has not been designated for the following species: blue whale, fin whale, North Pacific gray whale, and sperm whale. Critical habitat is designated for North Pacific right whales in the Gulf of Alaska and Bering Sea, but it does not occur in the action area. For leatherback sea turtles, critical habitat is designed on the outer coast of Washington within the action area.

For the species with designated and proposed critical habitat in the action area, Table 16 provides a high-level description of the range-wide status of critical habitat for each species. Because the action area encompasses a large portion of Puget Sound, further descriptions of critical habitat conditions and species status within the action area are given in the Environmental Baseline Section 2.3. In general, we describe the designated critical habitat affected by the proposed action by examining the condition and trends of the essential physical and biological features of that habitat. These features are essential to the conservation and recovery of the ESA-listed species because they support one or more of the species' life stages (*e.g.*, sites with conditions that support spawning, rearing, migration and foraging).

2.5.1 Southern Resident Killer Whale Critical Habitat

Based on the natural history of the Southern Residents and their habitat needs, NMFS identified three PBFs (PCEs), or physical or biological features, essential for the conservation of Southern Residents: 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.

Oil Spill Risk

In Section 2.4.1.1 Risk of Oil Spill to Southern Resident Killer Whale, we discussed in detail oil spill risk and direct effects SRKW. The following discussion summarizes that oil spill risk discussion. An actual large oil spill would affect water quality and prey resources in the vicinity of a spill that could indirectly affect SRKW through ingestion of toxins directly through the water column or through contaminated prey. Therefore, the proposed action indirectly adversely affects PBFs 1 and 2 by incrementally increasing oil spill risk in the action area, with some years having incrementally higher risk and some years having incrementally lower risk, depending on actual ship calls and the proportion of crude oil ship calls. In addition, the overall risk of oil spill associated with BP increases incrementally over time (cumulative probability). As described in the Baseline Section 2.3.7 and Section 2.4.1.1 Effects of the Action on Species, under current conditions (base case) in WDOE's 2015 VTRA, the modeled spill of 1.8 million (average) gallons has a probability of 0.05 percent chance in one year (0.0005 probability) among all shipping and boat traffic in the Salish Sea. With WDOE's 2015 VTRA, the probability of a 1.8-million gallon spill is on the order of 1.24 percent (0.0124 probability) over a 25 year period (cumulative probability). The spill category that exceeds 1 percent annual chance is the 12,000-gallon average spill (1- 1000 cubic meters/264,172 gallons spill range). This spill category has a 7.5 percent probability in one year (0.075 probability) among all shipping traffic. For the BP-specific TGA VTA, the modeled spills are in the range of 62,644 to 114,997 gallons for the 95th percentile spill (meaning of 10,000 model attempts, 95 percent of modeled spills were less than those numbers) and between 961 to 2,396 gallons for the 50th percentile spill volume for various assumptions in BP ship numbers, number of pier wings, and general and cumulative traffic scenarios.

Because it is impossible to predict an actual spill to a specific location (note- transfer errors/very small spills at BPs facility are addressed in Section 2.4.2), we do not consider an actual large oil spill an effect of the action, rather we consider the increased risk as the effect of the action (the risk is perceivable, measurable, and can be partially reduced with industry best practices). We also understand that there is not a direct linear relationship between number of ships and risk, and there are many factors and assumptions that go into calculating probabilities. Based on the oil spill risk models and the inherent danger associated with shipping crude oil, we conclude that SRKW designated critical habitat and proposed critical habitat in the action area are adversely affected by BP's incremental increase in risk in some years of oil spill in the action area. Because this risk cannot be translated into an actual predicted spill, we consider whether or not the incremental increase in risk of oil spill associated the proposed action translates to a substantial change in the threat level to the critical habitat (see Section 2.4.1.1) in consideration of the likely consequences of an actual spill.

In the event of a large oil spill, oil spill response activities would attempt to limit the spread of oil, remove oil, and limit the extent of ecosystem damage. Laws and processes are in place that would deal with recovering ecosystem function post spill. The Natural Resource Damage Assessment (NRDA) is the legal process that federal agencies including NOAA, together with the states and Indian tribes, use to evaluate the impacts of oil spills, hazardous waste sites, and ship groundings on natural resources both along the nation's coast and throughout its interior. NOAA and these partners, referred to collectively as natural resource trustees, work together to identify the extent of natural resource injuries, the best methods for restoring them, and the type and amount of restoration required. In addition to studying impacts to the environment, the NRDA process includes assessing and restoring the public's lost use of injured natural resources. In Section 2.4.1.1, we concluded that the BP's incremental increase in oil spill risk is not of a magnitude that would significantly change the existing threat level to designated critical habitat and proposed critical because the most likely spills are orders of magnitude less than what Lacy's (2017) study indicates would be catastrophic to the population and the largest spills among all traffic that would approach the 1.8 million gallon level among all traffic in Lacy's (2017) study have a very low probability. This conclusion includes the incremental increase in risk from the proposed action and considering the risk mitigation measures employed by BP and the industry, together with the Northwest Response Plan. We also recognize that some years will have less risk when BP operates with fewer ship calls. The most immediate threats to SR killer whales are from reduced food availability, environmental contaminants, disease, and disturbance from small whale watching vessels.

Vessel Noise

The vessel noise associated with the proposed action directly affects PBF #2 prey resources and PBF #3 passage conditions. The impacts to prey resources are through acoustic masking. From Holt 2008 (NOAA tech memo): "Killer whales produce a wide variety of clicks, whistles, and pulsed calls (Schevill and Watkins 1966, Ford 1989, Thomsen et al. 2001). Clicks are echolocation signals that are produced individually or in click trains. Individual clicks produced by Northern Resident killer whales are relatively broadband, short (0.1–25 milliseconds [ms]), and range in frequency from 8 to 80 kHz with an average center frequency of 50 kHz and an average bandwidth of 40 kHz (Au et al. 2004)." Per the analysis of vessel noise produced by the ships calling at BP's facility in the section above, those vessels may produce sounds in the frequency range of SRKW foraging clicks. Passage conditions (PBF #3) are affected by increased ship noise. Vessel noise and the physical presence of ships can interrupt SRKW movement, communication, and feeding efficiency. Vessel noise generated by specific ships calling at BP's Cherry Point facility is not available. NMFS expects the general type of vessels and existing noise contribution to continue with the proposed action, with the frequency of ships varying by year. Therefore, in some years BP-bound ships will contribute more or less to the overall noise profile on the Washington coast and in the Puget Sound/Salish Sea. Of all traffic in the action area, BP ships make up approximately 1.1 percent of vessels by time in transit. All oil and chemical tankers in the region combined are responsible for 2 percent of the overall noise profile. The increased number of ships calling at BP in some years is not expected to change the overall noise profile.

Section 2.4.4.1 describes in detail how ship noise can affect SRKWs in the action area. The main concern for SRKWs in the inland waters is from commercial and recreational whale watching boats that target and follow the whales, particularly in the summer core feeding area of the whales in the San Juan Islands. However, as described in the Baseline Section 2.3.6 and 2.3.7, large ships in Puget Sound/Salish Sea have been shown to generate sound that is within the hearing range of SRKW. More recently, researchers are expanding their scope to assess the effects of noise from large ships that transit through the Salish Sea, but that do not specifically target the whales. Viers et al., 2015, found that noise from large ships extends into frequencies used by Southern Residents for echolocation. This means vessels not targeting the whales can still cause disturbance and impair the whales' ability to find food and interact with each other. However, we do not expect that BP tanker traffic would cause high stress or more than minor behavioral responses and minor disturbance to feeding because BP-bound ship traffic disturbance is transitory when whale presence overlaps with ship presence, which would be occasional. This is because BP ships stay in shipping lanes within the inland waters and do not target/follow the whales and the noise generated by the ships is largely below SRKW audible sound levels. Therefore, the effect on critical habitat passage conditions are considered minor.

2.5.2 Designated Critical Habitat of Humpback Whales and Leatherback Turtle

The critical habitat of the two DPSs of humpback whale in the action area is similar to that of the designated critical habitat of leatherback turtles in that the essential biological features that are identified in the listings are essential prey resources. The action area overlaps critical habitat for the Mexico and Central America DPSs of humpback whales in the Strait of Juan de Fuca and extends out along the coast of Washington (Figures 37 and 38). The PBF identified in the critical habitat listing is the essential feature of prey availability defined as, "Prey species, primarily euphausiids and small pelagic schooling fishes of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth" (86 FR 21082).

The leatherback turtle critical habitat in the action area is part of a larger coastal designation of 25,004 square miles (64,760 square km) stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000-meter depth contour. The designation includes waters from the ocean surface at extreme low water down to a maximum depth of 262 feet (80 m). The PBF essential for conservation of leatherback turtles is the occurrence of prey species, primarily *scyphomedusae* (jellyfish) of the order *Semaeostomeae (Chrysaora, Aurelia, Phacellophora, and Cyanea*), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks. Leatherbacks feed off the coast of Washington from approximately May to October when waters are warmer.

The proposed action adversely affects the critical habitat of the two humpback whale DPSs within the Strait of Juan de Fuca and in a fan shape extending out along the coast of Washington and adversely affects leatherback turtle critical habitat in a fan shape extending from Cape

Flattery outward and south 40 miles (40 miles from the entrance to the Strait of Juan de Fuca) where oil spill risk will incrementally increase in some years as a result of the proposed action. Section 2.4.1.3 describes how humpback whales could be affected by an oil spill and 2.4.1.9 describes how leatherbacks could be affected in the event of an actual oil spill. An oil spill within designated critical habitat of these species could affect the quantity and quality of their prey species. A large spill would likely disperse over many, many miles, which could expose significant quantities of prey species to spilled oil. When oil is spilled in the ocean, it initially spreads primarily on the surface, depending on its relative density and composition. Some of the oil may evaporate. An oil slick may remain cohesive, or may break up in rough seas. Waves, currents, and wind can push oil into coastal areas and affect marine species in the path of the drift. Over time, oil waste weathers (deteriorates) and disintegrates by means of photolysis and biodegradation. The rate of biodegradation depends on the availability of nutrients, oxygen, and microorganisms, as well as temperature. The largest oil spill in Washington (Table 13) happened in 1972 at Cape Flattery. An estimated 2.3 million gallons of heavy fuel oil spilled from a World War II era military ship. The ship was being towed and the tow arm broke, causing the ship to run aground.

The extent to which prey species would be affected by an actual oil spill would depend on many factors. Following the BP Horizon oil spill in the Gulf of Mexico, researchers found crude oil combined with the chemical dispersant that was used caused acute toxicity in moon jellyfish (Echols el at. 2016). Indirectly, accumulation of PAHs in the tissue of prey species may cause bio-accumulation up the food web (Almeda et al. 2013). Spatially, the effect of an oil spill on the outer coast, even a relatively large spill, would likely be relatively small in proportion to the total square miles of designated and proposed habitat. The open seas, currents and winds would break up and disburse a spill, reducing potential acute toxicity to prey species and reducing the concentrations of PAHs. The pelagic nature of the prey species makes repeated or prolonged effects less likely. A spill would cause short term acute effects, but lingering prolonged exposure to spilled oil would be unlikely. Therefore, we conclude that the incremental increase in risk in some years associated with the proposed action presents a very small increase in risk to the functionality or conservation value of critical habitat of humpback whales and leatherbacks in the action area. In the event of an actual spill, prey resources would recover over time.

2.5.3 Puget Sound Chinook Critical Habitat

The action area contains designated areas for PBFs #4 and #5 for PS Chinook salmon. For PBF #6, the TRT described the PBF's but did not map specific areas as described below. Therefore, this opinion does not specifically address effects to PBF #6 as specific areas are not designated. Many of the limiting factors for this species are associated with freshwater spawning and rearing habitat quality. The action area does not extend into freshwater rivers.

> PBF (4) Estuarine areas free of obstruction and excessive predation with: (i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

> PBF (5) Nearshore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.
>
> PBF (6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation. For this PBF, NMFS did not identify specific offshore marine areas of Puget Sound and the Pacific Ocean. For salmonids in offshore marine areas beyond the nearshore extent of the photic zone, it becomes more difficult to identify specific areas where essential habitat features that may require special management considerations can be found. The TRT did identify certain prey species that are harvested commercially (e.g., Pacific herring) as physical or biological features essential to conservation that may require special management considerations or protection. However, because salmonids are opportunistic feeders we could not identify "specific areas" beyond the nearshore marine zone where these or other essential features are found within this vast geographic area occupied by Pacific salmon. Prey species move or drift great distances throughout the ocean and would be difficult to link to any "specific" areas.

Oil Spill Risk to PS Chinook Critical Habitat

Section 2.4.1.10 describes how PS Chinook salmon could be affected directly by oiled waters and indirectly through loss of prey resources and bioaccumulation of toxins in the food web. An oil spill in the inland waters of action area would affect the water quality and forage PBFs of nearshore marine habitat and potentially affect water quality and forage of estuarine habitat if a spill occurred near the mouth of a river or if currents and tides carried oiled waters into an estuary. For PS Chinook, the effects of an oil spill in the inland waters may have greater consequences to the local subpopulations within the area affected by a spill. PS Chinook salmon are highly dependent on estuary and nearshore habitat, which could result in local abundances from certain subpopulations being affected more sharply by oiled waters. The longer-term effects of oil spill to affected subpopulations from indirect food web impacts could have negative effects on successive cohorts, but given time, we would expect that these populations could rebuild to pre-spill levels. The ability of critical habitat to support subpopulation abundance in affected areas could be depressed for decades and this would negatively affect the timeline for recovery, fisheries, and Tribal Treaty Rights. Human intervention would likely be necessary to rebuild affected populations while the habitat recovers through hatchery and/or harvest management measures, as well as habitat restoration. Recall that we are assessing the effects incrementally increase in risk associated with the proposed action on critical habitat, not the effect of an actual spill. In the event of a large oil spill, oil spill response activities would attempt to limit the spread of oil, remove oil, and limit the extent of ecosystem damage. Laws and processes are in place that would deal with recovering ecosystem function post spill. The Natural Resource Damage Assessment (NRDA) is the legal process that federal agencies including NOAA, together with the states and Indian tribes, use to evaluate the impacts of oil spills, hazardous waste sites, and ship groundings on natural resources both along the nation's coast and throughout its interior. NOAA and these partners, referred to collectively as natural resource trustees, work together to identify the extent of natural resource injuries, the best methods for restoring them, and the type and amount of restoration required. In addition to studying impacts to the environment, the NRDA process includes assessing and restoring the public's lost use of injured natural resources.

The Exxon Valdez oil spill in Prince William Sound, Alaska, provides insight into how the Puget Sound might be affected and recover over time. Although that oil spill was on the order of 11 million gallons, which is highly unlikely in Puget Sound/Salish Sea because of industry best practices (double-hulled ships, inspections, local pilots, tug escorts, response capability).
As described more fully in Section 2.1.1.10 Oil Spill Risk to Listed Fish, following the Exxon Valdez spill, scientists have found it difficult to distinguish between the stochastic effects of the oil spill versus ongoing effects of short-term environmental variability, longer term climate change, fishery management (hatcheries and fishing industry), and predation pressure from increasing numbers of marine mammals. Using data pre- and post-spill, the authors applied time-series methods to evaluate support for whether and how herring and salmon productivity has been affected by each of five drivers: (1) density dependence, (2) the oil spill event, (3) changing environmental conditions, (4) interspecific competition on juvenile fish, and (5) predation and competition from adult fish or, in the case of herring, predation from humpback whales. The results showed support for intraspecific density-dependent effects in herring, sockeye, and Chinook salmon, with little overall support for an oil spill effect. Of the salmon species, the largest driver was the negative impact of adult pink salmon returns on sockeye salmon productivity. Herring productivity was most strongly affected by changing environmental conditions; specifically, freshwater discharge into the Gulf of Alaska was linked to a series of recruitment failures that occurred before, during, and after the oil spill (Ward et al., 2017).

In terms of habitat recovery, following the Exxon Valdez spill in 1989, NOAA reports the following timelines for species and habitat features that are considered recovered: (https://response.restoration.noaa.gov/oil-and-chemical-spills/significant-incidents/exxon-valdez-oil-spill/prince-william-sound-recovered.html):

> Rocky Intertidal Habitat- Recovered 1992 (3 years post spill)
> Sockeye and Pink Salmon Population- Recovered 2002 (13 years post spill)
> Subtidal Communities – Recovered 2010 (21 years post spill)

NOAA also reports, 25 years after the spill that intertidal communities and sediments are still considered “recovering.” This is because oil settled into the sediments and the natural breakdown of the oil is very slow. Herring are considered to be not recovering.

The PS Chinook Recovery Plan discusses oil spill as a threat to this species in terms of general water quality in Puget Sound and as a threat to the function of nearshore and marine habitat. The plan recognizes oil spill prevention, planning, and response efforts of the State of Washington, industry, and partners as a means to reduce the threat level. Under current conditions (base case) in WDOE’s 2015 VTRA, a spill of 1.8 million gallons has a probability of 0.05 percent chance in one year (0.0005 probability) among all traffic in the Salish Sea. With WDOE’s 2015 VTRA the risk of a 1.8-million gallon spill is on the order of 1.24 percent (0.0124 probability) over a 25 year period. With this model the spill category that exceeds a 1 percent annual chance is the 12,000-gallon average spill (1- 1000 cubic meters/264,172 gallons spill range). This spill category has a 7.5 percent probability in one year (0.075 probability). Recall that the TGA VTA for BP specific traffic showed models spills in the range of 62,644 to 114,997 gallons for the 95th percentile spill (meaning of 10,000 model attempts, 95 percent of modeled spills were less than that number) and between 961 to 2,396 gallons for the 50th percentile for various assumptions in BP ship numbers, number of pier wings, and general and cumulative traffic scenarios. Given this line of reasoning, the NMFS does not perceive BP's incremental increase in oil spill risk associated with the proposed action for large oil spill to be of a magnitude that would exacerbate the existing threat level to critical habitat. The spatial scale of an actual oil spill, if one to occur in association with BP, would likely be orders of magnitude less than what would be considered "catastrophic" to critical habitat- the effects would be adverse, but spatially small in proportion to the total area of critical habitat. The timelines for recovery of oil areas could be similar to Prince William Sound, but the spatial scale would be much smaller, with much more localized effects to habitat. This conclusion regarding the risk posed by the proposed action includes the consideration of incremental increase in risk from the proposed action in some years and considering the risk mitigation measures employed by BP and the industry, together with the Northwest Response Plan. We also recognize that some years will have reduced risk associated with BP operating with fewer ship calls.

Transfer Errors and Puget Sound Chinook Critical Habitat

Table 22 shows recent history of transfer errors/small spills at the BP Cherry Point facility. Spill records at the facility for the period from 1990 through 2010 indicate that incidents are infrequent (typically average two per year), and the volume of spills is usually very small. Many of the incidents reported were in quantities of drops or sheen on the water, and with an average spill volume of 9.8 gallons. Since the North Wing became operational in 2001, the average spill volume at the BP Marine Terminal has decreased to 0.65 gallons. After the addition of the North Wing, the number of releases per transfer decreased by 23 percent and volume spilled decreased by 87 percent (ERC 2011). These small spills will likely continue into the future, and may increase or decrease in proportion to actual ship calls. These releases cause very small-scale adverse effects to water quality and forage PBFs in the nearshore marine environment in the immediate vicinity of the facility. Effect to forage fish would be periodic and localized; and it is likely not possible to directly observe or quantify changes in local abundance and link those to periodic small spills. Nevertheless, Incardona et al. (2015) found that low level exposure of embryonic herring to PAHs may result in lasting physiological effects. Whether Incardonea et al.'s (2015) results are applicable to more advanced life stages of juvenile salmon is uncertain because the test species and developmental stages are different. The NMFS anticipates that small spills/transfer errors will continue to occur periodically into the future at the scale of a few drops to tens of gallons resulting in direct and indirect harm to nearshore marine critical habitat PBFs of water quality and forage in the immediate vicinity of the pier.

Physical Presence of the Pier and Ships in Critical Habitat

The critical habitat designation for PS Chinook includes nearshore habitat up to a depth of 30 meters (98 feet). The North Wing is at the far edge of critical habitat in deep water. Because the pier sits in deep water, many of the typical concerns associated with shading of aquatic vegetation and other effects on nearshore processes are not effects of this action. Section 2.4.5.2

describes the likely effects to PS Chinook from the pier. For critical habitat PBFs, the North Wing and the large tankers docked at it likely affect passage conditions of juvenile PS Chinook salmon because the fish are likely to detour around the structure or move under the structure and be exposed to increased predation. The effect of the North Wing on aquatic food resources is probably mixed. Piers can act as artificial reefs and increase diversity of prey resources for salmon. The pier may also provide habitat for predatory fish that feed on juvenile salmon and predatory birds that perch on the structure, and the pier is the source of low-level contaminants from its wastewater. In spatial scale, the North Pier is a very small portion of critical habitat in the Cherry Point area. The majority of the shallow nearshore habitat at Cherry Point is protected in a State of Washington Aquatic Preserve (https://www.dnr.wa.gov/managed-lands/aquatic-reserves/cherry-point-aquatic-reserve).

2.5.4 Puget Sound Steelhead Critical Habitat

Critical habitat for PS steelhead is not designated in Puget Sound, except at limited estuarine areas at the mouths of rivers. No critical habitat is designated at Cherry Point. Steelhead are not dependent on estuaries in the way that Chinook are. Steelhead are typically highly mobile when they leave their natal rivers and quickly head out to sea, transiting the Salish Sea fairly directly. The proposed action poses a slight additional threat to steelhead critical habitat from major oil spill if the oil were to move into an estuary. As discussed in Section 2.3.4, the risk to any one estuary is very small and steelhead are not dependent on estuary habitat, therefore the proposed action poses very little threat to steelhead critical habitat.

2.5.5 Hood Canal Summer Chum Critical Habitat

Critical habitat of Hood Canal summer extends outside of Hood Canal along the Strait of Juan de Fuca in the shallow nearshore. The proposed action poses very little risk to critical habitat within Hood Canal from oil spill because BP ships do not enter Hood Canal and exchange of water masses between the basins in Puget Sound and in Hood Canal is very limited (Burns 1985). Critical habitat could be adversely affected by a spill in the Strait of Juan de Fuca. The effects of a spill would similar to that discussed above for PS Chinook salmon critical habitat nearshore critical habitat and we draw the same conclusion; we do not perceive BP’s incremental increase in oil spill risk in some years associated with the proposed action for large oil spill to be of a magnitude that would exacerbate the existing threat level to critical habitat. The spatial scale of an actual oil spill, if one were to occur in association with the proposed action, would likely be orders of magnitude less than what would be considered “catastrophic” to critical habitat- the effects would be adverse, but spatially small in proportion to the total area of critical habitat. The timelines for recovery of oil areas could be similar to Prince William Sound, but the spatial scale would be much smaller, with much more localized effects to habitat. This conclusion regarding the risk posed by the proposed action includes the consideration of incremental increase in risk from the proposed action and considering the risk mitigation measures employed by BP and the industry, together with the Northwest Response Plan.

2.5.6 Southern DPS Eulachon Critical Habitat

Eulachon critical habitat is designated in the Elwha River. The proposed action poses very little risk to the estuary of the Elwha. The overall risk of oil spill associated with BP is small and the chance of a spill occurring near the Elwha specifically from all traffic is extremely small (WDOE 2015 VTRA). Therefore, the incremental increase in oil spill risk associated with proposed action poses very little threat to eulachon critical habitat.

2.5.7 Southern Green Sturgeon DPS Critical Habitat

The Southern DPS green sturgeon critical habitat in the action area consists of coastal marine waters out to a depth of 60 fathoms. The designation occurs along the outer coast of Washington and into the Strait of Juan de Fuca, with another area between Whidbey Island and Lopez Island in Puget Sound.

The PBFs for green sturgeon nearshore coastal marine areas include:

> (i) Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within marine and between estuarine and marine habitats.
>
> (ii) Water quality. Nearshore marine waters with adequate dissolved oxygen levels and acceptably low levels of contaminants (e.g., pesticides, organochlorines, elevated levels of heavy metals) that may disrupt the normal behavior, growth, and viability of subadult and adult green sturgeon.
>
> (iii) Food resources. Abundant prey items for subadults and adults, which may include benthic invertebrates and fishes.

The proposed action affects these critical habitat features through the incrementally increase in oil spill risk in these deep waters that could affect water quality and food resources. The potential consequences of a large oil spill on the outer coast and in the Strait would likely be fairly similar. An oil spill on the outer coast could affect the quantity and quality of prey. A large spill would likely disperse over many, many miles, which could expose significant quantities of prey species to spilled oil. When oil is spilled in the ocean, it initially spreads primarily on the surface, depending on its relative density and composition. Some of the oil may evaporate. An oil slick may remain cohesive, or may break up in rough seas. Waves, currents, and wind can push oil into coastal areas and affect marine species in the path of the drift. Over time, oil waste weathers (deteriorates) and disintegrates by means of photolysis and biodegradation. The rate of biodegradation depends on the availability of nutrients, oxygen, and microorganisms, as well as temperature. The largest oil spill in Washington (Table 20) happened in 1972 at Cape Flattery. An estimated 2.3 million gallons of heavy fuel oil spilled from a World War II era military ship. The ship was being towed and the tow arm broke, causing the ship to run aground.

The extent to which sturgeon food resources would be affected by an actual oil spill would depend on many factors. Indirectly, accumulation of PAHs in the tissue of prey species may cause bio-accumulation up the food web (Almeda et al. 2013). Spatially, the effect of an oil spill on the outer coast and in the Strait, even a relatively large spill, would likely be relatively small in proportion to the total square miles of designated habitat and would likely affect very few individual sturgeon, since this species is not common in the action area. The open seas, currents, and winds would break up and disburse a spill, reducing potential acute toxicity to prey species and reducing the concentrations of PAHs. A spill near Whidbey Island would be affected by strong currents.

In the event of an actual spill, there would be short term acute effects to food resources and water quality, with low level prolonged water quality effects. Following the Exxon Valdez oil spill, NOAA determined that subtidal communities were recovered 21 years after the spill. Intertidal communities were still considered to be “recovering” 25 years after the spill. The shallow bays that are important feeding areas for sturgeon like Grays Harbor are outside of the action area. Since the action area is at the far northern range of this species, relatively few individuals, relative to the population, would be exposed over time. The critical habitat features of water quality and prey resources would be expected to recover over time, but this could take decades. The incremental increase in risk associated with BP ships presents a relatively small risk in terms of spatial area to sturgeon critical habitat off the Washington coast and in the Salish Sea. In the event of an actual spill, prey resources would likely recover over time, but the extent to which oil remains in the sediment and continues to affect prey resources over time is a concern for sturgeon because they are long-lived and accumulate toxins over time.

2.5.8 Rockfish Critical Habitat

Critical habitat for bocaccio includes 590.4 square miles of nearshore habitat and 414.1 square miles of deepwater habitat. Critical habitat is not designated in areas outside of United States jurisdiction; therefore, although waters in Canada are part of the DPS’s range and within the action area, critical habitat was not designated in that area. Based on the natural history of bocaccio and their habitat needs, NMFS identified two physical or biological features, essential for their conservation:

1) Deepwater sites (>30 meters) that support growth, survival, reproduction, and feeding opportunities;

2) Nearshore juvenile rearing sites with sand, rock and/or cobbles to support forage and refuge.

Habitat threats include degradation of rocky habitat, loss of eelgrass and kelp, introduction of non-native species that modify habitat, and degradation of water quality as specific threats to rockfish habitat in the Georgia Basin.

Critical habitat for yelloweye rockfish includes 414.1 square miles of deepwater marine habitat in Puget Sound, all of which overlaps with areas designated for bocaccio. No nearshore component was included in the critical habitat listing for juvenile yelloweye rockfish as they, different from bocaccio, typically are not found in intertidal waters (Love et al., 1991). Yelloweye rockfish are most frequently observed in waters deeper than 30 meters (98 ft) near the upper depth range of adults (Yamanaka et al., 2006). Habitat threats include degradation of rocky habitat, loss of eelgrass and kelp, introduction of non-native species that modify habitat, and degradation of water quality as specific threats to rockfish habitat in the Georgia Basin.

Oil Spill and Rockfish Critical Habitat

Section 2.4.1.10 discusses in detail potential effects to species and habitat from a large oil spill. Based on the available information presented in that section, the NMFS perceives BP's potential incremental increase in oil spill risk associated with the proposed action for large oil spill to be of a magnitude that does not alter the existing threat level to designated critical habitat because the most likely spills are orders of magnitude less than what would likely be "catastrophic" to listed rockfish because the effects would be localized enough to likely not cause the complete loss of local subpopulation with the Salish Sea. Additionally, the largest spills that would approach the 1.8 million (among all traffic) have a very low probability. This conclusion regarding the risk posed by the proposed action includes the consideration of incremental increase in risk from the proposed action and considering the risk mitigation measures employed by BP and the industry, together with the Northwest Response Plan. The Recovery Plan acknowledges that, "There are numerous parallel efforts underway, independent from rockfish recovery, to protect and restore the Puget Sound ecosystem. Such efforts include oil spill prevention measures, contaminated sediment clean-up projects, and other important projects. These efforts will provide benefits to listed rockfish and habitats and prey base and are thus highlighted in the plan." The plan further states that oil spill response and prevention are already conducted in the range of the DPSs and the plan stresses their importance to a "healthy ecosystem that supports listed rockfish." To this end, NMFS concludes that the incremental increase in oil risk associated with the proposed action does not change the threat level to critical habitat of both rockfish species. We also recognize that some years will have incrementally less risk associated with BP operating with fewer shipments in some years.

Our conclusion for rockfish critical habitat is informed by rockfish recovery after the Exxon Valdez oil spill in Prince William Sound, Alaska. Ten years after the spill, data collected in 1999-2000 indicated that it was unlikely that rockfish were being exposed to lingering oil because known pockets of lingering oil rarely occurred in their preferred habitat (although these are different species of rockfish). Documented lingering bioavailable oil was in the subsurface sediments of the intertidal zone, and rockfish mostly occurred in different habitats of subtidal areas and in pelagic environments. Data collected by the Alaska Department of Fish and Game and the North Pacific Fisheries Management Council "in the years since the Spill indicate that the population is healthy in Prince William Sound and have shown no biomarkers of oil exposure. There have been no demonstrated differences in population or breeding success between oiled and unoiled areas (http://www.evostc.state.ak.us/index.cfm?FA=status.rockfish)." Rockfish have likely recovered from the Exxon Valdez oil spill in Prince William Sound. This comparison is taken with caution because rockfish populations in Prince William Sound were healthy at the time of the spill, likely making them much more resilient to impacts compared to the very small and scattered populations in the Salish Sea.

Transfer Errors and Rockfish Critical Habitat

Small spills at the facility likely cause low-level and spatially small adverse effects to nearshore critical habitat of bocaccio in the immediate vicinity of the facility, despite best management practices and cleanup measures. These small spills (drops, cups, to tens of gallons) likely have periodic negative effects on water quality and forage fish, although the effect to forage fish would be periodic and localized; and it is likely not possible to directly observe or quantify changes in local abundance and link those to periodic smalls spills. Nevertheless, Incardonea et al. (2015) found that low level exposure of embryonic herring to PAHs may result in lasting physiological effects. Whether Incardonea et al.'s (2015) results are applicable to larval and juvenile rockfish is uncertain because the test species and developmental stages are different. The NMFS anticipates that small spills/transfer errors will continue to occur periodically into the future at the scale of a few drops to tens of gallons resulting, and may increase proportionally when BP operates with more ships over baseline, and result in direct and indirect harm to bocaccio nearshore critical habitat, but at a very small spatial scale relative to the total amount of nearshore critical habitat with the Salish Sea.

Ballast Water and Rockfish Critical Habitat

The critical habitat designations for both rockfish species specifically identify introduction of non-native species as a threat to critical habitat. Section 2.4.6 Ballast Water discusses this threat in detail. The BP terminal has the capacity to receive ballast water from product tankers; however, no ballast water has been received at the BP terminal since early 2001. If a vessel does wish to discharge ballast water at the terminal, the ballast water must undergo laboratory analysis prior to discharge. The laboratory test results must be received by BP prior to acceptance of ballast water. This requirement makes it impractical for vessels to unload ballast water during the short period they are at dock. Given the existing laws, industry best practices, and BP's best practices at their facility, the proposed action presents very little risk to rockfish critical habitat from introduction of non-native species through ballast water.

Physical Presence of the Pier and Ships in Critical Habitat

The North Wing sits in deep water close to the transition from nearshore to deepwater critical habitat for rockfish. Section 2.4.5 describes in detail effects associated with the physical presence of the pier. In summary, the effect of the North Wing on aquatic food resources is probably mixed. Piers can act as artificial reefs and increase diversity of prey resources for fish and also provide physical structure that may attract rockfish by providing structure in deepwater that is otherwise absent in this area. The pier also provides habitat for predatory fish that feed on juvenile rockfish and predatory birds that perch on the structure. In addition, the pier creates a source of wastewater and associated contaminants and disturbance from ship operations. In spatial scale, the North Pier occupies a very small portion of habitat in the area of Cherry Point, making direct effects to BPFs of critical habitat spatially small and/or low in intensity.

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.

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 actions area's future environmental conditions caused by global climate change and on-going human development that are properly part of the environmental baseline vs. cumulative effects. Therefore, all relevant future climate-related environmental conditions and effects of on-going human development in the action area are described in the environmental baseline (Section 2.3).

As previously described in Section 2.3, all ship and boat traffic is predicted to increase over time as a baseline condition at existing facilities in proportion to human population growth. The WDOE's 2015 VTRA and BP's TGA VTA both consider potential future conditions with increased general traffic and added tanker traffic. These studies serve as surrogates for cumulative effects analyses, but do not necessarily do so with respect to the definition of cumulative effects in ESA regulations (i.e. these studies do not distinguish between federal and non-federal actions). All ship and boat traffic is predicted to increase over time as a baseline condition at existing facilities in proportion to human population growth. BP imports crude oil to its refinery. BP does not export crude, so this is not contemplated in this opinion. Still remaining as an unknown in the future traffic scheme in the action area is the Canadian Trans Mountain Pipeline Project. If the project were to be approved and built, it would increase the number of oil tankers transiting the Salish Sea. The project could increase oil tanker traffic from British Columbia through the Salish Sea from 60 to more than 400 vessels as the pipeline flow would increase from 300,000 to 890,000 barrels per day. The addition of crude oil tanker exports from the Canadian Trans Mountain Pipeline Project is included in some of the future scenarios or "worst-case" traffic models, which could overstate future risk in those models if the project is not built. However, we cannot assume that the project will be constructed. The project continues to move through legal and permitting processes in British Columbia, Canada.

Future actions in the nearshore and along the shoreline of Puget Sound/Salish Sea likely include port and ferry terminal expansions, residential and commercial development, shoreline modifications, road and railroad construction and maintenance, and agricultural development. Based on current trends, there will continue to be a net reduction in the total amount of shoreline armoring in Puget Sound (PSP 2019). Changes in tributary watersheds that are likely to affect the action area include reductions in water quality, water quantity, and sediment transport. Future actions in the tributary watersheds whose effects are likely to extend into the action area include operation of hydropower facilities, flow regulations, timber harvest, land conversions, disconnection of floodplain by maintaining flood-protection levees, effects of transportation infrastructure, and growth-related commercial and residential development. Some of these developments will occur without a Federal nexus, however, activities that occur in certain waters require federal permits and separate Endangered Species Act consultation.

All such future non-federal actions, in the nearshore as well as in tributary watersheds, will cause long-lasting environmental changes and will continue to harm ESA-listed species and their critical habitats. Especially relevant effects include the loss or degradation of nearshore habitats, pocket estuaries, estuarine rearing habitats, wetlands, floodplains, riparian areas, and water quality. We consider human population growth to be the main driver for most of the future negative effects on habitat.

If population growth trends remain relatively consistent with recent trends, we can anticipate future growth at approximately 1.5 percent per year. The human population in the Puget Sound region increased from about 1.29 million people in 1950 to about 3.84 million in 2014, was expected to reach 4.17 million by 2020, and nearly 5 million by 2040 (Puget Sound Regional Council 2016). The Puget Sound region currently has a human population of 4.2 million, slightly ahead of projections. Thus, future private and public development actions are very likely to continue. As the human population continues to grow, demand for agricultural, commercial, and residential development and supporting public infrastructure is also likely to grow. We believe the majority of environmental effects related to future growth will be linked to these activities, in particular land clearing, associated land-use changes (i.e., from forest to impervious, lawn or pasture), increased impervious surface, and related contributions of contaminants to area waters. Land use changes and development of the built environment that are detrimental to habitats are likely to continue under existing regulations. Though the existing regulations minimize future potential adverse effects on habitat, as currently constructed and implemented, they still allow systemic, incremental, additive degradation to occur.

Several not for profit organizations and State and federal agencies are implementing recovery actions in the action area. The Puget Sound Salmon Recovery Plan was adopted in 2007 (SSPS 2005; NMFS 2006a). NMFS recently adopted a Recovery Plan for Puget Sound Steelhead on December 20, 2019. A Recovery Plan for Puget Sound/Georgia Basin Yelloweye Rockfish and Bocaccio was completed in 2017 (NMFS 2017f) and implementation with state and other partners is ongoing. Notwithstanding the beneficial effects of ongoing habitat restoration actions, the cumulative effects associated with continued development are likely to have ongoing adverse effects on listed species. Only improved low-impact development actions together with increased numbers of restoration actions, watershed planning, and Recovery Plan implementation would be able to address growth related impacts into the future. To the extent that non-Federal recovery actions are implemented and offset ongoing development actions, adverse cumulative effects may be minimized, but will probably not be completely avoided.

While climate change is described in the baseline, it is an ongoing concern that is expected to exacerbate with time. Because the USACE authorization for the proposed action is essentially in perpetuity, we also project the likely effects of climate change. Mauger et al (2015) predict that circulation in Puget Sound is projected to be affected by declining summer precipitation, increasing sea surface temperatures, shifting streamflow timing, increasing heavy precipitation, and declining snowpack. While these changes are expected to affect mixing between surface and deep waters within Puget Sound, it is unknown how these changes will affect upwelling. Changes in precipitation and streamflow could shift salinity levels in Puget Sound by altering the balance between freshwater inflows and water entering from the North Pacific Ocean. In many areas of Puget Sound, variations in salinity are also the main control on mixing between surface and deep waters. Reduced mixing, due to increased freshwater input at the surface, can reduce phytoplankton growth, impede the supply of nutrients to surface waters, and limit the delivery of dissolved oxygen to deeper waters. Patterns of natural climate variability (e.g., El Niño/La Niña) can also influence Puget Sound circulation via changes in local surface winds, air temperatures, and precipitation.

The same document states that "sea level rise is projected to expand the area of some tidal wetlands in Puget Sound but reduce the area of others, as water depths increase and new areas become submerged. For example, the area covered by salt marsh is projected to increase, while tidal freshwater marsh area is projected to decrease. Rising seas will also accelerate the eroding effect of waves and surge, causing unprotected beaches and bluffs to recede more rapidly. The rate of sea level rise in Puget Sound depends both on how much global sea level rises and on regionally-specific factors such as ocean currents, wind patterns, and the distribution of global and regional glacier melt. These factors can result in higher or lower amounts of regional sea level rise (or even short-term periods of decline) relative to global trends, depending on the rate and direction of change in regional factors affecting sea level." Mauger et al 2015.

On the outer coast of Washington, activities that may occur in this area consist of state government actions related to ocean use policy and management of public resources, such as fishing or energy development projects. However, changes in ocean use policies as a result of government action are highly uncertain and may be subject to sudden changes as political and financial situations develop. Examples of actions that may occur include development of aquaculture projects; changes to state fisheries which may alter fishing patterns or influence the bycatch of ESA-listed marine mammals and sea turtles; installation of hydrokinetic projects near areas where marine mammals and sea turtles are known to migrate through or congregate; designation or modification of marine protected areas that include habitat or resources that are known to affect marine mammals and sea turtles; and coastal development which may alter patterns of shipping or boating traffic. None of these potential state, local, or private actions, however, can be anticipated with any reasonable certainty in the action area at this time. Even if some of the projects were developed with any certainty, the level of direct or indirect effects associated with most of these types of actions appear speculative at this point. Current and continuing non-federal actions that may occur in the action area and may be affecting ESA-listed marine mammals and sea turtles are addressed in the environmental baseline section.

On March 14, 2018, State of Washington Governor's Executive Order 18-02 was signed and it ordered 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 for Southern Resident killer whale recovery. The Task Force provided recommendations in a final report in November 2018[34]. 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, 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[35] that assessed progress made on implementing Year 1 recommendations, identified outstanding needs and emerging threats, and

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

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

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. Although these measures will not 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. 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. 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. 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.[36]

We also note that some of these types of action may involve federal authorizations and thus would be required to undergo additional ESA Section 7 consultations. Consequently, we do not assume those actions would occur in forming our conclusions here.

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 will add the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5) 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 diminishes the value of designated or proposed critical habitat for the

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

conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (Section 2.2).

The effects of the action considered in this opinion fall into two categories- those based on risk of an accident occurring (oil spill, transfer errors, ship strikes, contaminated ballast water) and those with tangible effects that are certain to occur as a result of the proposed action (ship noise and the physical presence of the pier). Large/catastrophic oil spills are an ever-present danger in the Salish Sea and the overall risk accumulates over time, yet the probability of a catastrophic spill is very small. To analyze the potential for large oil spill as a very low probability event with potentially high consequences to species, we analyze the incremental increase in risk as an effect of the action (the risk is perceivable, measurable, and partially mitigatable). In contrast, transfer errors/small spills occur with regularity (one per year on average), so we consider ongoing transfer error spills- not just the risk- to be an effect of the action. In the case of ship strikes, we know that large whales are infrequently struck by ships in the action area. For ship strikes, we consider the relative risk that additional BP ships pose in the action area to each species in relation to the numbers of whales in the action area and their susceptibility to ship strike. Therefore, we consider both the risk of ship strike and the consequences to the population of actual strikes to inform our jeopardy analysis. In the case of ballast water, we consider industry best practices to mitigate the risk of introducing invasive species to be adequate to the point that an accidental introduction of non-native species is not a significant concern for this proposed action.

2.7.1 Southern Resident Killer Whale – Integration and Synthesis

The proposed action causes an incremental increase in risk of a large oil spill in some years. As described in Section 2.4.1.1, NMFS does not perceive BP's potential incremental increase in oil spill risk associated with the proposed action for large oil spill to be of a magnitude that would significantly change the extinction risk from oil spill because the most likely spills (attributable to BP and all traffic in general) are orders of magnitude less than what Lacy's (2017) study indicates would be catastrophic to the killer whale population, and the largest spills that would approach "catastrophic" level among all shipping traffic in Lacy's study have a very low probability.

On-going transfer errors/small spills at the Cherry Point facility are likely to continue, with spills occurring on average once per year and being proportionally higher when BP operates with greater ship calls over baseline. We do not anticipate that these spills (drops, cups, to tens of gallons) will occur at a frequency or magnitude that would expose SRKW directly or indirectly to acute toxicity, and indirect food contamination is not likely to significantly affect toxin accumulation in the whales.

SRKW are susceptible to vessel strikes, but the risk from additional BP ships is extremely low because the ships move in predictable patterns in the shipping lanes and do not target the whale.

The noise generated by additional BP ships likely causes occasional low level disturbance to the whales, but the ships do not seek out and follow the whales and the noise of large ships is largely outside of their hearing range. The physical presence of the pier in the marine environment may cause the whales to change their swimming trajectory when in the vicinity, but this is likely a minor behavioral effect without consequence. The introduction of non-native species from ballast water discharge is a very low-level concern for this proposed action because laws, industry best practices, and BP's best management practices severely curtail this risk. In addition, the ongoing and incremental increase in treated wastewater discharge at the facility is of low concern.

The most immediate threats to SRKW are related to food availability (primarily Chinook salmon), disturbance from whale watching vessels, and water quality (particularly persistent, bioaccumulative toxins like PCBs). The proposed action does not exacerbate these immediate threats. The action may adversely affect a relatively small number of PS Chinook salmon, but not to a degree that would likely translate to a measurable reduction in available PS Chinook for SRKWs (the effects to Chinook are too low level and localized). Climate change and potential loss of food resources remain high threats to SRKW. Synergistically, Lacy (2017) analyzed combined threats to the population and offered this conclusion:

> "Across the ranges of threat levels that we examined, reduction of the prey base was the single factor projected to have the largest effect on depressing population size and possibly leading to extinction, although either higher levels of noise and disturbance or higher levels of PCB contamination are sufficient to push the population from slow positive growth into decline. If additional threats from proposed and approved shipping developments (such as catastrophic and chronic oil spills, ship strikes, and increased vessel noise) combine with the predicted decline of Chinook due to climate change, then the population could decline by as much as 1.7% annually, have a 70% probability of declining to fewer than 30 animals, and have a 25% chance of complete extirpation within 100 years. With respect to noise from commercial shipping, preliminary calculations suggest that the distribution of source levels of individual ships follows a power law, implying that quieting the noisiest ships will reduce overall noise levels by a disproportionate amount. Identifying the noisiest ships operating in SRKW critical habitat and creating incentives to reduce their noise outputs through speed restrictions and maintenance might generate considerable reductions in noise levels. The International Maritime Organization and the International Whaling Commission have urged nations to reduce the contribution of shipping to ocean ambient noise, with some countries adopting a pledge to reduce anthropogenic noise levels by 50% in the next decade. However, from the perspective of a foraging killer whale that emits high-frequency (18-32 kHz) echolocation clicks to detect and capture salmon, high-frequency noise from small, outboard vessels that follow whales might cause a greater reduction in a killer whale's foraging success than low-frequency (<1 kHz) background noise from commercial shipping."

In consideration of the environmental baseline in the action area, status of SRKWs, together with effects of the action and cumulative effects, the NMFS concludes that the proposed action does not reduce appreciably the likelihood of both the survival and recovery of Southern Resident killer whales.

2.7.2 Large Whales – Integration and Synthesis

The proposed action affects Central America and Mexico humpback, blue, fin, WNP gray, North Pacific right and sperm whale species with incrementally increased oil spill risk, increased ship noise, and increased ship strike risk. In the Effects of the Action section, we assessed each of these risks individually in light of each species' status in the action area, its range, abundance, life history characteristics, trajectory for recovery, key limiting factors, etc., and vulnerability to the risks. Those analyses were based heavily on information from the species' listings, recovery plans, and 5-year status reviews, if available. Individually, we found that each pathway of effect did not present a significant risk to the population of whales, although some individual whales may be directly affected in the action area to more of a degree than others because their numbers are more common in the action area, although still considered quite rare in the action area (e.g. Mexico DPS of humpback whales). The primary cause of all of the whale species decline was commercial whaling. For the most part, this stressor is no longer affecting large whales and the populations are either increasing or the status is unknown. Oil spill risk is identified as more of a threat to some of the species than for others. For example, blue whales are globally distributed, making oil spill in any one location less of a threat to the globally listed population. For other species that are primarily associated with coastal areas (e.g. humpbacks, NP right whales), oil spill in the context of offshore oil exploration is called out as the main concern (this is not an aspect of the proposed action).

For all of the large whale species, ship strike and ocean noise are identified as threats to varying degrees. For the coastal species, blue whales, humpback whales, and fin whales are most susceptible to ship strikes and disturbance from vessel noise. The coastal areas of Central America, Mexico, and Southern California in the California Current present the greatest overlap between these whales and heavy shipping traffic. For whales that feed in Arctic waters, increased shipping traffic is a concern as sea ice increasingly melts and opens up shipping lanes. Because the action area, especially the inland waters, is not within the primary range of many of the large whale species, we found that increased ship noise and increased vessel strike risk within the action area would likely not have bearing on the population trends of these whales, primarily because all of these listed whale species are rare in the action area (or the relative numbers of individuals that frequent the action area is small in proportion to the respective populations- e.g. Mexico DPS humpbacks) and the action area is a very small portion of whales' range. Taking all of these threats together, in light of the status of each species, the environmental baseline, the effects of the action, and cumulative effects, we conclude that the proposed action does not reduce appreciably the likelihood of both the survival and recovery of the listed large whale species.

2.7.3 Leatherback Sea Turtles– Integration and Synthesis

Leatherback sea turtles are widely distributed across the oceans of the world and face a variety of threats depending on the region in which they occur. In the marine environment, threats include, but are not limited to, direct harvest, debris entanglement and ingestion, fisheries bycatch, and boat collisions. Nesting aggregations in the eastern Pacific occur primarily in Mexico and Costa Rica, and in the western Pacific are found in Indonesia, the Solomon Islands, and Papua New Guinea. Leatherbacks within the action area are most likely to originate from nesting aggregations in the western Pacific. The 2020 Status Review delineates this western Pacific nesting population as the potential West Pacific DPS. The abundance of leatherback sea turtles is currently unknown but the most recent global estimate for nesting females is 34,500 turtles. The trend for the western Pacific subpopulation (potential West Pacific DPS) has been declining over the past four decades and continues to decline (NMFS and USFWS 2020).

The NMFS and USFWS (1998) Recovery Plan for leatherback turtles in the U.S. Pacific contains goals and criteria that must be met to achieve recovery for this species. These include research efforts to determine the stock structure of populations and to monitor their status, at least for populations that range into U.S. waters, in part because the abundance goals for leatherback populations in the western Pacific rest primarily on the productivity of nesting beaches.

The proposed action results in periodically increased risk of oil spill, vessel collisions, and noise disturbance. Climate change as a baseline condition will continue to threaten leatherbacks with episodic, recurring events in the action area (e.g., ocean cycles, climate change, storms, and natural mortality) will continue to influence leatherback sea turtles and may increase in frequency and/or severity as has been observed in recent years. Cumulative effects associated with increasing human population will also continue to affect leatherbacks (e.g. water quality degradation, increased boating).

Because leatherbacks are extremely rare in the Salish Sea and do not occur in concentrated numbers on the outer coast, the limited exposure of individual leatherback turtles to the adverse effects of the proposed action presents an extremely small additional risk to survival and recovery of the western Pacific leatherback sea turtle population (potential West Pacific DPS). The proposed action will not affect leatherback nesting habitat and populations. Given the best available information, we conclude that the proposed action is not likely to appreciably reduce the likelihood of survival or recovery of this species at the global scale (and at the West Pacific population scale). This conclusion is made in consideration of the environmental baseline, status of the species, direct and indirect consequences of the proposed action, together with cumulative effects.

2.7.4 Listed Fish Species – Integration and Synthesis

All of the listed fish species addressed in this opinion face uncertainty from climate change and continued habitat degradation from human development. Recovery efforts are also underway to improve habitat conditions that limit these populations. The proposed action poses a threat to each fish species from oil spill risk. Puget Sound Chinook salmon and the rockfish species are the most vulnerable in the action area because Chinook are heavily dependent on estuary and nearshore habitat in the Salish Sea and the two rockfish species occur in very low numbers with scattered distribution, making them vulnerable to further isolation if a sudden loss of fish were to occur from an oil spill. In the Effects of the Action Section, we conclude that fish could be directly killed by an oil spill and successive cohorts could be adversely affected by contaminants in the food web, particularly those species that have a primary association with estuaries and nearshore habitats. An oil spill could also depress forage fish spawning in the long term in oiled areas.

We looked at the Exxon Valdez oil spill to inform the severity of potential effects together with the oil spill risk assessments for Puget Sound/Salish Sea. The Exxon Valdez spilled approximately 11 million gallons of crude oil. A spill this size is highly unlikely in the action area because ships are now double-hulled and many risk mitigation measures are in place in the action area. The largest modeled spill in WDOE's 2015 VTRA has an average spill size of 1.8 million gallons and has probability of 0.05 percent chance in one year (0.0005 probability) among all traffic in the Salish Sea. Over a 25-year period, the risk of a 1.8-million-gallon spill is on the order of 1.24 percent (0.0124 probability). With this model, the spill category that exceeds a 1 percent annual chance is the 12,000-gallon average spill (1- 1000 cubic meters/264,172 gallons spill range). This spill category has a 7.5 percent probability in one year (0.075 probability). The TGA VTA for BP specific traffic showed models spills in the range of 62,644 to 114,997 gallons for the 95th percentile spill (meaning of 10,000 model attempts, 95 percent of modeled spills were less than that number) and between 961 to 2,396 gallons for the 50th percentile for various assumptions in BP ship numbers, number of pier wings, and general and cumulative traffic scenarios. Given this line of reasoning, the NMFS perceives BP's potential incremental increase in oil spill risk associated with the proposed action for large oil spill to be of a magnitude that does not alter the existing threat level to the listed fish species in the action area because the most likely spills are orders of magnitude less than what would likely be "catastrophic" to each fish species because the effects would be localized enough to allow for affected populations or subpopulations to recover over time. Additionally, the largest spills that would approach the 1.8 million (among all traffic) have a very low probability.

Transfer errors/small spill at the Cherry Point facility are likely to continue and increase proportionally when BP operates with more ship calls over baseline. These transfer errors have very localized effects to PS Chinook salmon, PS steelhead, and the two rockfish species. The incremental increase in discharge of treated wastewater from the North Wing will also contribute to slight increases in contaminants in the immediate vicinity of facility. The direct losses of fish or indirect food web effects are expected to affect very few individual fish in proportion to the respective populations. The other fish species are unlikely to be affected by transfer errors or treated wastewater because they do not have a primary association with the shoreline in the Cherry Point area. Increased ship noise is not likely to harm fish and ballast water presents very little risk. The physical presence of the pier may increase predation pressure on juvenile PS Chinook in the vicinity of the pier, but this is not likely to have a bearing on the larger populations. Very small numbers of PS Chinook salmon may be harmed by propeller wash.

In summary we expect a small number of PS Chinook, bocaccio, and yelloweye rockfish to be adversely affected by the existence and increased operations (periodically increased ship calls) of the BP facility. Even when we consider the current status of the threatened and endangered fish populations and degraded environmental baseline within the action area, the proposed action itself is not expected to affect abundance, distribution, diversity, or productivity of any of the component populations of the ESA-listed species, nor further degrade baseline conditions or limiting factors. Because the proposed action will not reduce the productivity, spatial structure, or diversity of the affected populations, the action, when combined with a degraded environmental baseline and additional pressure from cumulative effects, it will not appreciably reduce the likelihood of survival and recovery of these listed fish species in the action area.

For Hood Canal summer chum, Southern DPS eulachon, and Southern DPS sturgeon, the proposed action poses very little tangible risk to these fish. The physical presence of the pier, transfer error spills, and treated wastewater discharge at the BP facility are unlikely to affect these species because they do not occur or are extremely rare in the Cherry Point area. Ship noise poses little risk to these fish as well, with minor behavioral changes being the only consequence to transient exposure. Ballast water presents very little risk given the best management practices and industry standards in place. For oil spill risk, the NMFS perceives BP's incremental increase in oil spill risk in some years associated with the proposed action for large oil spill to be of a magnitude that does not alter the existing, baseline threat level to these listed fish species in the action area because the most likely spills are orders of magnitude less than what would likely be "catastrophic" to each fish species because the effects would be localized enough to allow for affected populations or subpopulations to recover over time. Additionally, the largest spills that would approach the 1.8 million (among all traffic) have a very low probability. This conclusion regarding the risk posed by the proposed action includes the consideration of incremental and varying increase in risk from the proposed action with a rolling average number of 385 total ships, with periodically increased ship calls, and considering the risk mitigation measures employed by BP and the industry, together with the Northwest Response Plan. For the proposed action as a whole, even when we consider the current status of the fish populations and degraded environmental baseline within the action area, the proposed action itself is not expected to affect abundance, distribution, diversity, or productivity of any of the component populations of the ESA-listed species, nor further degrade baseline conditions or limiting factors. Because the proposed action will not reduce the productivity, spatial structure, or diversity of the affected populations, the action, when combined with a degraded environmental baseline and additional pressure from cumulative effects, will not appreciably reduce the likelihood of survival and recovery of these listed fish species in the action area.

2.7.5 Critical Habitat– Integration and Synthesis

Critical habitat has not been designated for the following species: both DPSs of humpback whales, blue whale, fin whale, North Pacific gray whale, and sperm whale. Critical habitat is designated for North Pacific right whales in the Gulf of Alaska and Bering Sea, but it does not occur in the action area.

2.7.6 Southern Resident Killer Whale Critical Habitat– Integration and Synthesis

The proposed action indirectly affects PBFs 1 (water quality) and 2 (prey resources) by incrementally increasing oil spill risk in the action area, with some years have incrementally higher risk and some years having incrementally lower risk, depending on actual ship calls and the proportion of crude oil ship calls. Because it is impossible to predict an actual spill, we do not consider an actual large oil spill an effect of the action, rather we consider the increased risk as the effect of the action (the risk is perceivable, measurable, and can be partially reduced with industry best practices). We also understand that there is not a direct linear relationship between number of ships and risk, and there are many factors and assumptions that go into calculating probabilities. Based on the oil spill risk models and the inherent danger associated with shipping crude oil, we conclude that SRKW critical habitat in the action area is adversely affected by BP's incremental increase in risk in some years of oil spill in the action area. Because this risk cannot be translated into an actual predicted spill, we consider whether or not the incremental increase in risk of oil spill associated with BP translates to a substantial change in the existing threat level to the conservation value of critical habitat. In the event of a large oil spill, oil spill response activities would attempt to limit the spread of oil, remove oil, and limit the extent of ecosystem damage. Laws and processes are in place that would deal with recovering ecosystem function post spill. The Natural Resource Damage Assessment (NRDA) is the legal process that federal agencies including NOAA, together with the states and Indian tribes, use to evaluate the impacts of oil spills, hazardous waste sites, and ship groundings on natural resources both along the nation's coast and throughout its interior. NOAA and these partners, referred to collectively as natural resource trustees, work together to identify the extent of natural resource injuries, the best methods for restoring them, and the type and amount of restoration required. In addition to studying impacts to the environment, the NRDA process includes assessing and restoring the public's lost use of injured natural resources. In Section 2.4.1.1, we concluded that the BP’s incremental increase in oil spill risk is not of a magnitude that would pose a significant threat to the species or significantly change the baseline extinction risk from oil spill to the species because the most likely spills are orders of magnitude less than what Lacy’s (2017) study indicates would be catastrophic to the whales and the largest spills that would approach the 1.8 million gallon level among all traffic in Lacy’s (2017) study have a very low probability. This conclusion includes the incremental and varying increase in risk from the proposed action with a rolling average number of 385 total ships and considering the risk mitigation measures employed by BP and the industry, together with the Northwest Response Plan. The most immediate threats to SR killer whales are from reduced food availability, water quality, and disturbance from whale watching vessels. The proposed action does not exacerbate these immediate threats.

The proposed action directly affects passage conditions (PBF #3) from increased ship noise in some years. Vessel noise and the physical presence of ships can interrupt SRKW movement, communication, and feeding efficiency. NMFS expects the general type of vessels and noise contribution to continue with the proposed action, with the frequency of ships increasing in some years, but not exceeding the proposed 385 average on a 5-year rolling basis. Therefore, in some years BP-bound ships will contribute more or less to the overall noise profile in Puget Sound/Salish Sea. Of all traffic in Puget Sound, BP ships make up approximately 1.1 percent of vessels by time in transit. All oil and chemical tankers in the region combined are responsible for 2 percent of the overall noise profile. The additional number of ships calling at BP in some years is not expected to change the overall noise profile in the Salish Sea that the whales experience.

The main concern for SRKWs in the inland waters is from commercial and recreational whale watching boats that seek out and follow the whales, particularly in the summer core feeding area of the whales in the San Juan Islands. However, as described in the Baseline Section 2.4.4.1, large ships in Puget Sound/Salish Sea have been shown to generate sound that is within the hearing range of SRKW. More recently, researchers are expanding their scope to assess the effects of noise from large ships that transit through the Salish Sea, but that do not specifically target the whales. Viers et al., 2015, found that noise from large ships extends into frequencies used by Southern Residents for echolocation. This means vessels not targeting the whales can still affect critical habitat passage conditions. However, we do not expect that BP tanker traffic would cause enough additional disturbance to further degrade existing passage conditions because BP ship noise is transitory when whale presence overlaps with ship presence, which would be occasional. This is because BP ships stay in shipping lanes within the inland waters and do not target/follow the whales and the noise generated by the ships is largely below SRKW audible sound levels. Therefore, the effect on critical habitat passage conditions are considered minor.

Taking into account the combined effects of the action together with baseline conditions and cumulative effects, we conclude that the proposed action will not appreciably diminish the value of designated or proposed critical habitat for the conservation of the species.

2.7.7 Humpback Whales and Leatherback Turtle Critical Habitat– Integration and Synthesis

For the designated critical habitat of humpback whales in the Strait of Juan de Fuca and designated critical habitat of leatherback turtles on the outer coast, the PBF essential for conservation of the species is the availability of prey resources. The availability of these prey species is linked to complex ocean processes that will continue to be affected by natural weather patterns, climate cycles, and longer-term climate change. The incremental increase in risk of oil spill associated with the proposed action presents a very small risk to prey resources. Spatially, the effect of an oil spill, even a relatively large spill, would likely be relatively small in proportion to the total square miles of proposed and designated critical. The open seas, currents, and winds would break up and disburse a spill, reducing potential acute toxicity to prey species and reducing the concentrations of PAHs. The pelagic nature of the prey species makes repeated or prolonged effects less likely. A spill would cause short term acute effects prey resources in the event of an actual spill, but prolonged effects to food availability and quality would be unlikely, therefore we conclude that the incremental increase in risk in some years of spill caused by the proposed action, will not appreciably diminish the value of proposed and designated critical habitat for the conservation of these species. This conclusion is made in light of the environmental baseline and cumulative effects in the action area, and in consideration of the potential consequences of an actual spill.

2.7.8 Listed Fish Species Critical Habitat– Integration and Synthesis

The environmental baseline for PS Chinook salmon critical habitat in the action area is degraded, primarily from water quality impacts from human development and extensive shoreline armoring in Puget Sound. Climate change presents a great threat to the condition of the nearshore habitat, as sea level rise could bring further loss of nearshore habitat and result in more shoreline armoring. As described in detail in Section 2.5.3, the tangible effects of the project on PS Chinook salmon critical habitat are minor. These include transfer error spills, ship noise, treated wastewater, and the associated effects related to the physical presence of the pier in the marine environment. The incremental increase in oil spill in some years associated with the proposed action does not appear to be great enough to significantly change the existing threat level to critical habitat in the action area. The threat of invasive species from contaminated ballast water is very small given industry best practices and BP’s policies. Together these tangible effects and risk-based threats, when added to the environmental baseline and cumulative effects, while also considering potential consequences of an actual spill, do not appreciably diminish the value of critical habitat for the conservation of PS Chinook salmon. We draw the same conclusions for PS steelhead, Hood Canal summer chum, bocaccio and yellow rockfish, eulachon, and green sturgeon; the tangible effects of the project for these species are either minor, do not occur within designated critical habitat, and/or are spatially small/minor. Despite degraded baseline conditions, uncertainty from climate change, and cumulative effects, the additive effects of the action do not appreciably diminish the value of critical habitat for the conservation of these designated critical habitats in the action area.

2.7.9 Conclusion– Integration and Synthesis

After reviewing and analyzing the current status of the listed species and designated 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 Southern Resident killer whale, Mexico and Central America humpback whale, blue whale, fin whale, Western North Pacific gray whale, North Pacific right whale, sperm whale, leatherback turtle, Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer chum, Southern DPS Eulachon, Southern DPS North American green sturgeon, Puget Sound/Georgia Basin bocaccio (rockfish), Puget Sound/Georgia Basin yelloweye rockfish, or destroy or adversely modify proposed and designated critical habitat of these species within the action area.

2.8 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the taking 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 Incidental Take Statement (ITS). Therefore, if the USACE's proposed action (or final DA permit if it differs from the proposed action) is later found to not comply with the Magnuson Amendment, this opinion and any incident take statement would become invalid.

In this opinion, we analyzed the incremental increase in risk of major oil spill as a result of BP's predicted increased use (greater than the calculated baseline of 140 crude oil ship calls in some years and greater than 385 total ships in some years) at its facility with the addition of the North Wing at Cherry Point. We do not consider an actual large oil spill to be an effect of the action, rather we analyze the incremental increase in risk as the effect of the action (the risk is perceivable, measurable, and partially mitigatable with industry best practices). To inform our conclusions on risk, we also consider the potential consequences of an actual spill to formulate the NMFS opinion on the severity of the threat posed by an increase in risk. We also analyzed the probable effects of transfer errors/small spills at the facility. We determined that transfer error spills occur with some regularity (once per year on average at a scale of drops to gallons). These small spills are likely to harm relatively small numbers of juvenile Chinook salmon, juvenile steelhead, yelloweye rockfish and bocaccio, but not jeopardize these species. We note that are not providing a take exemption for any amount of oil spill[37] because oil spill is not an "otherwise lawful activity" incidental to the proposed action. Additionally, for large spills as analyzed above, we cannot reasonably anticipate that the incidental taking of individual listed species would occur as a result of an oil spill attributable to the proposed action because of the uncertainty of predicting future accidents with very low probabilities of occurring.

For potential vessel collisions with listed species, we analyzed the relative risk to whales and turtles from increased vessel traffic associated with addition of the North Wing. The North Wing allows for operations to include up to 420 ship calls per year versus 385 for a one-winged pier (35 additional ship call/70 trips). With BP voluntarily limiting ship calls to 385 ships per year on a five-year rolling average, the risk of ship strike will vary over time with actual ship calls, with some years presenting more or less risk compared to baseline. For some of the species, the risk of ship strike is more likely than for others because of relative numbers of individuals in the action area, vulnerability of the species to ship strike based on feeding or movement behavior, etc. Although we identify the additional risk in some years as an adverse effect of the proposed action, the incremental increase in risk is likely extremely small and is therefore unlikely to result in the taking of any individuals of the listed species as discussed above through ship strike.

For other effects of the action that we analyzed, we determined the risk was so small as to not be a concern (e.g. ballast water). For these pathways, we determined that adverse effects and therefore incidental take is not likely to occur.

The pathway for incidental take of PS Chinook salmon, PS steelhead, and bocaccio and yelloweye rockfish is from the physical presence of the North Wing and docked ships in the marine environment and the resulting increase in one or more of the following for each species; predation pressure and migratory delay (related to shade, bird perches, and/or artificial lighting), propeller wash, noise, as well as an incremental increase in contaminant loading from treated wastewater from the North Wing (Section 2.4.5).

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[37] In the event of an actual spill of any size, BP would be subject to the U.S. Oil Pollution Act in 1990 (OPA). OPA serves as the leading Federal regulatory mechanism to prevent, respond to, and address damage caused by oils spill and created the Oil Spill Liability Trust Fund. In addition, in 2001, the U.S. Coast Guard, EPA, Department of Interior, Fish and Wildlife Service and NOAA (NMFS and NOS) entered into an agreement that provides a framework for cooperation and participation in providing protection of listed species, improve oil spill planning and response procedures and streamline ESA section 7 consultations for oil spill cleanup. Oil spill planning and response procedures are set forth in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The agreement is intended to facilitate compliance with the ESA during an emergency without degrading the quality of an oil spill response, improve oil spill planning and response process, and ensure inter-agency cooperation to protect listed species and critical habitat.

2.8.1 Amount or Extent of Take

Incidental take of Puget Sound Chinook salmon, Puget Sound steelhead, and bocaccio and yelloweye rockfish will occur from the presence of the North Wing through various pathways (e.g. shade leading increased predation pressure and migration delay, increased wastewater contaminants related to the square footage of the pier) and increased ship numbers (increased shade and physically occupying space in the marine environment, noise, and propeller wash). This take cannot be accurately quantified as a number of fish because the distribution and abundance of fish that occur within the action area are affected by many habitat variables and seasonal and annual fluctuations in local abundance. For example, there is no practicable means to monitor for the number of fish taken through increased predation. Therefore, we will not quantify the amount of take in term of number of animals, but will quantify the size of habitat shaded by the pier and any ships docked there as a surrogate for incidental take because the size of the area shaded by the pier and ships relates proportionally to the number of fish expected to be taken, and thus will serve as a meaningful re-initiation trigger. In addition, we quantify the increased ship numbers also as a surrogate for take through propeller wash and noise related directly to increased ship numbers and operations.

The best available surrogate indicators for the extent of take are:

1. For harm associated with the presence of the North Wing on PS Chinook salmon, PS steelhead, and bocaccio and yelloweye rockfish, we use the area under the North Wing and the additional ship calls that it adds to the operations of the facility as a whole as a habitat surrogate. The take pathways are related proportionally to the pier size (e.g. predation related to shade and artificial lighting). In addition, the ships cast shade and physically occupy space in the marine environment in proportion to the number of ship calls. The extent of take is the total area of the North Wing of approximately 54,000 square feet of solid dock surface and an additional 7,000 square feet of grated walkways and gangways, together with the added ship calls that the North Wing contributes to the operations of the facility as a whole; an additional 35 ships in any one year above 385 total ships calling at the facility as a whole within a five-year rolling average defined as up to 420 ships in a single year among both the North and South wings of the facility, but not to exceed 385 total ships per year on a five-year rolling average among both pier wings.

2. For harm to PS Chinook salmon, PS steelhead, and bocaccio and yelloweye rockfish associated with propeller wash and ship noise, the surrogate for and extent of take is the added ship calls that the North Wing contributes to the facility operations as a whole; an additional 35 ships in any one year above 385 total ships calling at the facility as a whole within a five-year rolling average defined as up to 420 ships in a single year among both the North and South wings of the facility, but not to exceed 385 total ships per year on a five-year rolling average among both pier wings.

The incidental take surrogate identified above is rationally connected to the type and extent of anticipated take because the extent of habitat affected by the proposed action correlates with the number of individual fish affected. The surrogate can be effectively monitored by tracking the number and placement of ships at both the North and South pier wings, added to the area covered by the North Wing of the facility, as well as any changes to the structure which could increase the extent of shading and add additional wastewater. With respect to propeller wash and noise, which is related solely to the number of ships, again, this can be effectively monitored.

2.8.2 Effect of the Take

In Section 2.7, NMFS determined that the level 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 designated and proposed critical habitat.

2.8.3 Reasonable and Prudent Measures

“Reasonable and prudent measures” are non-discretionary measures to minimize the amount or extent of incidental take (50 C.F.R. § 402.02). The USACE or BP Cherry Point Refinery shall minimize incidental take by:

1. Not increasing the size or berthing capacity of the North Wing under the subject USACE authorization/permit.

2. Record the total number of annual ship calls at the BP facility (both piers) and record the type of ship (crude oil or refined product) and which pier it used to ensure that the number of ship calls do not exceed 385 per year on a 5-year rolling average with a maximum of 420 ship calls in any one year.

2.8.4 Terms and Conditions

The terms and conditions described below must be complied with by the entity to whom they are directed in order to implement the RPMs (50 CFR 402.14). There is a continuing duty to monitor and report the impacts of incidental take as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with such terms and conditions, their exemption under section 7(o)(2) of the ESA would lapse.

1. To implement reasonable and prudent measure No. 1, the USACE shall ensure that the authorization for the North Wing contains a permit condition that the size and or berthing capacity of the North Wing cannot be increased under this authorization and note that any request to increase the size or berthing capacity of the North Wing would require additional USACE authorization and environmental reviews, including ESA section 7 consultation.

2. To implement reasonable and prudent measure No. 2, the USACE shall ensure that the applicant provides an annual report detailing the number of ship calls at the BP Cherry Point facility (total number for ship calls for both pier wings and total number of crude oil tankers vs refined product ships and total ships calls relative to the five year rolling average of 385 ships). The report will be submitted

to NMFS by February 15 each year for the duration of the North Wing's operation.

The applicant must submit monitoring reports to:

National Marine Fisheries Service
Oregon Washington Coastal Office
Attn: WCRO-2014-00005, Janet Curran
Janet.curran@noaa.gov and
projectreports.wcr@noaa.gov

2.9 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 C.F.R. § 402.02). The following conservation recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be carried out by the USACE and the applicant, and where appropriate, users of the proposed project, should be encouraged to conduct these activities:

- NMFS recommends that the USACE and BP develop an outreach program for BP's shipping companies to participate in the ECHO Program and adhere to recommended speed reductions, within appropriate safety parameters, to reduce ship noise within the Salish Sea/Puget Sound and choose routes that limit disturbance in whale feeding areas, particularly in the presence of killer whales.
- NMFS recommends that USACE and BP develop an outreach program to BP's shipping companies to adhere to the NOAA Fisheries West Coast Region Recommendations to Avoid Collisions to minimize the risk of marine mammal and sea turtle vessel collisions. The outreach program should include the following measures at a minimum for shipping companies:
  - Consult the Local Notices to Mariners in your area or Coast Pilot for more information.
  - If possible, post extra crew on the bow (or appropriate observation point) to watch for whales such that ships can move out of a potential path of collision.
  - Reduce speeds while in the advisory zones, or in areas of high seasonal or local whale abundance.
  - If practicable, re-route ships to avoid areas of high whale abundance.
  - Report any injured, entangled or ship-struck whales and turtles to the 24/7 hotline at (877) SOS-WHALE (767-9425).

Please notify NMFS if the Federal action agency carries out any of these recommendations so that NMFS will be kept informed of actions that are intended to improve the conservation of listed species or their designated critical habitats.

2.10 Reinitiation of Consultation

This concludes formal consultation for the BP Cherry Point Refinery North Wing Pier.

As provided in 50 C.F.R. § 402.16, reinitiation of formal consultation is required 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 take 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 agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; (4) a new species is listed or critical habitat designated that may be affected by the action; or (5) BP begins to export crude oil by ship from its Cherry Point Facility.

2.12 "Not Likely to Adversely Affect" Determinations

Sei Whales

When evaluating whether the proposed action is not likely to adversely affect listed species or critical habitat, NMFS considers whether the effects are expected to be completely beneficial, insignificant, or discountable. Completely beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Effects are considered discountable if they are extremely unlikely to occur.

Sei whales have a global distribution and occur in the North Atlantic Ocean, North Pacific Ocean, and Southern Hemisphere (NMFS 2011c). The species is cosmopolitan, but with a generally antitropical distribution centered in the temperate zones. Sei whales are distributed far out to sea in temperate regions of the world and do not appear to be associated with coastal features (Caretta *et al.* 2013). The action area extends up to 40 miles off the Pacific Coast of Washington to the edge of the Continental shelf and slope, thus sei whales are unlikely to occur in the action area and be exposed to any adverse effects from the action. The risk of exposure to any effects of the proposed action is extremely unlikely and therefore discountable for this species. We conclude that the proposed action is not likely to adversely affect Sei whales.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the USACE and descriptions of EFH for Pacific Coast groundfish (PFMC 2005), coastal pelagic species (PFMC 1998), and Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in Sections 1 and 2 of this document. The action area includes areas designated as EFH for various life-history stages of Pacific Coast groundfish, coastal pelagic species, and Pacific Coast salmon. The PFMC described and identified EFH for Pacific Coast groundfish (PFMC 2005), coastal pelagic species (PFMC 1998), and Pacific Coast salmon (PFMC 2014). The action area also includes estuarine habitat area of particular concern (HAPC).

3.2. Adverse Effects on Essential Fish Habitat

The EFH implementing regulations, 50 CFR 6000.810(a), define “adverse effect” as: “any impact that reduces the quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.”

The ESA portion of this document describes the adverse effects of this proposed action on ESA-listed species and critical habitat, and is relevant to the effects on EFH for Pacific coast groundfish, coastal pelagic species, and Pacific coast salmon.

Potential Oil Spill

As described in Section 2.3.4 and 2.4 the probability of a major oil spill in the action area is very small; however, if a spill were to occur, various elements of EFH would be affected. The level of impact on marine habitats in the action area from an oil spill would depend on where a spill occurred would be determined by the following factors (O’Sullivan and Jacques 2001):

- Extent to which oil can penetrate the substrate;
- Amount of natural wave energy available to disperse the oil;
- Length of time the oil will remain in the environment;
- Feasibility of clean-up operations; and

- Presence of sensitive populations or communities of plants or sessile animals.

Should a spill occur in the action area, most of the oil would be removed by natural processes and modern cleaning techniques, but some oily residues, if buried, could persist for long periods of time, and chemical dispersants can be toxic. In the unlikely event of an accident and spill, a comprehensive system for responding to the spill and minimizing any damage to environmental resources has been established. This system includes federal and state requirements for spill response planning on the part of the terminal and vessel operators, pre-positioning of spill response and clean-up equipment by both governmental agencies and companies with operations that may generate spills, and continual training of spill responders. We do not consider an actual large oil spill an effect of the proposed action, rather we identify the incremental increase in oil spill risk as an adverse effect of the action and this risk is proportional to the increased number in some years of crude oil ships that call at BP Cherry Point.

Operation of the Facility

The effects of operation of the facility are summarized in 2.5.3 under Puget Sound Chinook critical habitat and effects of transfer errors/small spills, treated wastewater discharge, and the physical presence of the pier and ships in the marine environment. The scale of these effects is proportional to the number of ships calling at the BP facility.

3.3 Essential Fish Habitat Conservation Recommendations

To minimize oil spill risk, transfer errors, and the effects of the pier in the marine environment, The USACE shall ensure that the USACE and the Applicant adhere to Terms and Conditions 1 and 2 in Section 2.8.4 of this opinion.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, EFH in the action area for Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the USACE must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS’ EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The USACE must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600.920(l)).

4. 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.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is the USACE. Other interested users could include the applicant or other resource agencies. Individual copies of this opinion were provided to the USACE. The format and naming adheres to conventional standards for style.

4.2 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.

4.3 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., and the MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion [*and EFH consultation, if applicable*] 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 MSA implementation, if applicable*], and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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