QUILCENE BAY MUSSEL FARM EXPANSION (NWS-2007-01412) BIOLOGICAL EVALUATION

FINAL

Prepared for:
Penn Cove Shellfish LLC
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www.penncoveshellfish.com

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Compiled and Edited by:

Penn Cove Shellfish, LLC
P.O. Box 148
Coupeville, WA 98239

Adapted from Original Totten Inlet Mussel Farm Report Authored by:

Marlene Meaders, Chris Cziesla, and Kerrie McArthur
Confluence Environmental Company

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1.0 INTRODUCTION

Penn Cove Shellfish is applying for a U.S. Army Corps of Engineers (Corps) permit under the Nationwide Permit 48 (NWP 48) program to expand an exisiting floating mussel aquaculture facility in Quilcene Bay, Washington (Figure 1). Quilcene Bay is one of two inlets at the northern end of Hood Canal in the Puget Sound. Quilcene Bay extends 3.2 miles in a south to north direction and 0.9 miles east to west, and it is hydraulically connected to Dabob Bay and Hood Canal. The marine waters of Quilcene Bay have a total surface area of 1,626 acres at 10.0 feet (ft) mean high water (MHW), with an intertidal area of approximately 808 acres. Relative to the deeper bays in Puget Sound, Quilcene Bay is a deeper basin, with a mean depth of 60 ft and a maximum depth of 222 ft.

The Quilcene Bay Mussel Farm expansion (NWS-2007-01412) would consist of an additional 9 raft clusters floating over about 9 acres of subtidal habitat (60' to 120') in water too deep to support SAV, . The project requires a permit from the Corps under Section 10 of the Rivers and Harbors Act. Section 7 of the Endangered Species Act (ESA) requires federal agencies to ensure that their actions do not jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat. Issuance of permits by federal agencies is considered an action and, therefore, requires ESA compliance. Under ESA Section 7(c), the Corps is required to analyze the potential effects of its action (issuing the permit) on listed species and designated critical habitat.

Confluence Environmental Company (Confluence) prepared a similar Biological Evaluation (BE) on behalf of Taylor Shellfish to help the Corps evaluate the potential effects of their proposed project on listed species. To determine if listed species, or their critical habitat, are present in the vicinity of the proposed action, the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) websites were accessed on July 14th, 2017. Based on information from NMFS and USFWS (Appendix A), the ESA-listed species that may occur in the project area are provided in Table 1, and are addressed in this BE.

Critical habitat has been designated or proposed for these species (Appendix A), although it may not occur in the project or action areas. If critical habitat exists in North Totten Inlet, then effects to primary constituent elements (PCEs) will be analyzed.

The following listed species were identified as maybe occurring in the vicinity:

- Northern spotted owl (*Strix occidentalis caurina*), listed as threatened in 1990.

However due to the lack of documented occurrence in the project and action area, the lack of suitable habitat in the action area, and lack of potential effects, the project will have ***no effect*** on this species and they are not discussed further is this document.

Table 1 Federally Listed Species Considered

Common Name	Scientific Name	Listing date	Federal Status	Critical Habitat
Fish				
Bull trout (PS/Coastal DPS)	*Salvelinus confluentus*	11-1-1999	T	Yes*
Chinook salmon (PS ESU)	*Oncorhynchus tshawytscha*	6-28-2005	T	Yes
Steelhead (PS DPS)	*O. mykiss*	1-5-2006	T	Proposed
Eulachon (Southern DPS)	*Thaleichthys pacificus*	3-18-2010	T	Yes*
Green sturgeon (Southern DPS)	*Acipenser medirostris*	4-7-2006	T	Yes
Bocaccio rockfish (PS/GB DPS)	*Sebastes paucispinis*	4-28-2010	E	Yes
Canary rockfish (PS/GB DPS)	*S. pinniger*	4-28-2010	T	Yes
Yelloweye rockfish (PS/GB DPS)	*S. ruberrimus*	4-28-2010	T	Yes
Birds				
Marbled murrelet (WA/ OR/ CA DPS)	*Brachyramphus marmoratus*	10-1-1992	T	Yes*
Marine Mammals				
Southern resident killer whale	*Orcinus orca*	11-18-2005	E	Yes

DPS – Distinct population segment; ESU – Evolutionarily Significant Unit; E – Endangered; T – Threatened; PS – Puget Sound, GB – Georgia Basin; WA – Washington; OR – Oregon; CA – California
* Critical habitat has been identified, but does not occur within the proposed action area (as discussed in Section 4.0)

2.0 PROJECT DESCRIPTION

This section provides a brief description of the proposed project and defines the project and action areas. The project area includes those areas immediately adjacent to the project, while the larger action area is defined as "all areas to be affected directly or indirectly by the proposed action" (50 CFR 402.02).

2.1 Proposed Project

Penn Cove Shellfish proposes to expand and operate a floating mussel aquaculture facility (Quilcene Bay Mussel Farm) along the southeast shore of Quilcene Bay, within Jefferson County, Washington. The tidelands adjacent to the project area are part of tidelands owned and/or operated by Coast Seafoods. (Figures 2 & 3). The proposed 9-raft cluster Quilcene Bay Mussel Farm would be located on the northern third of Penn Cove subleased aquatic lands. The proposed mussel farm would cultivate "Mediterranean" (also known as "Gallo") mussels (*Mytilus galloprovincialis*). Penn Cove Shellfish has cultivated this species of mussel at this site and in Penn Cove since 1996 (Quilcene) and 1993 (Penn Cove).

The following sections describe raft design, how the rafts would be constructed, methods for culturing, harvesting, and processing mussels, and conservation measures used to avoid or reduce impacts to listed species and their habitat.

2.1.1 Raft Design

The proposed project consists of 9 raft clusters, each comprised of separate 3-raft units (Figure 2). The rafts themselves would float above 0.99 acres of subtidal habitat, located between -50 ft and -75 ft MLLW. The 21.57-acre lease area is located about 250 to 300 ft horizontal distance from the shoreline, and extends about 350 ft further offshore. The length of the expanded lease area parallels the shoreline for 800 ft.

Individual rafts would be 40 ft by 40 ft in dimension. Three raft units are to be attached end to end with 2 ft in between, resulting in a raft cluster 40' x 120' overall. It is anticipated that there would be 9 raft clusters, each comprised of separate 3-raft units (Figure 3). There would be an approximate 250-ft separation between raft units, end to end, and a 75-ft separation between raft clusters laterally. The longitudinal axis of each raft unit would be parallel to the shoreline. The total overwater coverage would be about 0.99 acres.

The rafts would be constructed of natural, untreated lumber (Douglas fir), galvanized steel cross beams, and polystyrene billets encapsulated in woven nylon covers (for floatation). The wooden raft structure would extend 1 to 2 ft above the water surface elevation (lower at times when the mussels have grown to maximum harvest size). Inert, polypropalene grow-out lines would be suspended from the raft structure (Figure 3). The grow-out lines would be stocked with hatchery-reared seed mussels. Periodically, the mussels would be thinned and reset as each mussel crop matures. Each raft unit would be secured in-place at both ends with nylon lines (rope) and pairs of concrete blocks (Figure 4).

Predator exclusion nets would seasonally enclose the underwater perimeter of the rafts. The mesh size of the nets is 4" hanging on the square and the net hangs as a curtain to a depth 2 feet below the end of the mussel lines around the outer edge of the raft cluster. The predator netting is used seasonally from fall to spring to exclude overwintering diving ducks which prey on the juvenile mussels less than 1.5" in length. Nets are changed out to prevent them from becoming excessively fouled by other organisms, which causes the nets to become block the flow of water and algae through to the grow-out lines of mussels. .

2.1.2 Raft Construction

Construction of the raft units would occur at Coast Seafood facility located at Linger Longer Road in Quilcene, (Figure 8). The proposed action would not require alteration of either facility.

The raft parts and concrete anchors would be prefabricated at the Linger Longer Road site. (Figure 8). These units would be unloaded using a boom crane truck. Assembly of the rafts (welding parts together and attaching floatation) would occur in the upper beach area, at about the +6 ft to +8 ft MLLW elevation. Currently, this beach is used almost daily for parking or for storing oyster shell. No new beach area would be disturbed by raft assembly for the proposed action. Assembly would take about 2 hours per raft. Assembled rafts would be floated off the beach on an incoming tide and attached to one another once in place in the water. Floating and anchoring the rafts into place within the lease area would take about 2 hours per raft.

2.1.3 Culture Methods

Each raft unit would have about 650, 20 foot-long seed lines or grow-out lines suspended from the structure (Figure 3). Mussel seed is transplanted from seed lines to grow-out lines for final grow-out. The mussel lines would not come near or in contact with the substrate. The immature mussels require about 14 months to reach harvestable size. The estimated biomass at the time of seeding is 6,500 pounds wet weight. Each raft unit would generate an average of 29,250 pounds whole body, wet weight for sale per growing period. The growing period averages 14 months (range: 12 to 23 months). It is estimated that the proposed action would produce an average of 789,750 pounds wet weight of mussels for sale each year.

2.1.4 Harvest Methods

When mussels are ready to harvest from the grow-out lines, an aluminum 64'x 17' harvest vessel, the 'Mytilus', would motor up adjacent to a raft and tie off. Mussel lines are then cut loose of the beams supporting them and then brought aboard the Mytilus via a conveyor. The mussels are run through a series of machinery which strip the mussels from the lines and the separate and grade them after which they are inspected, weighed and bagged. The bags of mussels are then placed in to insulated plastic totes, layer iced and then offloaded with a crane onto a 34' work skiff for transport to the Quilcene Boat Haven, then loaded into a refrigerated truck for transpost to the packing and shipping plant operated by Penn Cove Shellfish in Coupeville, Washington.

Mussel harvest from the rafts would not involve any dredge harvesting, tilling, or harrowing of bottom sediments.

2.1.5 Phased Implementation

Development of the Quilcene Bay Mussel Farm expansion would occur over a period of about 1 to 2 years, depending on: (a) the availability of mussel "seed" from the hatchery to start the first crop, (b) the financial resources required to construct the new rafts and (c). the weather.

2.1.6 Conservation Measures

Best Management Practices (BMPs) for mussel raft culture, including siting and raft configuration, would be employed to maintain water quality. Penn Cove Shellfish's *Environmental Code of Practice* (Penn Cove Shellfish 2013), included in Appendix B, lists primary BMPs that would be utilized in operating the proposed action. Additional relevant shellfish culture conservation measures adopted by the Corps from its consultation with the NMFS (2009; 2011) and USFWS (2009a) on NWP 48 for the State of Washington would be used for the proposed Quilcene Bay Mussel Farm expansion. Avoidance of potential effects, where possible, is the first priority. Avoidance, conservation, and minimization measures are described in more detail in the following sections:

- Construction and Siting of Rafts
- Maintenance, Repair, and Work
- Species-Specific Activities
- Farm Plan Record-Keeping Log

Construction and Siting of Rafts

- The rafts would be constructed of natural, untreated lumber (Douglas fir), welded steel cross beams, and polystyrene floats encapsulated in woven nylon bags, all which would have no negative effect on water quality.
- The rafts would be arranged parallel to the tidal currents to minimize interactions with flow patterns. By design, the downstream areas influenced by the rafts would not include sensitive intertidal and shallow subtidal zones.
- The rafts were planned and configured to minimize effects on benthic organisms by placing them in deep water with optimum fast currents for waste particle dispersion, resuspension, and assimilation.
- Because the raft units are not fixed structures (like a pier), and each unit would be separated approximately 70 feet apart, tidal currents and wind would constantly move the rafts and their shadows over the bottom substrate, although the site location substrate is deeper than upon which macroalgae grows. This would allow light to reach the bottom around the periphery of each raft unit.

Maintenance, Repair, and Work

- Damage to aquatic vegetation and substrates from boats or barges would be minimized or avoided through the following practices:
  - Measures would be implemented to prevent anchors, chains, and ropes from dragging on the bottom. These measures include the use of connected anchors and midline floats, as practical.
  - Boats and barges would typically be moored and operated in deeper water and away from aquatic vegetation to prevent potential impacts from propeller scour or anchors. If boats need to access the shoreline, then vessels would not ground in attached kelp beds. No eelgrass is present in the project or action areas.
  - The project area would not be used to store materials such as tools, bags, marker stakes, rebar, or nets. Materials that are not in use or immediately needed would be removed to an off-site storage area and the site kept clean of litter.
- Operators of vehicles or machinery would reduce contamination from vehicles and equipment through the following practices:
  - Unsuitable material (e.g., trash, debris, asphalt, or tires) would not be discharged or used as fill (e.g., used to secure nets, create berms, or provide nurseries).
  - All vessels operated within 150 ft of any stream, waterbody, or wetland would be inspected daily for fluid leaks before beginning operations. Any leaks detected would be repaired before resuming operation.
  - No petroleum products would be stored in the project or action areas.
- Approximately twice annually the site and moorings would be evaluated by a diver. The diver would manually remove debris (e.g., pieces of rope, weights, dropped tools) from bottom sediments at that time.
- Employees are trained in meeting environmental objectives.

Species Specific Activities

- The rafts would be sited and configured to minimize effects on marine mammals. During maintenance and harvest operations, due care would be taken to avoid disturbance of marine mammals, particularly seals and sea lions, in compliance with the Federal Marine Mammal Protection Act.

- Predator exclusion nets are kept taut around the raft to prevent trapping diving birds.

- Survivorship and growth data by year-class would be collected from farm inspections during harvest..
- Periodic dive surveys would be conducted below the rafts to retrieve any gear or equipment that may have fallen off the rafts. Any debris collected would be recorded.
- Spills or cleanups conducted on the beach would be recorded and the appropriate agencies notified.

2.2 Project and Action Areas

The expansion "project area" is defined as the 9 acres of aquatic lands north of the existing 12.57 acres where the current mussel farm operates in Quilcene Bay. The proposed mussel rafts would be located at Section 31,Township 27N, Range 1W, Section 5 (Figure 2). The project area is within Quilcene Bay at the northern end of Hood Canal. The "action area" for fish resources is defined as extending 230 ft from the rafts (Figure 5), which is the greatest distance measured that could detect any chemical or biological changes to water quality from the rafts studied in Totten Inlet by NewFields in 2009. The action area for avian species is defined as a 1-mile radius around the project area, which is the line-of-sight typically used to evaluate potential effects to birds when noise effects are considered to be minor (FWS 1986).

3.0 EXISTING ENVIRONMENTAL CONDITIONS AND EFFECTS OF THE ACTION

Presented below are discussions of existing environmental conditions and temporary, permanent, direct, indirect, and net effects of the proposed action. This section addresses only environmental attributes and habitat qualities important to listed species that may be present in the action area and potentially affected by the project. The topics discussed will include:

- Water Quality
- Sediment Quality
- Macroalgae
- Benthic Community
- Forage Fish
- Migration Corridor

Detailed characterization of baseline conditions were documented in several studies prepared for a limited-scope Environmental Impacts Statement for a similar project by Taylor Shellfish, the North Totten Inlet Mussel Farm (TCRSD 2010). In addition, Thurston County selected an Independent Technical Review Committee (ITRC) to review and comment on the baseline studies. The following information includes a summary of the major findings from the final reports that incorporated the review and comments of the ITRC, as they relate to ESA listed species.

3.1 Water Quality

This section describes existing conditions and potential effects of the proposed action related to dissolved oxygen (DO).

3.1.1 Existing Conditions

Quilcene Bay serves as a drainage basin for the Little and Big Quilcene Rivers. Little Quilcene River and two of its largest tributaries (Howe and Ripley Creek) are discussed collectively because of similarities in watershed characteristics and a common outlet in Quilcene Bay. The Little Quilcene River drains into Quilcene Bay north of the Big Quilcene River in eastern Jefferson County. The Little Quilcene River has a drainage area of approximately 30 square miles, with 12 miles of mainstem and 29 miles of tributaries. The Big Quilcene River is located in eastern Jefferson County north of the Dosewallips River and south of the Little Quilcene River. With a drainage area of 68 square miles, the Big Quilcene River is the largest stream system within the Quilcene-Dabob Watershed Planning Area. Precipitation varies from 75 inches per year in the headwaters to 50 inches per year in the town of Quilcene, with an overall average of 63 inches per year (JS'KT 1994). Summer chum and chinook, both federally listed, as well as coho, steelhead, pink and cutthroat trout spawn in the Little Quilcene river and the Big Quilcene River supports runs of coho, summer chum, fall chum, winter steelhead, searun and resident cutthroat trout. utilize the entire Quilcene Bay estuary complex during their juvenile rearing stage. The Quilcene Bay herring stocks are currently at high levels of abundance and have comprised an increasing portion of the south/central Puget Sound region's spawning biomass and is currently the largest in Puget Sound, with mean annual spawning biomass of almost 2,400 tons in the last ten years; 833 tons more than next largest stock in that time frame (Cherry Point).

Dissolved oxygen at the existing Quilcene Bay Mussel Farm site is evaluated using direct measurements at -3 m and -7 m which are recorded and viewable on the NOAA NANOOS NVS web site. (Carrington 2013-17). There have also been long-term studies that evaluated DO at the existing Penn Cove mussel rafts (Carrington, Newcomb 2015). According to sonde data from 01/01/17 to 07/06/17, DO in the project area ranged from 5.46 to 15.17 ppm at the surface (-1 m depth) and 4.55 to 12.72 ppm at the -7 meters depth. The lowest DO concentrations were generally observed during the spring and summer months.

3.1.2 Effects of the Action

Construction and assembly of the rafts would occur at existing upland facilities. Therefore, construction of the rafts would have no impact on existing water quality conditions in Quilcene Bay.

According to model predictions, operation of the mussel rafts may reduce DO concentrations within the action area, but even the lowest concentrations predicted would are slightly below the biological stress threshold of 5.0 ppm except potentially in late August when DO decreases naturally (NewFields 2009). Existing data (from the existing Taylor Shellfish Deepwater Point mussel rafts) used within predictive models indicated that DO concentrations could be reduced from 10 to 70 percent within the

[1] The biological stress concentration benchmark is 5.0 ppm, depending on temperature and salinity. As DO concentrations drop below 5.0 ppm, an organism becomes increasingly stressed, more susceptible to disease, or can even die from suffocation if it cannot move away to better conditions.

proposed mussel rafts. However, use of data from the Deepwater Point site may overestimate low DO events within the predictive models because ambient DO concentrations in the summer are lower at this site compared to the proposed project area.

NewFields (2009) predicted that DO concentrations would be lower in the Taylor raft array. Sampling conducted in March, June, and September 2003 at the existing Deepwater Point farm indicated that DO concentrations decreased by 10 to 25 percent of ambient conditions in the center of the raft. In August 2003, DO concentrations at the center of the raft decreased 30 percent and up to 70 percent further into the raft. Water exiting the raft array returned to ambient DO concentrations just downstream. Although the location of where DO would return to ambient conditions was not identified, the measurement at 230 ft was within ambient conditions, which indicates that it would occur at least within that distance from the rafts. Actual changes in DO concentrations at the proposed Quilcene Bay Mussel Farm would likely be tied to current velocity and seasonal fluctuations in background DO. The total area of reduced DO was estimated to be within a surface area ranging from 0.99 to 1.5 acres, which is equivalent to 11 and 16 percent of the aquatic lease area, respectively. This amount of change in DO would not be significant in terms of overall habitat changes to water quality.

3.2 Sediment Quality

This section describes existing conditions and potential effects of the proposed action related to sediment quality.

3.2.1 Existing Conditions

Quilcene Bay is located on the eastern shore of the Olympic Peninsula. The entire bay is contained within the confines of Jefferson County. Quilcene Bay currently supports five to six commercial shellfish operations which utilize more than 1/2 of the bay's three square miles as their prime shellfish growing and harvesting areas. On the southwest shore there exists a commercial oyster hatchery. The hatchery supplies substantial quantities of oyster "seed to west coast operations; water from Quilcene Bay is the sole source for the hatchery. Sediment quality data and concentrations of water-column dissolved oxygen (DO) collected in Hood Canal from 1932 to 2005 were evaluated as part of the Hood Canal Dissolved Oxygen Program. The influence of these measures on the composition of sediment-dwelling invertebrate assemblages (benthos) was examined. Sediment chemical contamination and toxicity was low, and confined to Port Gamble, Port Ludlow, and Dabob Bay. Coarse sands were found in northern Hood Canal and along shorelines. Organic carbon concentrations increased in fine-grained sediments. DO concentrations decreased from north to south and from shallow to deep water. Minimum DO levels measured from 1932 through 2005 decreased over time, periodically falling below critical values at most southern stations and at an increasing number of central and northern stations.

Benthic assemblages were identified for three regions and nine sub-regions of Hood Canal. The number of individuals and species decreased and stress-tolerant species became dominant southward as sediment grain size and near-bottom DO decreased, and organic carbon content and depth increased. These factors, in this order, acting together may have influenced the composition of the benthos. Obvious changes in assemblage structure occurred within DO ranges of >3 to 6 mg/L and < 1 mg/L. These two ranges may represent critical DO concentrations for Hood Canal benthos. Patterns of species succession over decreasing DO ranges were similar to responses by the benthos to stressors reported in fjords elsewhere. Additional analyses indicated that there had been little change in northern Hood Canal benthos that could be attributed to declining oxygen levels.

3.2.2 Effects of the Action

Construction and assembly of the rafts would occur at existing upland facilities. Therefore, construction of the rafts would have no impact on sediment quality in Quilcene Bay. Because only hand tools would be used for assembly, there would be no risk of pollutants entering the water that could affect sediment quality.

Shellfish filter feeding creates biodeposits (feces and pseudofeces) that contribute to biogenic sources of sediment (Peterson and Heck 2001; Dumbauld et al. 2009). Suspended culture results in only the transfer of organic matter to sediment, which can reduce oxygen in areas with low flushing rates (Nizzoli et al. 2005). Kaspar et al. (1985) found that sediments under suspended mussel cultures in New Zealand contained 8.0 to 8.7 percent TVS in comparison with 7.0 to 7.1 percent TVS found at reference sites. The authors concluded that the differences in sediment nitrate and nitrite were not significantly different.

Review of a study to characterize likely effects on the underlying sediments from the proposed action provided data from a sampling program designed and implemented at Taylor Shellfish's mussel farms at Deepwater Point and Gallagher Cove (Brooks 2005a). The transformation of organic nitrogen to inorganic nitrogen associated with mussel rafts appeared to occur close to the sediment surface, with the signal disappearing within a depth of 20 inches. Brooks (2005a) indicated that there were only minor effects to sediment characteristics.

Additionally, NMFS (2009) evaluated the production of feces and pseudofeces by shellfish in rafts and the accumulation of this material under the rafts in its Biological Opinion on NWP 48 for existing aquaculture activities in Washington State. The Biological Opinion reviewed several studies that evaluated the potential effects on sediment from aquaculture when examining dense three-dimensional suspended raft systems of scallops and kelp (Grant and Bacher 2001) and mussels (Saxby 2002). The studies suggested that sediment effects depend on the density of the culture system, water depth, ambient currents, tidal flows, wave energy, bottom topography and elevations, and sediment type and deposition characteristics. In West Coast estuaries, some limited sediment accumulation has been observed, but no adverse effects have been documented. NMFS (2009) concluded that when rafts are placed in areas with high tidal currents, feces and pseudofeces produced by shellfish are carried away by the currents, and these rafts have little effect on the underlying sediments, especially in deep water.

Since the proposed Penn Cove Shellfish Mussel Farm expansion would be located in deep waters with high tidal currents, the proposed project is not expected to result in the accumulation of sediment or detritus under the rafts; therefore, the proposed project is not expected to affect sediment quality in the action area.

3.3 Macroalgae

This section describes existing conditions and potential effects of the proposed action related to macroalgae.

3.3.1 Existing Conditions

There is limited to no macroalgae in the project area and surrounding habitat. During an inspection conducted 24 June, 2017, there was no marine vegetation on the beach at the beach site where

the mussel rafts will be assembled for deployment. The project area has some amount of sea lettuce (*Ulva* sp.) and brown kelp (*Laminaria* sp.), although the majority of macroalgae occurs in the intertidal habitat of Quilcene on the northern shore . During a dive survey conducted 19 December, 2014 the survey showed that *Ulva* was present only to depths of -10 ft MLLW and shoreward, but not covering any of the area where the raft-units would be located (Figure 4). Within this small area, there was not bottom coverage of fixed macroalgae observed. . There are no eelgrass beds in the action area (Figure 7 -Washington DNR 2015).

3.3.1 Effects of the Action

There would be little risk of adverse impact to marine plants during construction because fabrication of mussel raft parts will occur on land, and assembly of the rafts will occur on the beach at the parking and shell washing area of the Coast Seafoods Hatchery.

The proposed location of raft units is mostly in water depths too deep for macroalgae or SAV to grow. Because the raft units are not fixed structures, that each unit would be separated by several feet, and because of tidal currents and wind, the rafts and their shadows would constantly move over the substrate allowing for light to reach towards the bottom around the periphery of each unit.
Additionally, the rafts are not solid, which would allow some light to penetrate towards the bottom, especially after harvest and when the seed lines are newly placed. Due to lack of its presence, there is no expected potential for loss of macroalgae within the project area under the proposed rafts. From a positive impact standpoint, the raft structures may offer new attachment points for macroalgae to grow on the project site.

3.4 Benthic Community

This section describes existing conditions and potential effects of the proposed action related to the benthic community.

3.4.1 Existing Conditions

Quilcene Bay shoreline consists largely of protected and semi-protected sand flat and sand beaches. Sediment sources are moderate and alongshore, except where rivers and/or streams enter the bay where they become more abundant and fluvial. Sediment is scarce at the marina. Quilcene Bay is famous for its shellfish, particularly oysters, which are found in continuous and patchy sections throughout the bay. Salt marsh habitat is found along the southwest shoreline. Sargassum, barnacles, ulva and fucus are found in patchy segments (Shorezone Inventory 2001). Eelgrass is continuous throughout the northern end of the bay and the eastern shoreline. Herring are also know to spawn throughout the northern bay area and surf smelt spawn along the beaches on the (Penttila et al 2000).

The physiochemical data and macrobenthic community inventory were consistent for an area described as organically enriched, but not so eutrophic as to exclude sulfide-intolerant taxa. For example, the benthic community included polychaetes and mollusks tolerant of naturally-enriched conditions such as marine snails (*Alia gausapata*, *Alvania compacta*, and *Nassarium perpingis*), The north end of the bay, south of the Big Quilcene River, contains quantities of native littleneck (Leukoma staminea) and butter (Saxidomus gigantea) clams and the non-native but naturalized Manila (Venerupis philippinarum) and soft-shell (Mya arenaria) clams. The varnish clam (Nuttalia obscurata) is a more recent introduction, and has successfully recruited to freshwater influenced habitats near the mouth of the river.

3.4.1 Effects of the Action

There would be little risk of adverse impact to benthic epifauna during construction because fabrication of mussel raft sections would occur on land, and assembly of the rafts would occur on the beach at the Hatchery beach site. The assembled rafts would be towed to the project area for anchoring. While a small amount (0.006 acres) of benthic habitat may be displaced by the concrete block anchors, the anchor ropes will provide more than an equal amount of substrate for marine organisms to attach .

The environmental response of benthic organisms to the mussel raft expansion depends on numerous factors such as water depth, local currents (direction and speed), sediment grain size, DO concentrations in the benthic boundary layer, among other factors. To characterize likely effects on the underlying sediments from the proposed mussel culture rafts in South Quilcene Bay, review of a sampling program designed and implemented at Taylor Shellfish's existing mussel farms at Deepwater Point and Gallagher Cove during different seasons was conducted. According to Brooks (2005b), the megafaunal community was likely enhanced by the residual organic material present in the particulate waste released from the overlying mussel cultures and their symbiotic community. The results of the study also suggested that there would not be an adverse long-term effect arising from the proposed raft culture of mussels in North Totten Inlet, therefore the amount of area affected is not likely to significantly change the benthic community in the Quilcene Bay area.

3.5 Forage Fish

This section describes existing conditions and potential effects of the proposed action related to forage fish.

3.5.1 Existing Conditions

Due to the fluctuating nature of forage fish populations, management emphasizes the role of the ecosystem, rather than catch statistics (Bargmann 1998). Specifically, documented spawning habitat and potential spawning habitat for surf smelt (*Hypomesus pretiosus*), Pacific sand lance (*Ammodytes hexapterus*), and Pacific herring (*Clupea harengus pallasi*) is mapped on an annual basis and classified as

"Marine Habitat of Special Concern" under the WAC Hydraulic Code Rules (Lemberg et al. 1997). Within Puget Sound, each species of forage fish uses about 10 percent of the shoreline as spawning habitat, and the adjacent nearshore habitats as nursery grounds (Penttila 2007).

Pacific sand lance and surf smelt are both year-round residents in the nearshore areas of Puget Sound and spawn in the upper beach habitat typically above +5 ft MLLW in sand and small gravel substrate, respectively (Moulton and Penttila 2001). They are generally found in mixed schools in waters 59 to 98 ft deep. According to the Washington Department of Fish and Wildlife (WDFW) forage fish spawning database (WDFW 2014a), very few surf smelt and Pacific sand lance are not shown to spawn on intertidal beaches adjacent to the project area (September 2001 to November 2004 NOSC forage fish surveys). There is documented spawning of the Quilcene Bay Stock of Pacific herring along the northern shores at the head of Quilcene Bay, but none in the project area. Spawn timing for these three forage fish species in South Puget Sound is provided in Table 2.

Pacific herring typically broadcast spawn in eelgrass, marine algae, hard substrates, and occasionally polychaete tubes between a tidal elevation of 0 and -10 ft MLLW (Stick 2005; Penttila 2007; Stick and Lindquist 2009). However, marine algae is typically sparse in North Puget Sound and the Quilcene Bay stock often spawn on hard substrates (rocks and gravel).

Table 2 Forage Fish Life Stage Timing in Puget Sound

Species	Life Stage	Month												Stock Status	References
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Pacific herring	Adult													Moderately healthy	Pentilla 2007, Stick et al. 2014
	Larvae/Juvenile														
Pacific sand lance	Adult													NR	Pentilla 2007
	Larvae/Juvenile														
Surf smelt	Adult													NR	Pentilla 2007
	Larvae/Juvenile														

Documented presence
Assumed presence

Forage fish prey depends on life stage (size) and their location within nearshore habitat. Fresh et al. (1981) completed a stomach content analysis for forage fish within central and southern Puget Sound. The authors reported that juvenile herring in sublittoral habitats feed on calanoid copepods (45%), decapod larvae (23%), and chaetognaths (10%). In neritic habitats, prey items are dominated by calanoid and harpacticoid copepods and euphausids. Surf smelt and sand lance consume primarily pelagic prey; however, smelt are also epibenthic feeders.

Another important, but less common Puget Sound forage fish, is the northern anchovy (*Engraulis mordax*). Surveys from 2003 and 2004 indicated that no anchovy were observed near Quilcene Bay.

Anchovy spawning is temperature- dependent, requiring 10 to 23.3 degrees C, which falls within the temperature range of Quilcene Bay.(TCRSD 2010). Northern anchovy are a pelagic schooling fish that utilize open water for broadcast spawning during late spring and summer months (Penttila 2007). It is notable that northern anchovy were important components of harbor seal diets in Hood Canal and San Juan Islands (Lance and Jeffries 2009).

3.5.2 Effects of the Action

There would be no risk of adverse effects to forage fish during construction because fabrication of mussel raft parts would occur on land, and assembly of the rafts would occur on the beach at the Old Plant Site. Because only hand tools would be used for assembly, there would be no risk of pollutants entering the water that could affect water quality of forage fish habitat. Assembly would not occur where potential or documented forage fish spawning habitat exists.

The proposed culture activities are not located at elevations where herring,surf smelt or sand lance spawn (the raft structures would occur between -45 ft and -95 ft MLLW). These fish use the upper intertidal zone for spawning, typically spawning at high tide over mixed sand and gravel substrate. Therefore, the proposed project is not expected to impact spawning habitat of these forage fish species. The Quilcene Bay herring stock deposit spawn mostly on rocks and gravel. No spawning was documented in the action area. Because the deepwater location and tidal shifting, the raft units will not shade the benthos which lacks vegetation on the substrate, it is unlikely the proposed action would have any significant physical effect on herring spawn.

There are two main effects on forage fish from the proposed action: (1) prey availability, and (2) structure as an attractant (discussed below in Section 3.6). Prey availability would be linked to project effects on production of phytoplankton and zooplankton, and environmental parameters related to primary production and the benthos. Although peaks in mussel production coincide with patterns in phytoplankton blooms, there would not be significant changes to the water-column food web associated with the Quilcene Bay Mussel Farm. In fact, the complex surface area provided by mussels, raft structures, and anchor lines offers habitat for the colonization of diverse organisms (biofouling) that would be considered prey for forage fish (copepods, gammarid amphipods). For example, Tenore and Gonzalez (1976) found that fouling organisms on suspended lines attached to buoys or rafts increased forage opportunities for fish. CRMC (2008) reviewed the changes associated with suspended culture operations, and found that culture in high current waters does not disrupt the nutrient balance that would, in turn, create a hypoxic environment diminishing benthic food productivity for fish. The expanded Quilcene Bay Mussel Farm would be sited within a high flow environment and is not likely to significantly alter nutrients, phytoplankton, or benthic productivity.

The NMFS Biological Opinion for NWP 48 for shellfish aquaculture in Washington (NMFS 2009) also concluded that effects of management activities on benthic communities are unlikely to impact forage productivity. NMFS (2009) indicated that best available science supported the conclusion that existing

shellfish aquaculture in Washington State is "well within the range of normal benthic processes and effects on productivity are likely to be so limited in space (the footprint of the shellfish bed plus some down drift area to account for current) and duration (from a few hours to days, and certainly less than a year)." Therefore, it is unlikely that there would be any significant adverse impact to fish or their prey organisms caused by the proposed action. Alternatively, there could be positive effects for forage fish because of the encrusting organisms that will form on the raft structures, suspended lines, and anchor lines that could increase prey availability.

3.6 Migration Corridor

This section describes existing conditions and potential effects of the proposed action related to the migration corridor for ESA-listed fish.

3.6.1 Existing Conditions

Juvenile Chum salm and steelhead use the nearshore habitat extensively on their outmigration (Myers et al. 1998; Haring 2000; Good et al. 2005; Haque 2008). Chinook fry may orient themselves within 65 ft of the shoreline (Weitkamp 2000), and will even utilize nearshore structures, including riprap, piers, and log rafts (Weitkamp and Schadt 1982; Taylor and Willey 1997). Juvenile bocaccio and canary rockfish are recognized as utilizing nearshore habitat (Love et al. 1991; BRT 2009). Adult salmonids and rockfish typically migrate in deeper water, but may come into the nearshore to feed during migration (Shreffler and Moursund 1999; BRT 2009). Overall, fish generally migrate along, or adjacent to, shoreline habitat.

3.6.1 Effects of the Action

Overwater structures potentially affect migrating fish, depending on the size and type of structure. Ward et al. (1994) concluded that nearshore structures (e.g., Portland Harbor and associated development) in the lower Willamette River near Portland, Oregon presented few risks to migrating juvenile Pacific salmon. Other studies have shown that marinas attract large populations of juvenile salmon and baitfish (Weitkamp et al. 1981; Thom et al. 1988). Weitkamp et al. (1981) observed equal abundances of juvenile Chinook and chum along the edges of large piers compared to adjacent shoreline areas. In contrast, Able et al. (1998) observed reduced juvenile fish abundance under piers when compared to open-water or areas with only piles but no overwater structures. Toft et al. (2004) indicated that effects on nearshore fish densities and behaviors were evident when shoreline modifications extended from the supratidal into shallow subtidal waters, which may be why Able et al. (1998) observed changes associated with piers instead of pilings alone.

Nightingale and Simenstad (2001) noted observations of behavioral responses upon encountering large docks, including pausing, migration delays due to disorientation, school dispersal, and migration directional changes. These behavioral changes were observed both during the day and at night with artificial lighting. The mechanism of action is the alteration of ambient light, which produces sharp underwater light contrasts by casting shadows under the structures. The proposed mussel rafts are small, include a number of spaces in between individual rafts, and would allow for light to penetrate. In

addition, no artificial lighting would be used to create shadows at night. Therefore, no changes to fish behaviors are expected during migration.

A review conducted by Simenstad et al. (1999) found no studies that attributed predation mortality to overwater structures. Many authors have actually reported results that lead to the supposition that predation associated with overwater structures do not add significantly to juvenile salmonid mortality. For example, Cardwell and Fresh (1979) analyzed the stomach contents of maturing Chinook salmon, copper rockfish, and staghorn sculpin, and found that only staghorn sculpin stomachs contained juvenile salmonids, and the presence of juvenile salmonids in the stomach contents did not change in relation to added structure. Ratte and Salo (1985) provided no indication that predatory fish aggregated under piers, and that predators were actually less abundant in shaded habitat. Finally, Salo et al. (1980) found that juvenile salmon composed less than 4 percent of piscivorous fish diet in association with pier habitat.

Overall, negative effects to fish migration are not expected from the proposed mussel rafts. The new rafts would not extend from the shoreline and would not result in significant shading underneath. In addition, they would be positioned offshore, in deeper water which may provide safe harborage and food supply for smolting salmonids. There is no evidence that would support a change in fish behavior associated with the Quilcene Bay Mussel Raft. There is also no indication that overwater structure results in increased potential for predation. Therefore, the effect to the fish migration corridor from the proposed mussel raft is not considered to be significant.

4.0 EVALUATION OF EFFECTS ON LISTED SPECIES

This section discusses use by listed species of the action area, describes temporary and permanent direct and indirect effects on listed species from project activities, and provides an effect determination. This section discusses only attributes of listed species that are relevant to the project area and likely to be affected by the project (Table 1). Appendix C evaluates the project effects on Essential Fish Habitat (Table C-1), for federally-managed commercial fish species.

4.1 Chinook Salmon

4.1.1 Stock Status and Critical Habitat

Chinook (*Oncorhynchus tshawytscha*) salmon from the South Puget Sound tributaries had a "healthy" Salmon and Steelhead Stock Inventory (SASSI) status in 1993 (WDFW 1993). However, WDFW changed this stock's status to "not rated" in 2002 due to atypical habitat for Chinook salmon in South Puget Sound, as indicated by small stream sizes and low flows during the spawning season. Current returns of Chinook salmon in South Puget Sound are attributed to releases from hatcheries. According to the most recent harvest management plan (PSIT and WDFW 2010), the Deschutes River and McAllister Creek spawning populations are most likely hatchery origin, and would not be included in the

Estuarine and nearshore habitats are critical habitats for juvenile chinook as migration corridors and feeding and refuge.

4.1.2 Use of the Action Area

According to the Washington State Conservation Commission, (WSCC, Ginna Correa, November 2002), Chinook salmon, also known as king salmon, are not found in WRIA 17 in abundant numbers as spawners and, when found, are either the result of hatchery production or straying. The US Fish and Wildlife Service hatchery on the Big Quilcene River has been in existence since 1911. In 1980, they began a spring chinook program that continued until 1994. That run has not sustained itself over time, as recent spawner surveys indicate no adult returns to the river.

4.1.3 Effects of the Action

There would be no risk of adverse impact to Puget Sound Chinook salmon or their critical habitat during construction because fabrication of mussel raft parts will occur on land, and assembly of the rafts will occur on the beach at the Coast Seafoods parking and cultch washing upland area.

There would be no measureable risk of adverse effects to Puget Sound Chinook salmon or their critical habitat because their occurrence in Quilcene Bay is rare. In addition, changes associated with the proposed mussel raft would not significantly affect the PCEs for Chinook salmon, including water quality, prey items, or nearshore areas free of obstruction.

4.1.4 Effect Determination

Based on the analysis discussed in Section 3.0 above, and the implementation of the proposed project conservation measures, effects to the PCEs of Chinook salmon are expected to be insignificant and discountable. Chinook salmon may be present in the action area, even if their presence is considered rare. Therefore, this BE reaches the conclusion that the proposed action **may affect, not likely to adversely affect** Chinook salmon and their critical habitat.

4.2 Chum Salmon - Summer Run

4.2.1 Stock Status and Critical Habitat

Chum Salmon (Oncorhynchus keta), also known as dog salmon and/or calico salmon, federally listed as threatened under the Endangered Species Act, are found in several WRIA 17 watersheds. The Quilcene Run is one of six core stocks that make up the Hood Canal summer 2 chum salmon population as identified by the Puget Sound Technical Recovery 3 Team (PSTRT) (Currens 2004). They begin their upstream migration between mid to late August through mid-October with fry emergence toward the end of March through the end of April, depending on water temperatures. They are of native stock origin and managed for wild production (WDFW and WWTribes 1994; Ames et al 2000).The abundance of chum salmonin Puget Sound tends to fluctuate naturally during even/odd cycles, suggesting a possible competitive interaction with pink salmon in estuary or nearshore habitats (Salo 1991 in McHenry and Lichatowich 1996).

4.2.2 Use of the Action Area

Summer Chum populations in Quilcene Bay are managed as a single native stock of composite production. Similar to Chinook salmon, Summer Chum use the action area for rearing, foraging, and migrating. They remain in the estuary and nearshore environments, feeding primarily on copepods, tunicates and euphausiids, prior to migrating out to the ocean (WCCC - Correa, 2002). Chum return to freshwater in three to five years to spawn and tend to be group spawners with each female accompanied by one or more males. Summer Chum do not typically frequent nearshore areas, although there could be both spawning migrations and out-migrating juveniles within the action area from August through May.

4.2.3 Effects of the Action

There would be no risk of adverse impact to Summer Chum during construction because fabrication of mussel raft parts will occur on land, and assembly of the rafts will occur on the beach at the Coast Seafoods parking and cultch washing upland area.

There would be no measureable risk of adverse effects to Summer Chum or their proposed critical habitat. Changes associated with the proposed mussel raft would not significantly affect the PCEs for Summer Chum, including water quality, prey items, or nearshore areas free of obstruction.

4.2.4 Effect Determination

Based on the analysis discussed in Section 3.0 above, and the implementation of the proposed project conservation measures, effects to Summer Chum are expected to be insignificant and discountable. Summer Chum may be present in the action area, but the proposed project will not affect their migration, health, or forage habitat. Therefore, this BE reaches the conclusion that the proposed action **may affect, not likely to adversely affect** Summer Chum and their proposed critical habitat.

4.3 Steelhead Trout

4.3.1 Stock Status and Critical Habitat

Steelhead trout (*O. mykiss*) have been documented as using all the streams entering Quilcene and Dabob Bays and are combined into one stock. They spawn between mid-February and the beginning of June (WDFW and WWTribes 1994). Washington Department of Fish and Wildlife has been monitoring winter steelhead in the Little Quilcene River since 1999. An escapement goal has not been set. The status is Unknown, both in SASSI and .SaSI origin of this stock is unresolved (Thom Johnson, contribution to SaSI in review, 2002).
Steelhead trout critical habitat has not been designated, but is proposed to be the same PCEs as Chinook salmon and within the same locations.

4.3.2 Use of the Action Area

Steelhead trout use the action area for rearing, foraging, and migrating. Steelhead do not typically frequent nearshore areas (Busby et al. 1996; Shreffler and Moursund 1999), although there could be both spawning migrations and out-migrating juveniles within the action area from October through May (PSSTRT 2013).

4.3.3 Effects of the Action

There would be no risk of adverse impact to Puget Sound steelhead trout during construction because fabrication of mussel raft parts will occur on land, and assembly of the rafts will occur on the beach at the Coast Seafoods parking and cultch washing upland area.

There would be no measureable risk of adverse effects to steelhead or their proposed critical habitat. Changes associated with the proposed mussel raft would not significantly affect the PCEs for steelhead, including water quality, prey items, or nearshore areas free of obstruction.

4.3.4 Effect Determination

Based on the analysis discussed in Section 3.0 above, and the implementation of the proposed project conservation measures, effects to steelhead trout are expected to be insignificant and discountable. Steelhead may be present in the action area, but the proposed project will not affect their migration, health, or forage habitat. Therefore, this BE reaches the conclusion that the proposed action **may affect, not likely to adversely affect** steelhead and their proposed critical habitat.

4.4 Bull Trout

4.4.1 Stock Status and Critical Habitat

Bull trout (*Salvelinus confluentus*) have not been documented as using tributaries to Quilcene Bay (WDFW 2014b).

While bull trout critical habitat has been designated, no critical habitat for bull trout has been designated in Quilcene Bay.

4.4.2 Use of the Action Area

The southernmost population of bull trout in Puget Sound is found in the Puyallup River, but there is little to no information for bull trout south of the Nisqually River or near the Kitsap Peninsula (USFWS 2009a). Because bull trout are not known to occur near Quilcene Bay, it is unlikely that either juveniles or adults use the nearshore habitat associated with the proposed project. However, Puget Sound is generally used as a migration corridor or foraging area, and anadromous bull trout occupy territories ranging from about 33 ft to 2 miles and within 328 to 1,312 ft of the shoreline. Migration provides access

to more abundant or larger prey and possible overwintering options (Brenkman and Corbett 2005). Therefore, there is potential for bull trout to be distributed into Quilcene Bay for foraging. The majority of bull trout tend to migrate into marine waters in the spring and return to the rivers in the summer and fall (USFWS 2004), with a few fish overwintering in marine waters (Goetz et al. 2003).

Because the project action area is not within designated bull trout critical habitat (70 FR 56212) and there are no known runs of bull trout to tributaries of Quilcene Bay (USFWS 2009a), the use of the action area by bull trout is limited to rare foraging.

4.4.3 Effects of the Action

There would be little risk of adverse impact to bull trout during construction because fabrication of mussel raft parts will occur on land, and assembly of the rafts will occur on the beach at the Coast Seafoods parking and cultch washing upland area.

There would be no measurable risk of significant adverse operational impacts to bull trout because this species rarely, if ever, occurs in Quilcene Bay. According to the USFWS (2009a), existing mussel raft culture activities are identified as those with potential effects that are expected to be insignificant (immeasurable) or discountable (extremely unlikely to occur) for bull trout.

4.4.4 Effect Determination

Based on the analysis discussed in Section 3.0 above, and the implementation of the proposed project conservation measures, effects to bull trout are expected to be insignificant and discountable. Bull trout may be present in the action area, even if their presence is considered rare. Therefore, this BE reaches the conclusion that the proposed action **may affect, not likely to adversely affect** bull trout and would have **no effect** on critical habitat.

4.5 Eulachon

4.5.1 Stock Status and Critical Habitat

Eulachon (*Thaleichthys pacificus*) abundance exhibits considerable year-to-year variability (Hay and Beacham 2005). However, nearly all spawning runs from California to southeastern Alaska have declined in the past 20 years, especially since the mid-1990s. From 1938 to 1992, the median commercial catch of eulachon in the Columbia River was approximately 2 million pounds (900,000 kg) but from 1993 to 2006, the median catch had declined to approximately 43,000 pounds (19,500 kg), representing a nearly 98 percent reduction in catch from the prior period. Eulachon returns in the Fraser River and other British Columbia rivers similarly suffered severe declines in the mid-1990s and, despite increased returns during 2001 to 2003, presently remain at very low levels (NMFS 2014a).

While eulachon critical habitat has been designated, no critical habitat for eulachon has been designated in Quilcene Bay (NMFS 2014a).

4.5.2 Use of the Action Area

The closest populations of eulachon to Puget Sound are in the Elwha River (Shaffer et al. 2007), a tributary to Strait of Juan de Fuca. Since eulachon are not expected to make long spawning migrations, it is unlikely that they would be present within South Puget Sound. In a response to comments for the final determination to list the southern DPS of eulachon as a threatened species (75 FR 13012), NMFS stated that they found no record of eulachon spawning stocks in rivers draining into Puget Sound, and information on the spatial distribution of the species provided by WDFW revealed no evidence of eulachon spawning in Puget Sound now or in the past.

Because the project action area is not within designated eulachon critical habitat (50 CFR 226.222) and there are no known runs of eulachon to tributaries of Quilcene Bay (NMFS 2014a), the use of the action area by eulachon is limited to rare foraging.

4.5.3 Effects of the Action

There would be little risk of adverse impact to eulachon during construction because fabrication of mussel raft parts will occur on land, and assembly of the rafts will occur on the beach at the Coast Seafoods parking and cultch washing upland area.

There would be no measureable risk of adverse effects to eulachon because their occurrence in Quilcene Bay is rare. In addition, changes associated with the proposed mussel raft would not significantly affect water quality, prey items, or nearshore areas free of obstruction.

4.5.4 Effect Determination

Based on the analysis discussed in Section 3.0 above, and the implementation of the proposed project conservation measures, effects to eulachon are expected to be insignificant and discountable. Eulachon may be present in the action area, even if their presence is considered rare. Therefore, this BE reaches the conclusion that the proposed action **may affect, not likely to adversely affect** eulachon and would have **no effect** on critical habitat.

4.6 Green Sturgeon

4.6.1 Stock Status and Critical Habitat

Green sturgeon (*Acipenser medirostris*) are long-lived, slow-growing anadromous fish. There is no good data on current stock status of green sturgeon and data on population trends is lacking (NMFS 2014b).

While green sturgeon critical habitat has been designated, no critical habitat for green sturgeon has been designated in Quilcene Bay (50 CFR 226.219; NMFS 2014b).

4.6.2 Use of the Action Area

Green sturgeon utilize both freshwater and saltwater habitat. Adults live in oceanic waters, bays, and estuaries when not spawning. Green sturgeon are known to forage in estuaries and bays ranging from San Francisco Bay to British Columbia. Although spawning does not occur in Quilcene Bay or its tributaries (NMFS 2014b), green sturgeon may forage in Quilcene Bay.

4.6.3 Effects of the Action

There would be little risk of adverse impact to green sturgeon during construction because fabrication of mussel raft parts will occur on land, and assembly of the rafts will occur on the beach at the Coast Seafoods parking and cultch washing upland area.

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There would be no measureable risk of adverse effects to green sturgeon because their occurrence in Quilcene Bay is rare. In addition, changes associated with the proposed mussel raft would not significantly affect water quality, prey items, or nearshore areas free of obstruction.

4.6.4 Effect Determination

Based on the analysis discussed in Section 3.0 above, and the implementation of the proposed project conservation measures, effects to green sturgeon are expected to be insignificant and discountable. Green sturgeon may be present in the action area, even if their presence is considered rare. Therefore, this BE reaches the conclusion that the proposed action **may affect, not likely to adversely affect** green sturgeon and would have **no effect** on critical habitat.

4.7 Puget Sound Rockfish (Bocaccio, Canary Rockfish and Yelloweye Rockfish)

4.7.1 Population Status and Critical Habitat

Recreational catch and effort data spanning 12 years from the mid-1970s to mid-1990s suggests possible declines of bocaccio (*Sebastes paucispinis*), canary rockfish (*S. pinniger*), and yelloweye rockfish (*S. ruberrimus*) in abundance in Washington (Palsson et al. 2009). While catch data are generally constant over time, the number of angler trips increased substantially, and there was a decline in the average number of rockfish caught per trip. Taken together, these data suggest declines in the population over time.

Critical habitat for the three ESA-listed rockfish was designated on November 13, 2014 (79 FR 68042), although it will not take effect until February 11, 2015. The listing included 75.3 square miles (mi^2) of nearshore habitat in South Puget Sound for juvenile canary rockfish and bocaccio, and 27.1 mi^2 of deepwater habitat for adults and juveniles of all three species. Juvenile settlement habitats located in the nearshore with substrates such as sand, rock and/or cobble compositions that also support kelp (families Chordaceae, Alariaceae, Lessoniacea, Costariaceae, and Laminaricea) are essential for

conservation because these features enable forage opportunities and refuge from predators and enable behavioral and physiological changes needed for juveniles to occupy deeper adult habitats. Adult habitat includes sites that are deeper than 98 ft that possess or are adjacent to areas of complex bathymetry consisting of rock and or highly rugose habitat. The attributes that are included in the critical habitat include: (1) quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and (2) water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities.

Critical habitat for the three adult rockfish species, and juvenile canary rockfish and bocaccio overlap with the proposed North Totten Inlet Mussel Raft (ERMA 2014).

4.7.2 Use of the Action Area

Adult habitat for the three ESA-listed rockfish primarily includes deepwater (>151 ft) rocky substrates and shallow eelgrass and kelp beds for juveniles (BRT 2009). All three species have been observed within shallower depths and non-rocky substrates such as sand, mud, and other unconsolidated sediments (Miller and Borton 1980), although only juvenile bocaccio and canary rockfish are recognized as utilizing nearshore habitat (Love et al. 1991). Use of the nearshore is primarily in areas with rock or cobble composition and/or kelp species.

The project area substrate is fine to coarse grained with cobble, but no kelp species below the raft area. Habitat is not present for adult or juvenile ESA-listed rockfish species in the action area . Overall, adult use of the project area is unlikely. Bocaccio and rockfish juvenile use is possible, although also considered rare.

4.7.3 Effects of the Action

There would be little risk of adverse impact to the three ESA listed rockfish species during construction because fabrication of mussel raft parts will occur on land, and assembly of the rafts will occur on the beach at the Coast Seafoods parking and cultch washing upland area.

There would be no measureable risk of adverse effects to the three ESA-listed rockfish species because their occurrence in Quilcene Bay is rare. In addition, changes associated with the proposed new mussel rafts would not significantly affect water quality, prey items, or nearshore areas free of obstruction.

4.7.4 Effect Determination

Based on the analysis discussed in Section 3.0 above, and the implementation of the proposed project conservation measures, effects to bocaccio, canary, and yelloweye rockfish are expected to be insignificant and discountable. The three ESA-listed rockfish species may be in the action area, even if their presence is considered rare. Therefore, this BE reaches the conclusion that the proposed action

may affect, not likely to adversely affect bocaccio, canary, and yelloweye rockfish and their critical habitat.

4.8 Marbled Murrelet

4.8.1 Population Status and Critical Habitat

The 2013 estimated population size of marbled murrelets (*Brachyramphus marmoratus*) in the Pacific Northwest (Washington, Oregon, and northern California) was estimated at about 19,617 birds, with a population estimate for Puget Sound and the Strait of Juan de Fuca at 4,395 birds (WDFW 2014c).

Critical habitat has been designated by USFWS, but there is no critical habitat within the action area.

4.8.2 Use of the Action Area

Marbled murrelets are year-round residents in coastal marine waters and embayments. Murrelets feed near the surface or dive in pursuit of small fish and invertebrates in relatively shallow marine waters (generally less than 98 ft deep) typically within 5 miles from the shore (Huff et al. 2006; Raphael et al. 2007). Murrelets forage both during the day and at night, and may exhibit bi-modal foraging behavior, which means that they follow the daily vertical migrations of prey, which are at shallower depths at night and deeper during the day. According to the USFWS (1997), the diet of the marbled murrelet varies based on prey availability, but typically includes the three main forage fish species found in the Puget Sound, as well as, northern anchovy (*Engraulis mordax*), capelin (*Mallotus villosus*), Pacific sardine (*Sardinops sagax*), and juvenile rockfishes (*Sebastes* sp.). The main invertebrate prey includes squid (*Loligo* sp.), euphausids, mysid shrimp, and large pelagic amphipods. Becker et al. (2007) reported that reproductive success in California populations was strongly correlated with the abundance of mid-trophic level prey (e.g., sand lance, juvenile rockfish) during the breeding and post-breeding seasons.

Marbled murrelets are known to use North Hood Canal , however with the exception of proximity to nesting sites and direct human footprint, none of the marine variables measured appear to be strongly correlated with murrelet abundance (General Technical Report PNW-GTR-933). In the event marbled murrelets are present in the action area, their use of the action area is likely limited to "fly-overs" and perhaps foraging.

4.8.3 Effects of the Action

There would be little risk of adverse impact to birds during construction because fabrication of mussel raft parts will occur on land, and assembly of the rafts will occur on the beach at the Coast Seafoods parking and cultch washing upland area. Noise from hand tools and disturbance from human activity is expected to be temporary, occasional, and minor.

Operation of the proposed mussel farm is not expected to have an adverse impact on marbled murrelets. Predator exclusion nets around the rafts will have small mesh and will be kept taut and without loose edges that could trap diving birds.

According to the USFWS (2009a), existing mussel raft culture activities were identified as having insignificant (immeasurable) or discountable (extremely unlikely to occur) effects to marbled murrelets.

4.8.4 Effect Determination

Based on the analysis discussed in Section 3.0 above, and the implementation of the proposed project conservation measures, effects to marbled murrelets are expected to be insignificant and discountable. Therefore, this BE reaches the conclusion that the proposed action **may affect, not likely to adversely affect** marbled murrelets and would have **no effect** on critical habitat.

4.9 Southern Resident Killer Whale

4.9.1 Population Status and Critical Habitat

The number of killer whales (*Orcinus orca*) in Puget Sound has never been large, perhaps numbering between 100 and 200 before 1960 (NMFS 2014c). The peak abundance in recent years occurred in 1996, when 97 whales were counted, while the current estimate is 78 individuals (Center for Whale Research 2017).

SRKW critical habitat has been designated in Washington, consisting of approximately 2,560 mi^2 of the inland waterways (71 FR 69054). The shallow waters of Puget Sound (waters less than 20 ft deep relative to extreme high water) are not considered to be within the geographical area occupied by the species. Because the proposed mussel raft would be located in waters between -45 ft and -95 ft MLLW, it would overlap with SRKW critical habitat.

4.9.2 Use of the Action Area

Killer whales that migrate into Puget Sound typically go as far south as the Nisqually River (Wiles 2004). Palo (1972 *as cited in* NMFS 2008) commented that SKRW traveled to South Puget Sound most often during the fall and winter, following the salmon and herring runs, but only noted McNeil Island and Carr Inlet as the farthest southwest destination. It was further commented by Osborne (1999 *as cited in* Wiles 2004) that in recent years, early autumn is the only time of year that K and L pods regularly occur in the Sound. In contrast, transient orcas are more unpredictable in their movements than residents. According to Wiles (2004), most sightings of transients in Washington occur in the summer and early fall, with a smaller number of sightings continuing throughout the year. Use of Quilcene Bay by SRKW is unknown, but is likely to be rare since Quilcene Bay is a confined bay at the northern end of Hood Canal and they have not been seen in Quilcene Bay in recent decades.

4.9.3 Effects of the Action

There would be little risk of adverse impact to SRKW during construction because fabrication of mussel raft parts will occur on land, and assembly of the rafts will occur on the beach at the Coast Seafoods parking and cultch washing upland area..

Noise from hand tools and disturbance from human activity is expected to be temporary, occasional, and minor.

The rafts would be sited and configured to minimize effects on marine mammals. During maintenance and harvest operations, due care will be taken to minimize disturbance of SRKW, in compliance with the Federal Marine Mammal Protection Act.

Noise generated by marine vessels, hand tools, and disturbance associated with human maintenance and harvesting activities is expected to be similar to baseline activities at existing mussel farms in Quilcene Bay and Penn Cove. If present, SRKW may avoid the area temporarily,but they would be expected to return when human disturbances cease. Significant adverse impacts are not likely to occur to SRKW as a result of implementation of the proposed action.

4.9.4 Effect Determination

Based on the analysis discussed in Section 3.0 above, and the implementation of the proposed project conservation measures, effects to SRKW are expected to be insignificant and discountable. Therefore, this BE reaches the conclusion that the proposed action **may affect, not likely to adversely affect** SRKW and their critical habitat.

5.0 INTERRELATED AND INTERDEPENDENT ACTIONS AND CUMULATIVE EFFECTS

Cumulative effects are effects from state agency or private activities that are reasonably certain to occur within the area of the federal action subject to consultation (50 CFR 402.02 Definitions). Federal actions unrelated to the proposed action are not considered in this section, because they require separate consultation pursuant to Section 7 of the Endangered Species Act. Interdependent actions are from actions with no independent utility apart from the proposed action. Interrelated actions include those that are part of a larger action and depend on the larger action for justification. No interrelated or interdependent actions or cumulative effects are expected to occur that may adversely affect a listed, proposed, or candidate species in the action area.

6.0 SUMMARY

The proposed action has the potential to adversely affect listed species or their habitat. Construction could temporarily increase noise and possibly causes listed species to avoid the immediate work area, but these effects would be temporary, occasional, and minor. Operation could affect water quality (nitrogen concentrations) and benthic epifauna, but the affect is expected to be insignificant. Best management practices and raft design and placement would be used to reduce impacts. Therefore, this BE reaches the following conclusions:

- **May affect, not likely to adversely affect** Puget Sound Chinook salmon or their critical habitat;
- **May affect, not likely to adversely affect** Steelhead trout or their proposed critical habitat;
- **May affect, not likely to adversely affect** Summer Run Chum salmon or their critical habitat;

- **May affect, not likely to adversely affect** bull trout and will have **no effect** on their critical habitat;
- **May affect, not likely to adversely affect** bocaccio, canary, and yelloweye rockfish or their proposed critical habitat;
- **May affect, not likely to adversely affect** marbled murrelet and will have **no effect** on their critical habitat; and
- **May affect, not likely to adversely affect** SRKW or their critical habitat.

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Figures

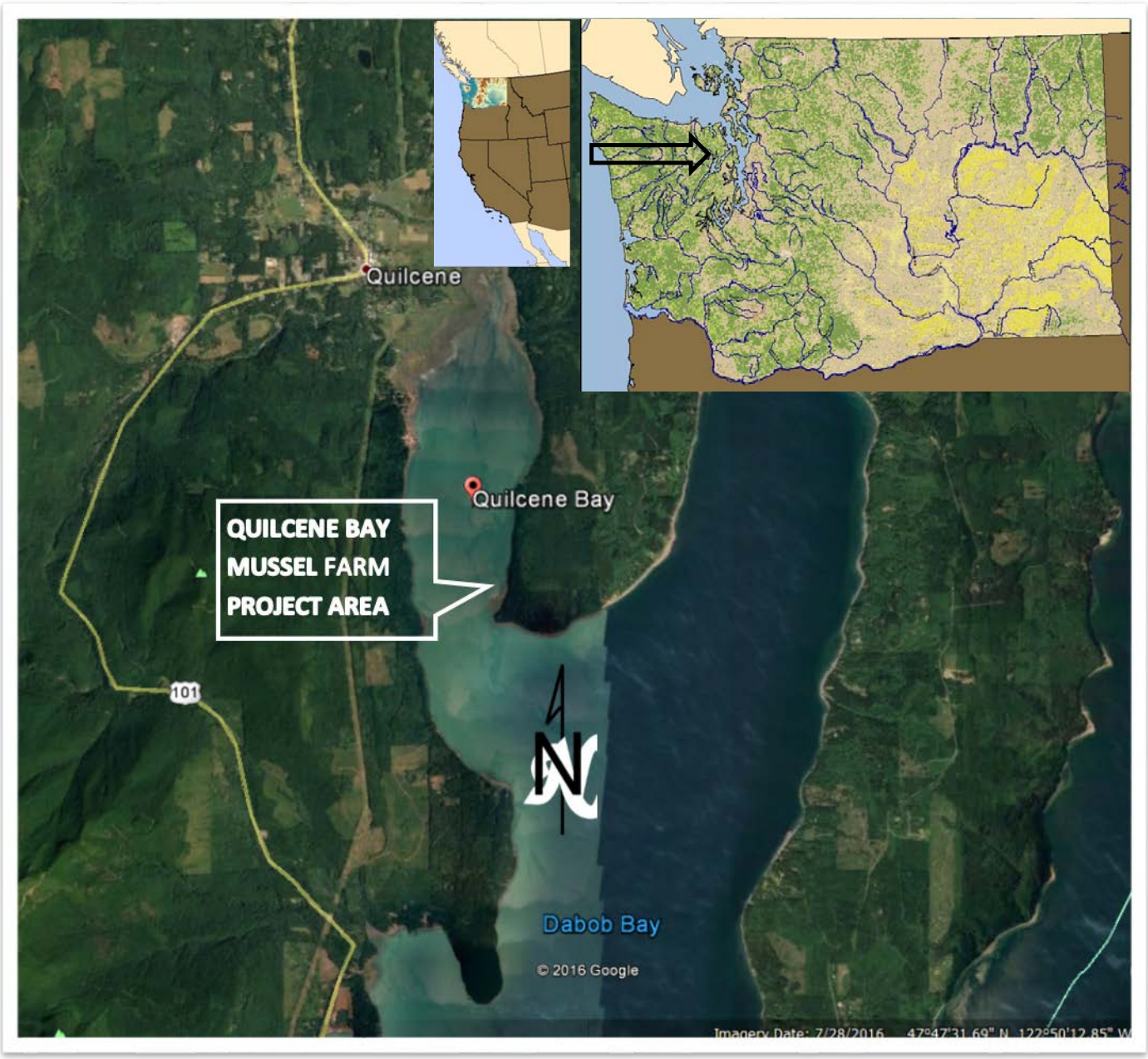


FIGURE 1

Project Vicinity Map

Quilcene Bay Mussel Farm BE

Quilcene Bay, Washington
for Penn Cove Shellfish
Source: Google Maps

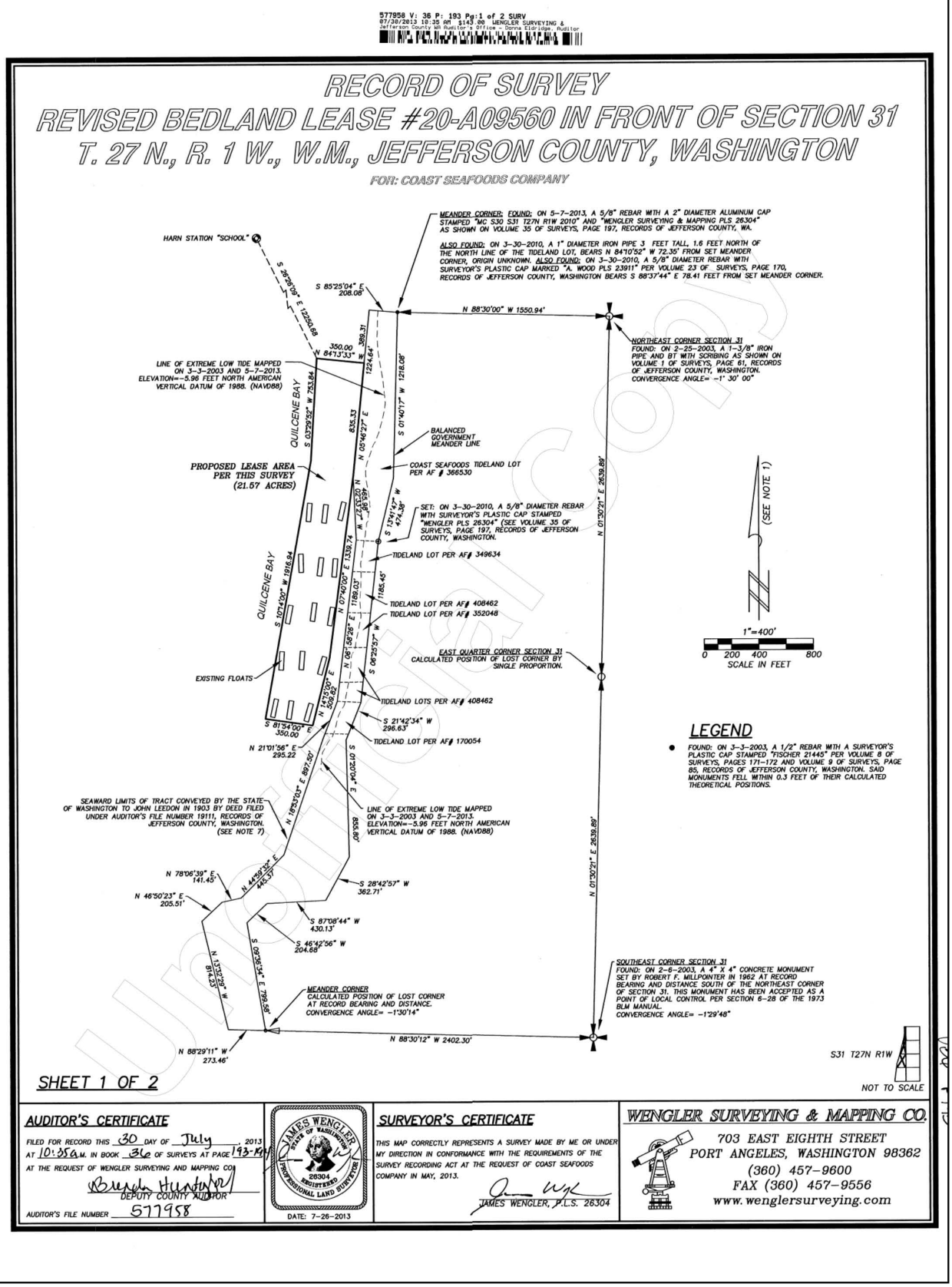


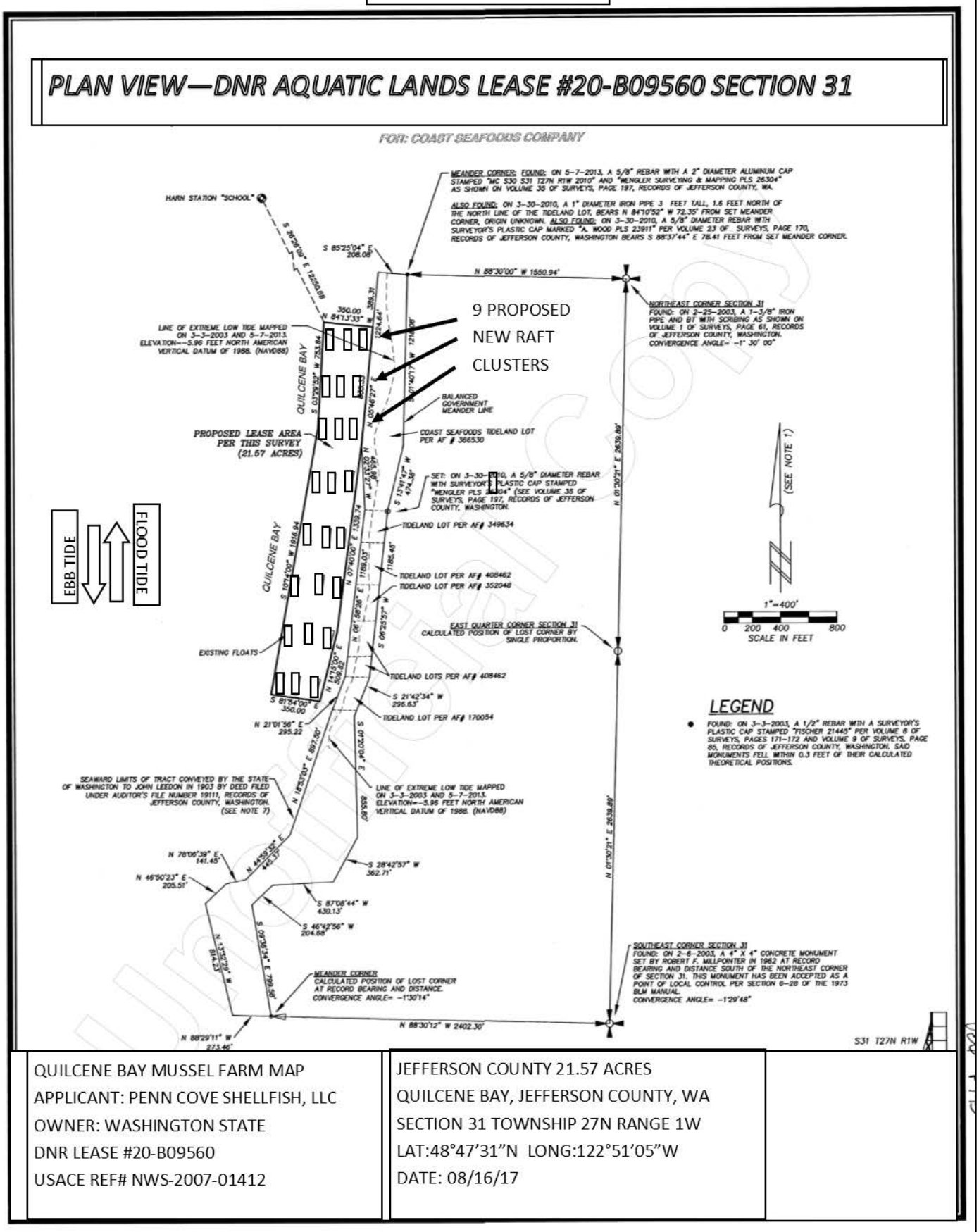
FIGURE 2

Pre-Project Site Survey Map

Quilcene Bay Mussel Farm BE

Quilcene Bay, Washington
for Penn Cove Shellfish

PLAN VIEW



QUILCENE BAY MUSSEL FARM MAP APPLICANT: PENN COVE SHELLFISH, LLC OWNER: WASHINGTON STATE DNR LEASE #20-B09560 USACE REF# NWS-2007-01412	JEFFERSON COUNTY 21.57 ACRES QUILCENE BAY, JEFFERSON COUNTY, WA SECTION 31 TOWNSHIP 27N RANGE 1W LAT:48°47'31"N LONG:122°51'05"W DATE: 08/16/17

FIGURE 3

Post Project Comparison Survey Depiction

Quilcene Bay Mussel Farm BE

Quilcene Bay, Washington
for Penn Cove Shellfish

FIGURE 4

Pre-Project and Post Project Comparison

Quilcene Bay Mussel Farm BE

Quilcene Bay, Washington
for Penn Cove Shellfish

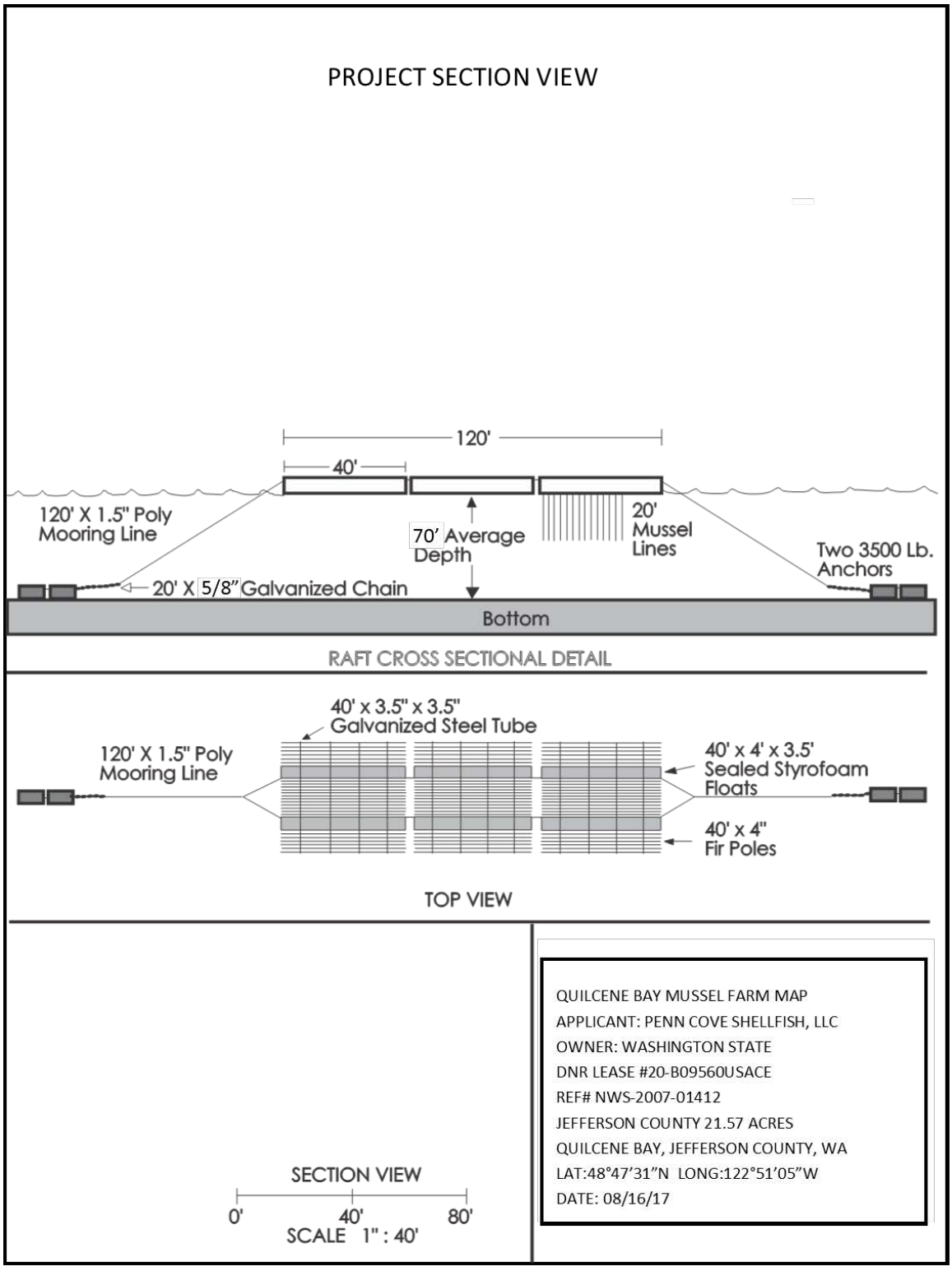


FIGURE 5 - **Principle Features of Floating Raft Clusters**

Quilcene Bay Mussel Farm BE
Quilcene Bay, Washington
for Penn Cove Shellfish

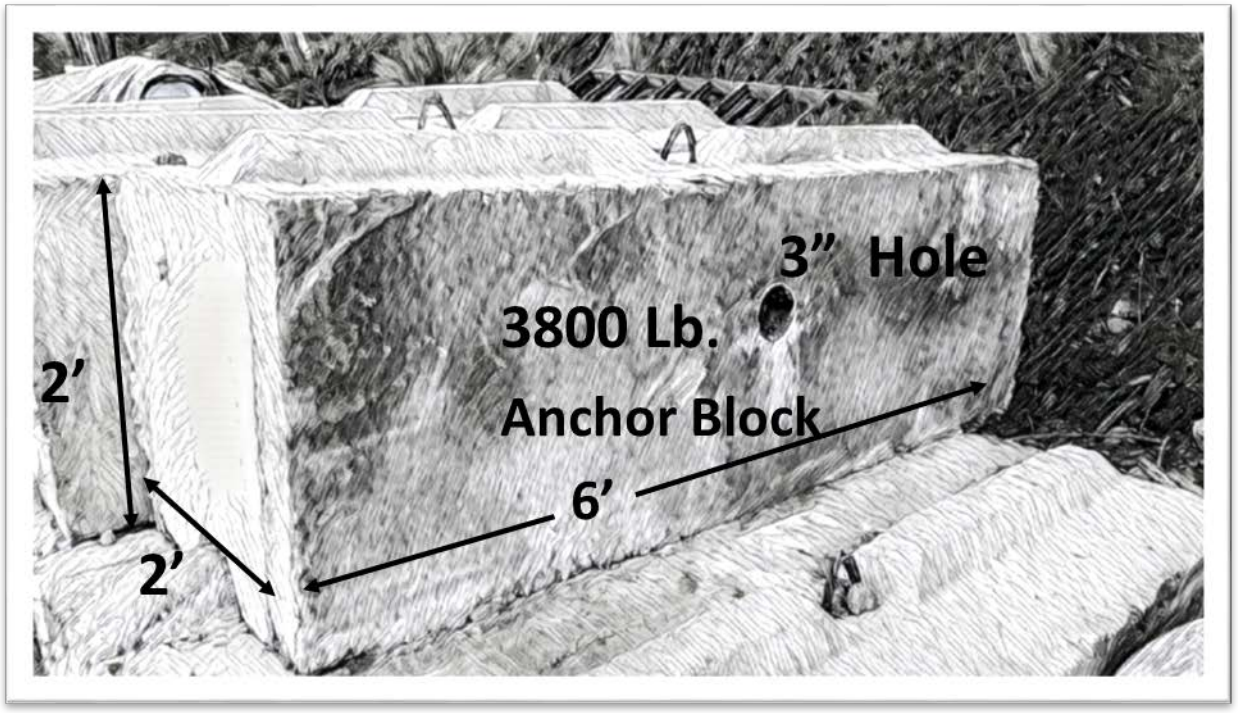
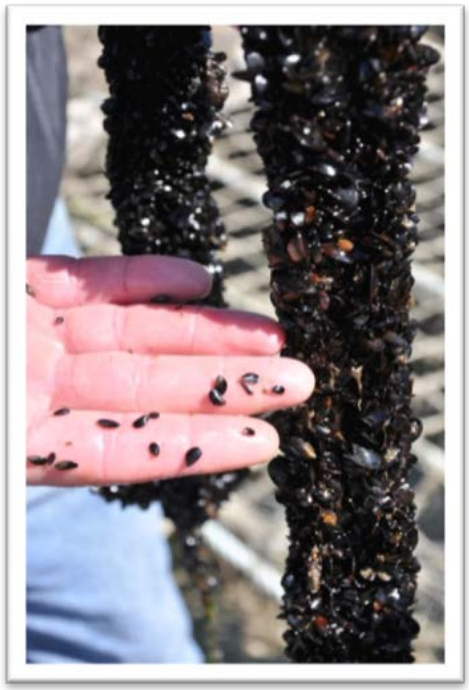


FIGURE 6 - Typical Anchor Block

Quilcene Bay Mussel Farm BE
Quilcene Bay, Washington
for Penn Cove Shellfish
Source: Google Maps



Mussel Set

Mature Mussels

FIGURE 7

Examples of Mussels on Grow-out Lines

Quilcene Bay Mussel Farm BE

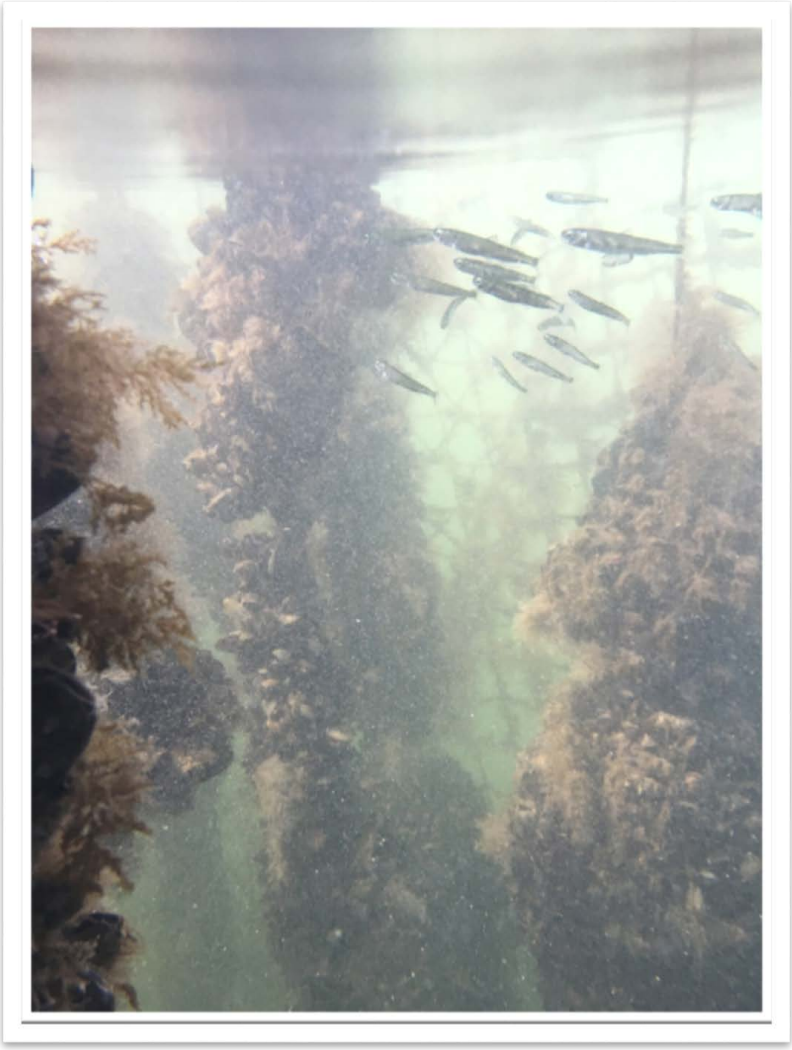
Quilcene Bay, Washington

Penn Cove Shellfish

FIGURE 8 - **Project Action Area**

Quilcene Bay Mussel Farm BE
Quilcene Bay, Washington
for Penn Cove Shellfish
Source: Google Maps

Oyster Catchers Roost on Mussel Rafts

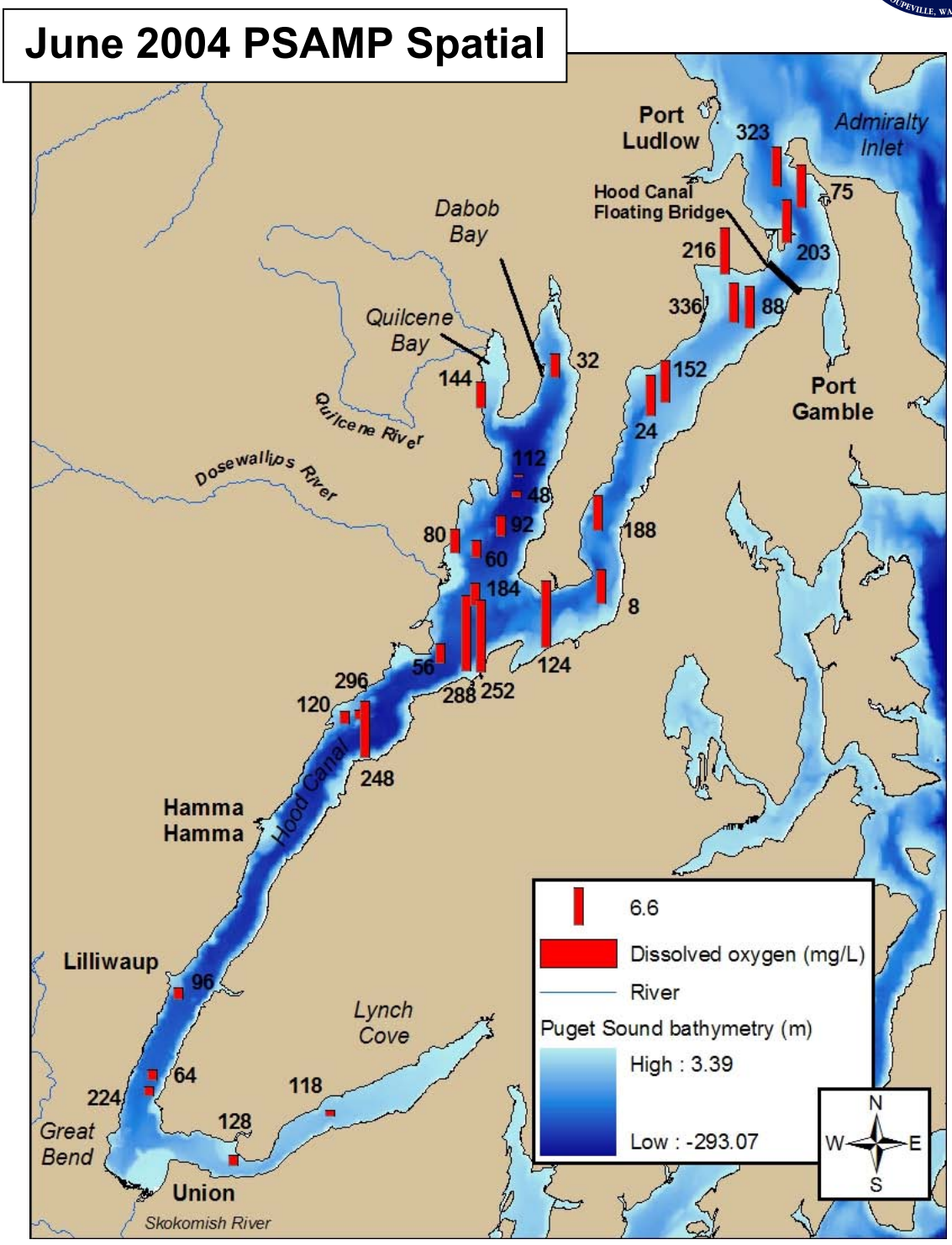


Chum Salmon Smolts Feeding Amongst Mussel Rafts

FIGURE 9

Typical Ecosystem Services of Mussel Rafts

Quilcene Bay Mussel Farm BE
Quilcene Bay, Washington
for Penn Cove Shellfish

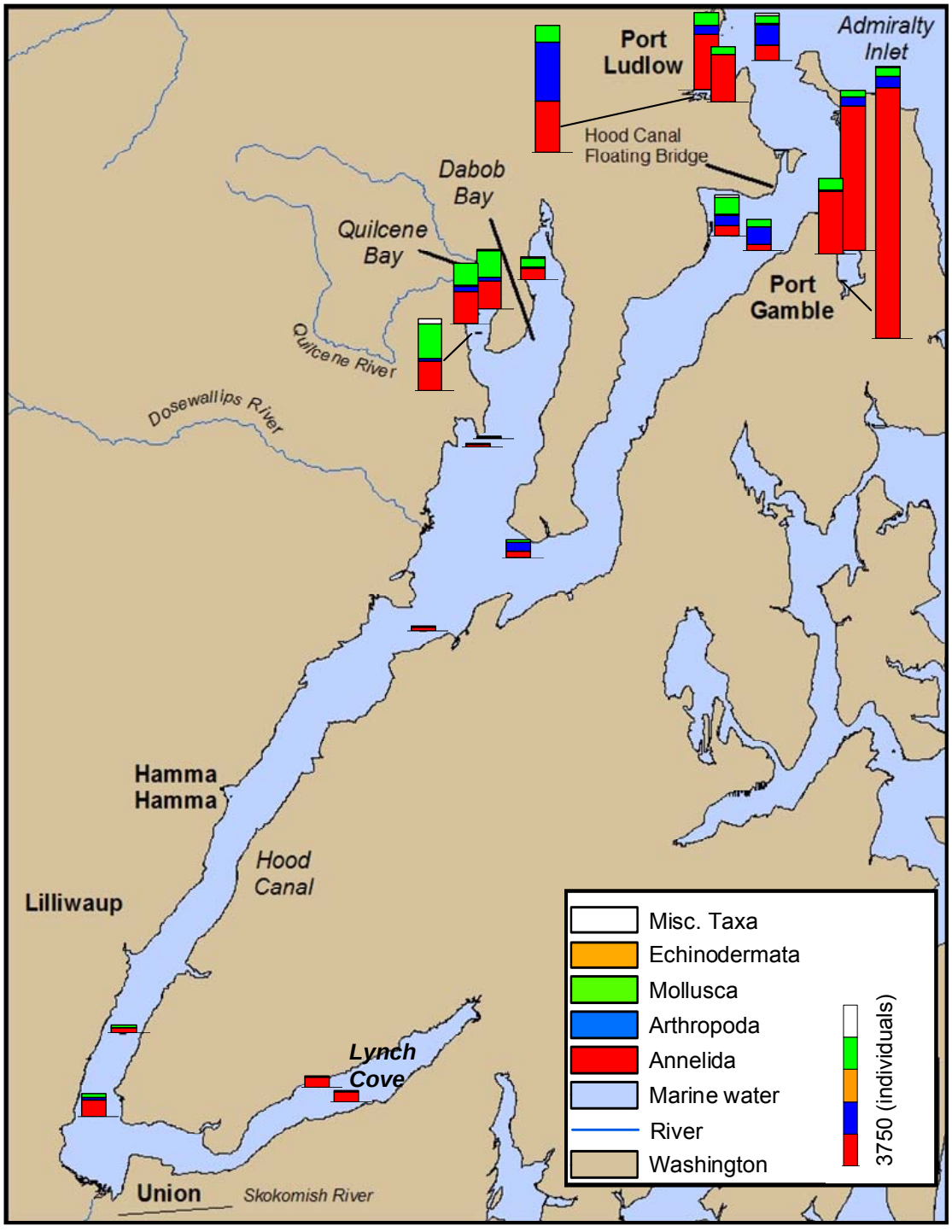


Dissolved oxygen concentrations measured during the June 2004 PSAMP Spatial Sediment Monitoring Program, and depth in meters relative to local extremely lower-low water (ELLW).

FIGURE 10

PSAMP Dissolved Oxygen Monitoring Concentrations

Quilcene Bay Mussel Farm BE
Quilcene Bay, Washington
Penn Cove Shellfish



Major taxa abundance measured at each station in Hood Canal for the 1999 PSAMP/NOAA Monitoring Program.

FIGURE 11

Major Taxa Abundance of Project Area

Quilcene Bay Mussel Farm BE
Quilcene Bay, Washington
for Penn Cove Shellfish

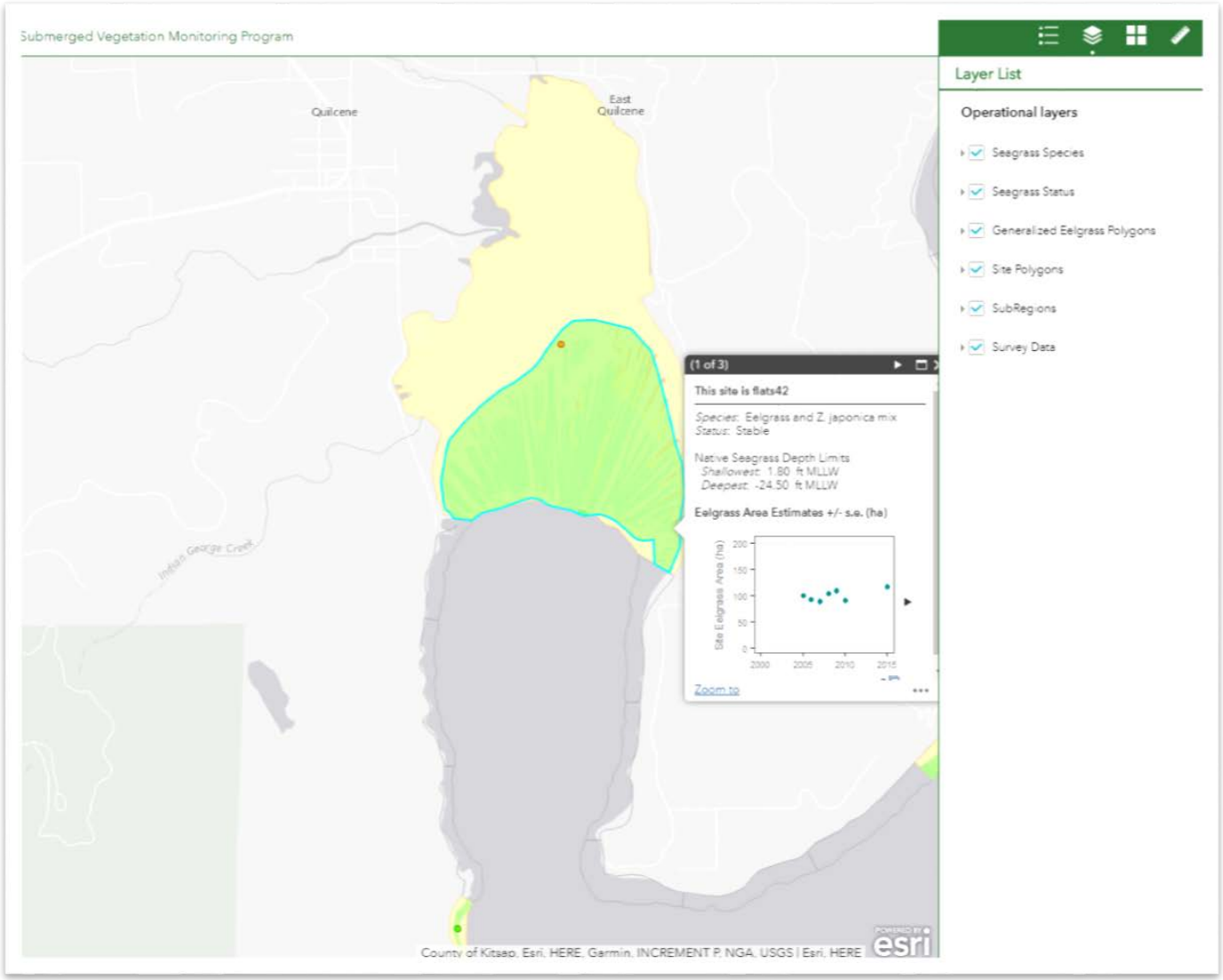


FIGURE 12

Submerged Vegetaion Map of Quilcene Bay

Quilcene Bay Mussel Farm BE

Quilcene Bay, Washington
for Penn Cove Shellfish
Source: Google Maps

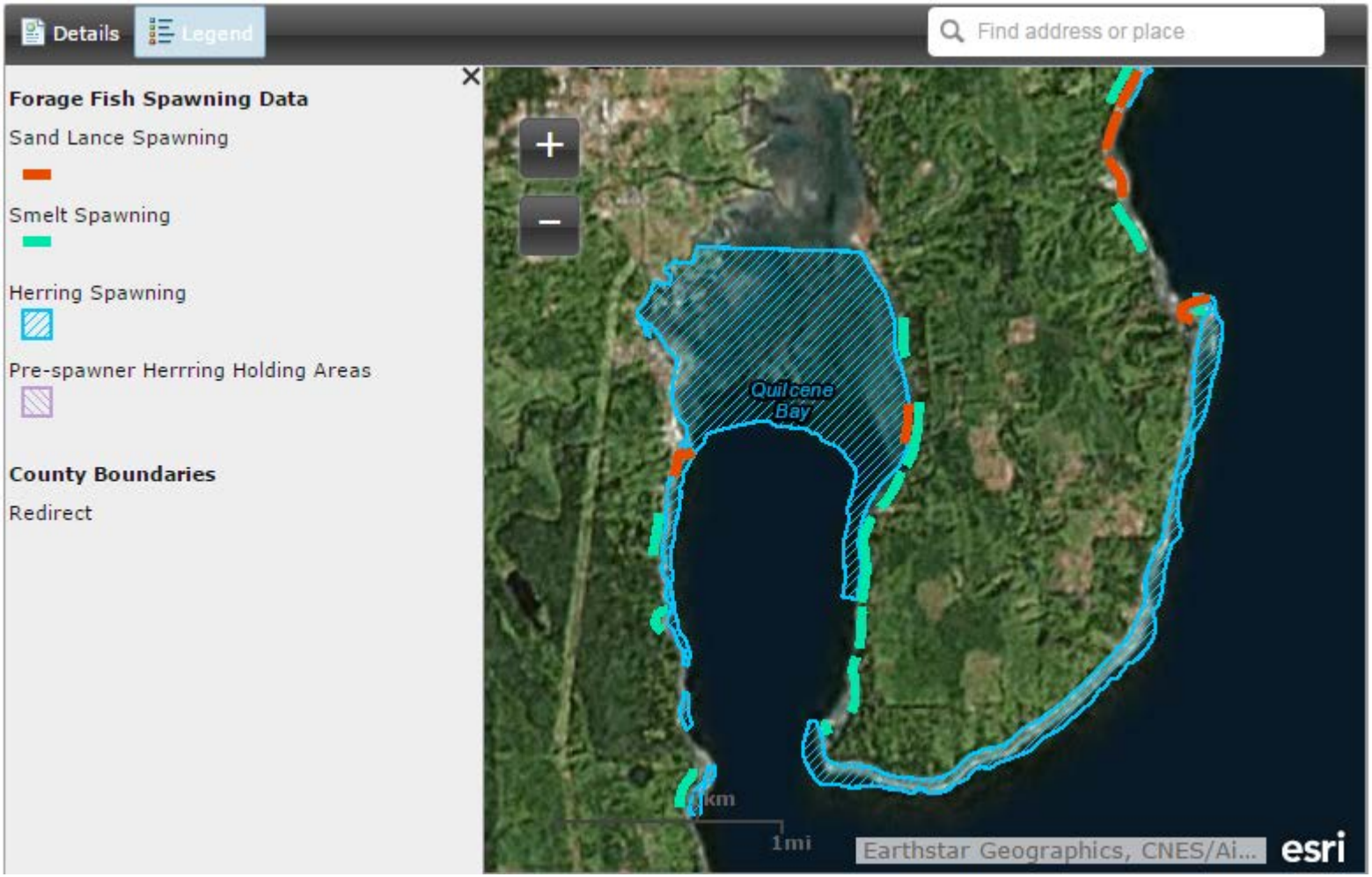


FIGURE 13

Documented Forage Fish Spawning of Quilcene Bay

Quilcene Bay Mussel Farm BE

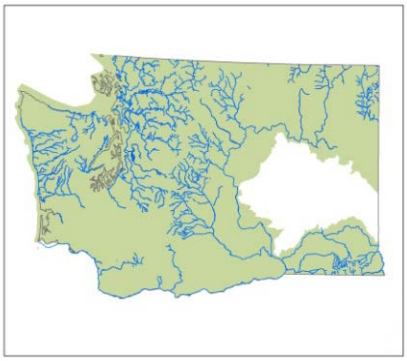
Quilcene Bay, Washington
for Penn Cove Shellfish
Source: WDFW 2014

Appendix A

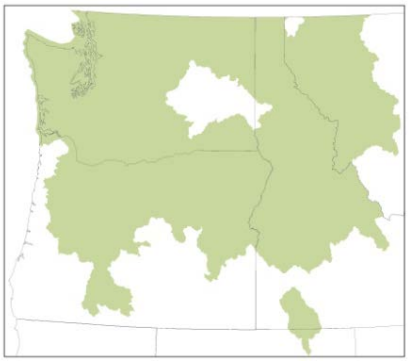
Agency Websites for ESA Species and Critical Habitat

Species Fact Sheet
Bull Trout
Salvelinus confluentus

Photo credit: R. Tabor, FWS



Washington



Conterminous United States

STATUS: THREATENED
CRITICAL HABITAT: DESIGNATED

Bull trout potentially occur in these Washington counties: Whatcom, Skagit, Snohomish, King, Pierce, Thurston, Lewis, Cowlitz, Clark, Skamania, Clallam, Jefferson, Mason, Grays Harbor, Pacific, Wahkiakum, San Juan, Island, Kitsap, Okanogan, Chelan, Kittitas, Yakima, Klickitat, Benton, Grant, Douglas, Walla Walla, Franklin, Lincoln, Ferry, Stevens, Pend Oreille, Spokane, Whitman, Columbia, Garfield, Asotin

(Maps may reflect historical as well as recent sightings)

In 1999, the populations of bull trout, *Salvelinus confluentus*, within the conterminous United States were federally listed as threatened by the U.S. Fish and Wildlife Service (Service). The most recent critical habitat designation was completed in 2010.

Current and Historical Status

Bull trout (*Salvelinus confluentus*, family Salmonidae) are char native to the Pacific Northwest and western Canada. The historical range of bull trout includes major river basins in the Pacific Northwest at about 41 to 60 degrees North latitude, from the southern limits in the McCloud River in northern California and the Jarbidge River in Nevada to the headwaters of the Yukon River in the Northwest Territories, Canada. To the west, the bull trout's current range includes Puget Sound, various coastal rivers of British Columbia, Canada, and southeast Alaska. Bull trout occur in portions of the Columbia River and tributaries within the basin, including its headwaters in Montana and Canada. Bull trout also occur in the Klamath River basin of south-central Oregon. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta and Montana and in the MacKenzie River system in Alberta and British Columbia, Canada.

Bull trout are believed to have declined throughout 50% of their range. There are nine major watersheds where bull trout have likely been extirpated: the Okanogan River, Lake Chelan, Satsop River, Lower Nisqually River, and White Salmon River in Washington; the Clackamas River (recently reintroduced here), Santiam River, and Upper Deschutes River in Oregon; and the McCloud River in northern California.

Description and Life History

Bull trout are a cold-water fish of relatively pristine stream and lake habitats in western North America. They are grouped with the char, within the salmonid family of fishes. Bull trout coloration ranges from green to greyish-blue (sometimes displaying silvery sides when in lakes and marine waters), and are spotted with pale yellowish to orange spots. The absence of black spots on the dorsal fin distinguishes bull trout from most other species of char and trout that are native to the Pacific Northwest.

Bull trout should not be confused with Dolly Varden (*Salvelinus malma*). Although they look very alike based on external similarity of appearance, morphological (form and structure) and genetic analyses have confirmed the distinctiveness of the two species in their different, but overlapping, geographic distributions. Both species occur together in western Washington, for example, with little or no interbreeding. Lastly, bull trout and Dolly Varden each appear to be more closely related genetically to other species of *Salvelinus* than they are to each other. The bull trout is most closely related to the Japanese white-spotted char (*S. leucomaenis*) whereas the Dolly Varden is most closely related to the Arctic char (*S. alpinus*).

The size and age of bull trout at maturity depends upon life history strategy. Resident fish tend to be smaller than migratory fish at maturity, and produce fewer eggs. Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years.

The life history of bull trout may be one of the most complex of any Pacific salmonid. Four general life-history forms of bull trout have been recognized:

- ***Nonmigratory or resident bull trout***. This life history form includes fish generally found in small streams and headwater tributaries. These non-migratory bull trout, in general, appear to grow more slowly than other life-history forms, are smaller at maturity, and generally do not live as long as migratory forms.

- ***Riverine or fluvial bull trout***. This freshwater life history form includes fish that migrate entirely within fresh water streams. This includes fish that overwinter and mature in large rivers or streams and then migrate to small tributaries to spawn.

- ***Lacustrine or adfluvial bull trout***. This freshwater life history form includes fish that overwinter and mature in large lakes or reservoirs and then migrate to small tributaries to spawn. These are typically the largest forms of bull trout, reaching sizes up to 30 lbs.

- ***Marine or amphidromous/anadromous bull trout***. This is the rarest life history form, and only occurs in western Washington within the coterminous United States. This includes fish that migrate out to marine nearshore waters and sometimes into other stream systems to overwinter and mature, returning to small tributaries in their natal watershed to spawn.

Bull trout typically spawn from late July to December, with peak spawning in September for most interior populations and late October for most coastal populations. The period of egg incubation to emergence of fry from their spawning gravels may take up to 210 days (7 months). Juvenile migratory bull trout rear one to four years in their natal stream before migrating either to a river, lake/reservoir, or nearshore marine area to mature. Resident and migratory forms or mixed migratory forms may all be found together, and either form may give rise to offspring exhibiting either resident or migratory behaviors.

Habitat

- Bull trout have some of the most specific habitat requirements of any salmonid, and these are often described as the "Four C's": **Cold, Clean, Complex and Connected habitat.**

- Bull trout require **colder water** temperature than most salmonids. Water temperature above 15 degrees Celsius (59 degrees Fahrenheit) is believed to limit bull trout distribution. They typically spawn in water temperatures below 9 degrees Celsius (48 degrees Fahrenheit).

- They require the **cleanest stream substrates** for spawning and rearing. Juvenile bull trout frequently use the spaces between cobble and boulders to shelter.

- They need **complex habitats,** including streams with riffles and deep pools, side channels, undercut banks, and lots of large instream wood/logs for shelter and foraging.

- They also rely on river, lake and ocean **habitats that connect** to headwater streams for annual spawning and feeding migrations. These annual migrations are necessary to complete their life history.

Reasons for Decline

The following activities or types of land use have contributed to the bull trout's decline: dams, forest management practices, livestock grazing, agricultural practices, transportation networks, mining, residential development and urbanization, fisheries management activities, and any of a host of general practices as well as some natural events (e.g., fire or flood under certain

circumstances) that may contribute to historical and current isolation and habitat fragmentation. Nonnative species, forest management practices, and fish passage issues are the top factors limiting bull trout populations at the range-wide level, both currently and historically.

Conservation Efforts

Areas of critical habitat have been designated within their range in the coterminous United States to protect habitat and promote the recovery of the species. Three separate draft bull trout recovery plans were completed between 2002 and 2004, first for the Columbia and Klamath region (U.S. Fish and Wildlife Service 2002) and then subsequently for the Coastal-Puget Sound region (U.S. Fish and Wildlife Service 2004a) and Jarbidge River region (U.S. Fish and Wildlife Service 2004b). None have been finalized. In 2008, a 5-year status review conducted by the Service concluded bull trout status was stable (status remained unchanged) range-wide, including some populations that were increasing and others that were decreasing in various parts of the range. Numerous conservation efforts (e.g., culvert replacements, fish passage improvements at dams, instream and riparian habitat restoration, nonnative fish suppression, improved forest management and livestock grazing practices) have occurred across their range since the time of listing which have resulted in significant improvements to bull trout habitat.

Beginning in 2010, the Service began to revise its recovery strategy for bull trout across the coterminous United States and anticipates issuing an updated draft recovery plan in 2012.

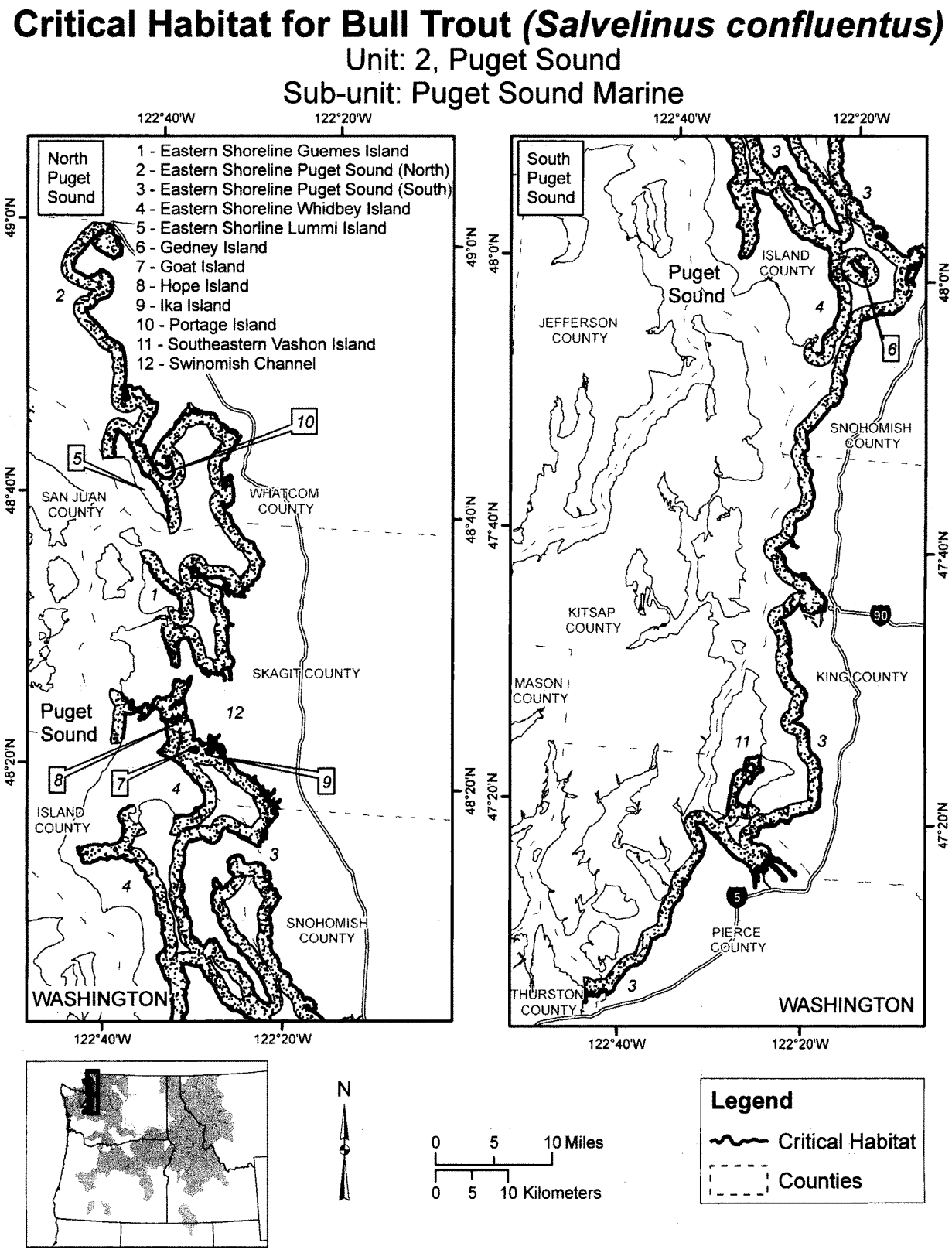
References and Links

Final Rule to List Bull Trout (November 1999)
Final Designation of Critical Habitat for Bull Trout (October 2010)
Bull Trout Critical Habitat Map for Washington State
Final Critical Habitat Designation - Unit Maps
5-Year Status Review for Bull Trout (April 2008)
Draft Bull Trout Recovery Plans (2002 and 2004)

(xiii) Puget Sound Marine Subunit.

(A) [Reserved for textual description of unit.]

(B) **Note:** Map of Critical Habitat for the bull trout (*Salvelinus confluentus*), Puget Sound Marine Subunit, follows:



Chinook Salmon *(Oncorhynchus tshawytscha)*

Status

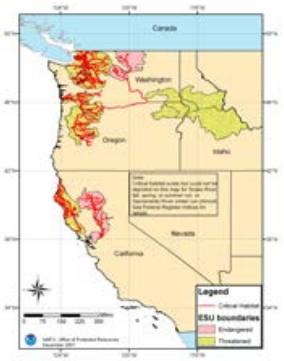
ESA Endangered - 2 ESUs
ESA Threatened - 7 ESUs
ESA Candidate Species - 1 ESU
ESA Species of Concern - 1 ESU

The Sacramento River winter-run chinook is one of NOAA Fisheries' Species in the Spotlight

- Sacramento River Winter-Run Chinook Salmon Spotlight Species 5-Year Action Plan
- West Coast Regional Office salmon management program
- Recovery plan for Central Valley salmon and steelhead trout
- Other NOAA Fisheries Species in the Spotlight

Chinook Salmon
(Oncorhynchus tshawytscha)
Photo: NOAA

Chinook Salmon Range Map
(click for larger view PDF)



Chinook Salmon Critical Habitat
(click for larger view PDF)

Species Description

Weight: 40 pounds (18 kg), but can be up to 120 pounds (55 kg)

Length: considered mature at about 3 feet (1 m)

Appearance: at sea, they are blue-green back with silver flanks

Lifespan: they spend 3 months-2 years in freshwater and about 2-4 years at sea

Diet: insects, amphipods, and other crustaceans while young, and mainly fish as adults

Behavior: adults migrate from a marine environment into the freshwater streams and rivers of their birth in order to mate (**"anadromous"**)

Chinook salmon are very similar to **coho salmon** in appearance while at sea (blue-green back with silver flanks), except for their large size, small black spots on both lobes of the tail, and black pigment along the base of the teeth.

Adults migrate from a marine environment into the freshwater streams and rivers of their birth in order to mate (called anadromy). They spawn only once and then die (called semelparity).

They feed on terrestrial and aquatic insects, amphipods, and other crustaceans while young, and primarily on other fishes when older.

Populations exhibit considerable variability in size and age of maturation, and at least some portion of this variation is genetically determined. There is a relationship between small size and long distance of migration that may also reflect the earlier timing of river entry and the cessation of feeding for Chinook salmon stocks that migrate to the upper reaches of river systems. Body size, which is related to age, may be an important factor in migration and spawning bed, or redd, construction success.

Juvenile Chinook may spend from 3 months to 2 years in freshwater before migrating to estuarine areas as smolts and then into the ocean to feed and mature. Chinook salmon remain at sea for 1 to 6 years (more commonly 2 to 4 years), with the exception of a small proportion of yearling males (called jack salmon) which mature in freshwater or return after 2 or 3 months in salt water.

There are different seasonal (i.e., spring, summer, fall, late-fall or winter) "runs" in the migration of Chinook salmon from the ocean to freshwater, even within a single river system. These runs have been identified on the basis of when adult Chinook salmon enter freshwater to begin their spawning migration. However, distinct runs also differ in the degree of maturation at the time of river entry, the temperature and flow characteristics of their spawning site, and their actual time of spawning. Freshwater entry and spawning timing are believed to be related to local temperature and water flow regimes.

Adult female Chinook will prepare a redd (or nest) in a stream area with suitable gravel type composition, water depth and velocity. The adult female Chinook may deposit eggs in 4 to 5 "nesting pockets" within a single redd. Spawning sites have larger gravel and more water flow up through the gravel than the sites used by other Pacific salmon. After laying eggs in a redd, adult Chinook will guard the redd from just a few days to nearly a month before dying.

Chinook salmon eggs will hatch, depending upon water temperatures, 3 to 5 months after deposition. Eggs are deposited at a time to ensure

Did You Know?

- The species name comes from the common name used among natives in Alaska and Siberia.
- Chinook salmon are the state fish of Alaska.
- King salmon is another name for this species because of their large size.

that young salmon fry emerge during the following spring when the river or estuary productivity is sufficient for juvenile survival and growth.

As the time for migration to the sea approaches, juveniles lose their parr marks, the pattern of vertical bars and spots useful for camouflage. They then gain the dark back and light belly coloration used by fish living in open water. Chinook salmon seek deeper water, avoid light, and their gills and kidneys begin to change so that they can process salt water.

Two distinct types or races among Chinook salmon have evolved.

One race, described as a "stream-type" Chinook, is found most commonly in headwater streams of large river systems. Stream-type Chinook salmon have a longer freshwater residency, and perform extensive offshore migrations in the central North Pacific before returning to their birth, or natal, streams in the spring or summer months. Stream-type juveniles are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. A stream-type life history may be adapted to areas that are more consistently productive and less susceptible to dramatic changes in water flow. At the time of saltwater entry, stream-type (yearling) smolts are much larger, averaging 3 to 5.25 inches (73-134 mm) depending on the river system, than their ocean-type (subyearling) counterparts, and are therefore able to move offshore relatively quickly.

The second race, called the "ocean-type" Chinook, is commonly found in coastal streams in North America. Ocean-type Chinook typically migrate to sea within the first three months of life, but they may spend up to a year in freshwater prior to emigration to the sea. They also spend their ocean life in coastal waters. Ocean-type Chinook salmon return to their natal streams or rivers as spring, winter, fall, summer, and late-fall runs, but summer and fall runs predominate. Ocean-type Chinook salmon tend to use estuaries and coastal areas more extensively than other pacific salmonids for juvenile rearing. The evolution of the ocean-type life history strategy may have been a response to the limited carrying capacity of smaller stream systems and unproductive watersheds, or a means of avoiding the impact of seasonal floods. Ocean-type Chinook salmon tend to migrate along the coast. Populations of Chinook salmon south of the Columbia River drainage appear to consist predominantly of ocean-type fish.

Chinook salmon are easily the largest of any salmon, with adults often exceeding 40 pounds (18 kg); individuals over 120 pounds (55 kg) have been reported. Chinook mature at about 36 inches and 30 pounds.

Habitat

Juvenile Chinook may spend from 3 months to 2 years in freshwater before migrating to estuarine areas as smolts and then into the ocean to feed and mature. They prefer streams that are deeper and larger than those used by other Pacific salmon species.

Critical habitat has been designated for the 9 ESA-listed Chinook salmon ESUs.

Distribution

In the U.S., Chinook salmon are found from the Bering Strait area off Alaska south to Southern California. Historically, they ranged as far south as the Ventura River, California. **Maps of the 17 ESUs** of Chinook salmon are available on the NMFS West Coast Regional Office website.

Chinook salmon also occur along the coast of Siberia and south to Hokkaido Island, Japan.

Population Trends

In recent years, some populations have shown encouraging increases in population size. Population trends for specific ESUs can be found in the **2005 status review report for Pacific salmon and steelhead** [pdf].

Threats

- **Various human-induced and natural factors**

Conservation Efforts

A variety of conservation efforts have been undertaken with some of the most common initiatives including:

- captive-rearing in hatcheries
- removal and modification of dams that obstruct salmon migration
- restoration of degraded habitat
- acquisition of key habitat
- improved water quality and instream flow

For the

The **Pacific Coast Salmon Recovery Fund (PCSRF)** was established by Congress in 2000 to support the restoration of salmon species. We oversee the fund, and state and tribal governments carry out the fund.

Regulatory Overview

In 1985, NMFS received a petition to list the winter run of Chinook salmon in the Sacramento River under the Endangered Species Act (ESA). In 1990, they were listed as Threatened. NMFS received another petition to list this population as Endangered and this occurred in 1994.

In 1990, NMFS received a petition to list Snake River Chinook; two ESUs from this river were listed.

After these listings and receiving other petitions to list Pacific salmonids, the **Northwest Fisheries Science Center** and the **Southwest Fisheries Science Center** launched a systematic review of all West Coast salmon runs. A **detailed listing history** of all Chinook salmon ESUs is available on the NMFS West Coast Regional Office website.

Critical habitat has been designated for the 9 ESA-listed Chinook salmon ESUs.

Taxonomy

Kingdom: Animalia
Phylum: Chordata
Class: Osteichthyes

Order: Salmoniformes
Family: Salmonidae
Genus: *Oncorhynchus*
Species: *tshawytscha*

Key Documents

(All documents are in PDF format.)

Title	*Federal Register*	Date
Spotlight Species 5-Year Action Plan	n/a	01/25/2016
Not Warranted 12-month finding on petition to delist Snake River fall-run ESU	**81 FR 33469**	05/26/2016
» **Petition to delist Snake River fall-run Chinook salmon ESU**		
Appendices for Proposed ESA Recovery Plan for Snake River Fall Chinook Salmon		10/2015
Proposed ESA Recovery Plan for Snake River Fall Chinook Salmon		09/2015
Draft Recovery Plan for Northern California Steelhead, Central California Coast Steelhead, and California Coastal Chinook		10/2015
ESA Listing Rules, Critical Habitat Designations, and other Chinook *Federal Register* Notices	various	various
Recovery Plan for winter-run Chinook, Central Valley spring-run Chinook and Central Valley Steelhead	**79 FR 42504**	07/22/2014
Not Warranted 12-month finding on petition to list Upper Klamath and Trinity Rivers Basin DPS	**77 FR 19597**	04/02/2012
» **Petition to List Upper Klamath DPS under the ESA**		
Species of Concern Fact Sheet: Detailed	n/a	06/16/2009
• **Fact Sheet Highlights**	n/a	08/05/2010
Recovery Plan for Upper Columbia Spring-run Chinook	**72 FR 57303**	10/09/2007
Recovery Plan for Puget Sound Chinook	**72 FR 2493**	01/19/2007
Status Review Update of All ESA-Listed ESUs	n/a	06/2005
Final 4(d) Protective Regulations for Threatened Salmonid ESUs	**65 FR 42422**	07/10/2000
5-year reviews		various

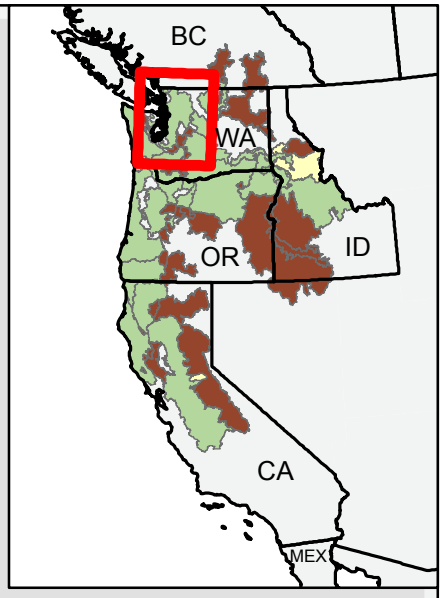
More Information

- **NMFS West Coast Regional Office Chinook Salmon ESU Information**
- **NMFS Critical Habitat**
- **NOAA's National Marine Sanctuaries**
  - **Gulf of the Farallones Sanctuary Chinook Salmon Species Card**
- **U.S. Fish and Wildlife Service CyberSalmon Chinook Salmon Information**

Updated: May 26, 2016

Puget Sound Chinook Salmon Evolutionarily Significant Unit

Current as of January 2015



Nooksack River
North Fork Nooksack River
Bellingham
Skagit River
North Fork Stillaguamish River
South Fork Stillaguamish River
Port Angeles
Glines Canyon Dam
Dungeness River
Elwha River
Everett
Sultan River
Snohomish R.
North Fork Skykomish River
Skykomish River
Dosewallips River
Seattle
Cushman Dam
SF Skokomish R.
North Bend
Green River
Howard Hanson Dam
Tacoma
Puyallup River
Olympia
Nisqually River
La Grande Dam

County Boundary

Class

ESU Boundary

Historical Watershed: Anthropogenically Blocked

N

0 22.5 Kilometers

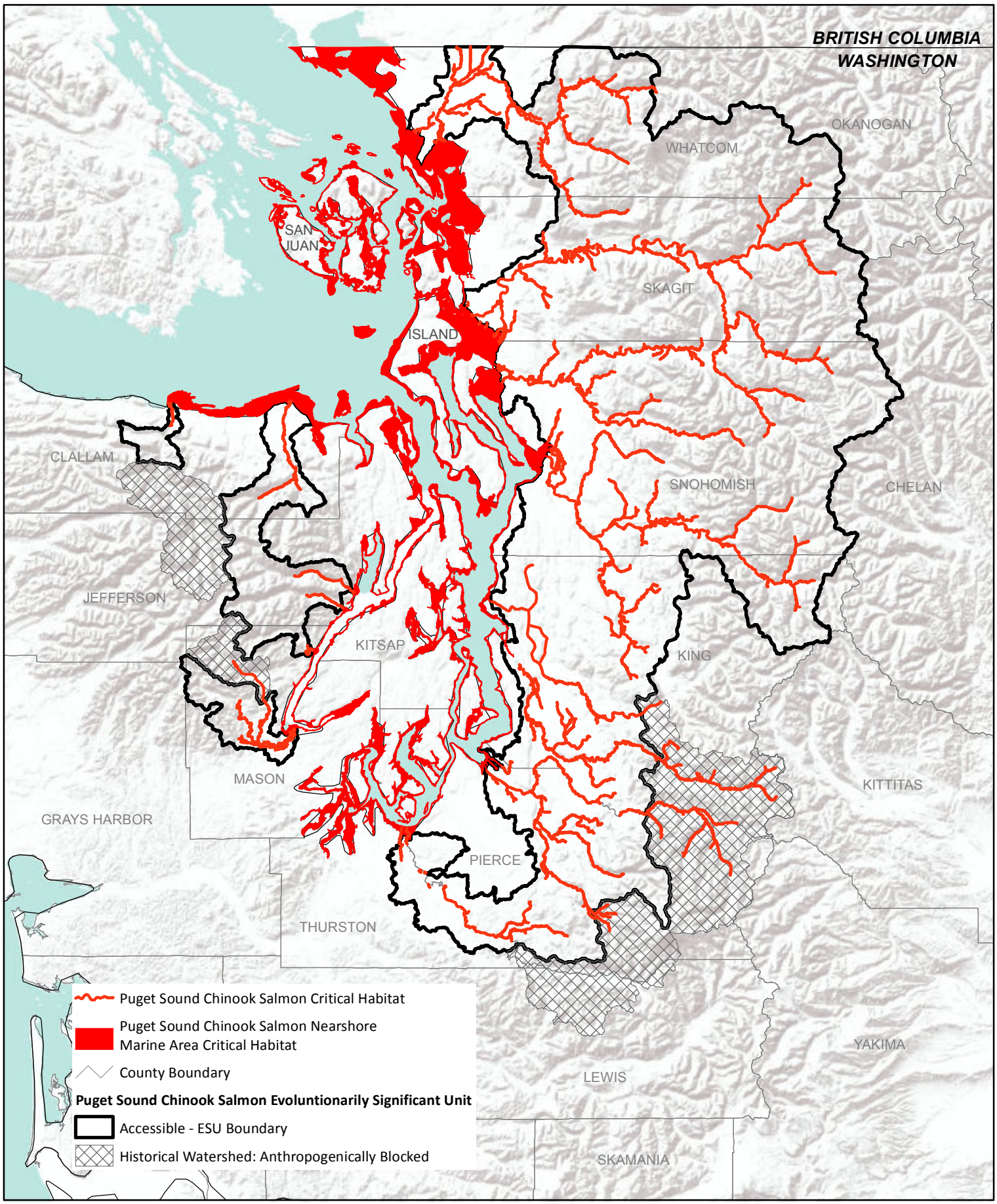
0 22.5 Miles

Map is for general reference only

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmosheric Administration
NATIONAL MARINE FISHERIES SERVICE
PROTECTED RESOURCES DIVISION
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OREGON 97232

NOAA FISHERIES

Critical Habitat
Puget Sound Chinook Salmon



0 50 Miles

See Federal Register Notice for detailed description of critical habitat (70 FR 52630)

DOC-NOAA Fisheries-West Coast Region

Chum Salmon *(Oncorhynchus keta)*

Status

ESA Threatened - 2 ESUs

Species Description

Weight: 8-15 pounds (3.6 to 6.8 kg) on average, but can weight up to 45 pounds (20 kg)

Length: up to 3.6 feet (1.1 m)

Appearance: metallic greenish-blue in the ocean;
spawning males have enormous canine-like fangs and striking body color marked by a reddish line and jagged black line

Lifespan: about 4 years

Diet: while in rivers, they eat insects and marine invertebrates while in rivers; as adults in the ocean, they eat **"copepods"**, fishes, **"mollusks"**, squid, and **"tunicates"**.

Behavior: migrate from a marine environment into the freshwater streams and rivers of their birth;
they spawn only once and then die;
they form schools, unlike most other species that rear in fresh water

Second only to **Chinook salmon** in adult size, chum salmon individuals have been reported up to 3.6 feet (1.1 m) and 45 pounds (20 kg). However, average weight is around 8 to 15 pounds (3.6 to 6.8 kg).

Chum salmon are best known for the enormous canine-like fangs and striking body color of spawning males (a calico pattern, with the front two-thirds of the flank marked by a bold, jagged, reddish line and the posterior third by a jagged black line). Females are less flamboyantly colored and lack the extreme dentition of the males. Ocean stage chum salmon are metallic greenish-blue along the back with black speckles. They closely resemble both sockeye and coho salmon at this stage. As chum salmon enter fresh water, their color and appearance changes dramatically. Both sexes develop a "tiger stripe" pattern of bold red and black stripes.

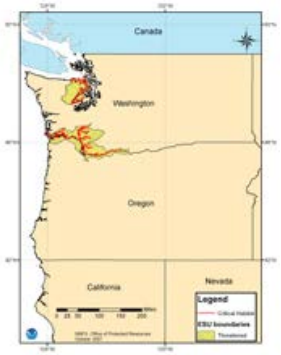
In order to mate, chum salmon adults migrate from a marine environment into the freshwater streams and rivers of their birth (called anadromy). They spawn only once and then die (called semelparity). Unlike most species that rear extensively in fresh water, chum salmon form schools, presumably to reduce predation.

Chum salmon feed on insects and marine invertebrates while in rivers. As adults, their diet consists of **"copepods"**, fishes, **"mollusks"**, squid, and **"tunicates"**.

Age at maturity appears to follow a latitudinal trend in which a greater number of fish mature at a later age in the northern portion of the species' range. Most chum salmon mature and return to their birth stream to spawn between 3 and 5 years of age, with 60 to 90 percent of the fish maturing at 4 years of age. The species has only a single form (sea-run) and does not reside in fresh water. As the time for migration to the sea approaches, juvenile chum salmon lose their parr marks (vertical bars and spots useful for camouflage). They then gain the dark back and light belly coloration used by fish living in open water. They seek deeper water and avoid light; their gills and kidneys begin to change so that they can process salt water.

Chum Salmon
(Oncorhynchus keta)
Photo: David Sepp, NOAA
(click for larger, high-resolution photo)

Chum Salmon Range Map
(click for larger view PDF)



Chum Salmon Critical Habitat
(click for larger view PDF)

Did You Know?

- **Chum salmon are also called dog salmon.**
- **Spawning males have enormous canine-like fangs.**

Habitat

Chum salmon spawn in the lowermost reaches of rivers and streams, typically within 62 miles (100 km) of the ocean. Spawning sites are often near springs. They migrate almost immediately after hatching to estuarine and ocean waters, in contrast to other Pacific salmonids, which migrate to sea after months or even years in fresh water. This means that survival and growth in juvenile chum salmon depend less on freshwater conditions than on favorable estuarine and marine conditions.

Critical habitat was designated on September 2, 2005, for the threatened Columbia River ESU and Hood Canal Summer-run ESU.

Chum Salmon
(Oncorhynchus keta)
Photo: NOAA

Distribution

The species has the widest natural geographic and spawning distribution of any Pacific salmonid, primarily because its range extends farther along the shores of the Arctic Ocean than that of the other salmonids. Spawning populations are known from Korea and Japan and into the far north of Russia. Historically, in North America, chum salmon were distributed throughout the coastal regions of western Canada and the United States, as far

south as Monterey, California. Presently, major spawning populations are found only as far south as Tillamook Bay on the northern Oregon coast.

Population Trends

Chum salmon may historically have been the most abundant of all Pacific salmonids. Seven of 16 historical spawning populations in the **Hood Canal Summer-run ESU** are extinct. Recently some of these populations have shown encouraging increases in numbers, but the **2005 status review report** [pdf] [6.3 MB] shows that the population trend overall is a 6% decline per year. In the Columbia River, historical populations reached hundreds of thousands to a million adults each year. In the past 50 years, the average has been a few thousand a year. Currently, it is thought that 14 of the 16 spawning populations in the **Columbia River ESU** are extinct. About 500 spawners occur in the ESU presently, and the long-term trend is flat.

Threats

- **Various human-induced and natural factors**

Conservation Efforts

A variety of conservation efforts have been undertaken with some of the most common initiatives including captive-rearing in hatcheries, removal and modification of dams that obstruct salmon migration, restoration of degraded habitat, acquisition of key habitat, and improved water quality and instream flow.

The **Pacific Coast Salmon Recovery Fund (PCSRF)** was established by Congress in 2000 to support the restoration of salmon species. The fund is overseen by NMFS and carried out by state and tribal governments.

Regulatory Overview

The **Columbia River ESU** and **Hood Canal Summer-run ESU** were listed as threatened under the Endangered Species Act (ESA) on March 25, 1999. Their threatened status was reaffirmed on June 28, 2005.

A final **critical habitat** designation was published on September 2, 2005, with an effective date of January 2, 2006.

In addition, final revised protective regulations were issued on June 28, 2005.

Taxonomy

Kingdom: Animalia
Phylum: Chordata
Class: Osteichthyes
Order: Salmoniformes
Family: Salmonidae
Genus: *Oncorhynchus*
Species: *keta*

Key Documents

(All documents are in PDF format.)

Title	*Federal Register*	Date
5-year reviews		various
Negative 90-day Finding on petition to list Puget Sound winter-run chum salmon under ESA >**Petition**	**82 FR 33064**	07/19/2017
Recovery Plan for Hood Canal Summer-run Chum	n/a	05/2007
Proposed Recovery Plan for Hood Canal ESU	**71 FR 47180**	08/16/2006
Designation of Critical Habitat for 12 ESUs of West Coast Salmon and Steelhead in Washington, Oregon, and Idaho	**70 FR 52630**	09/02/2005
ESA Listing Rule for Columbia River and Hood Canal summer-run ESUs Reaffirming ESA Status	**70 FR 37160**	06/28/2005
Status Review Update of All ESA-Listed ESUs	n/a	06/2005
Chum Salmon *Federal Register* Notices	n/a	various

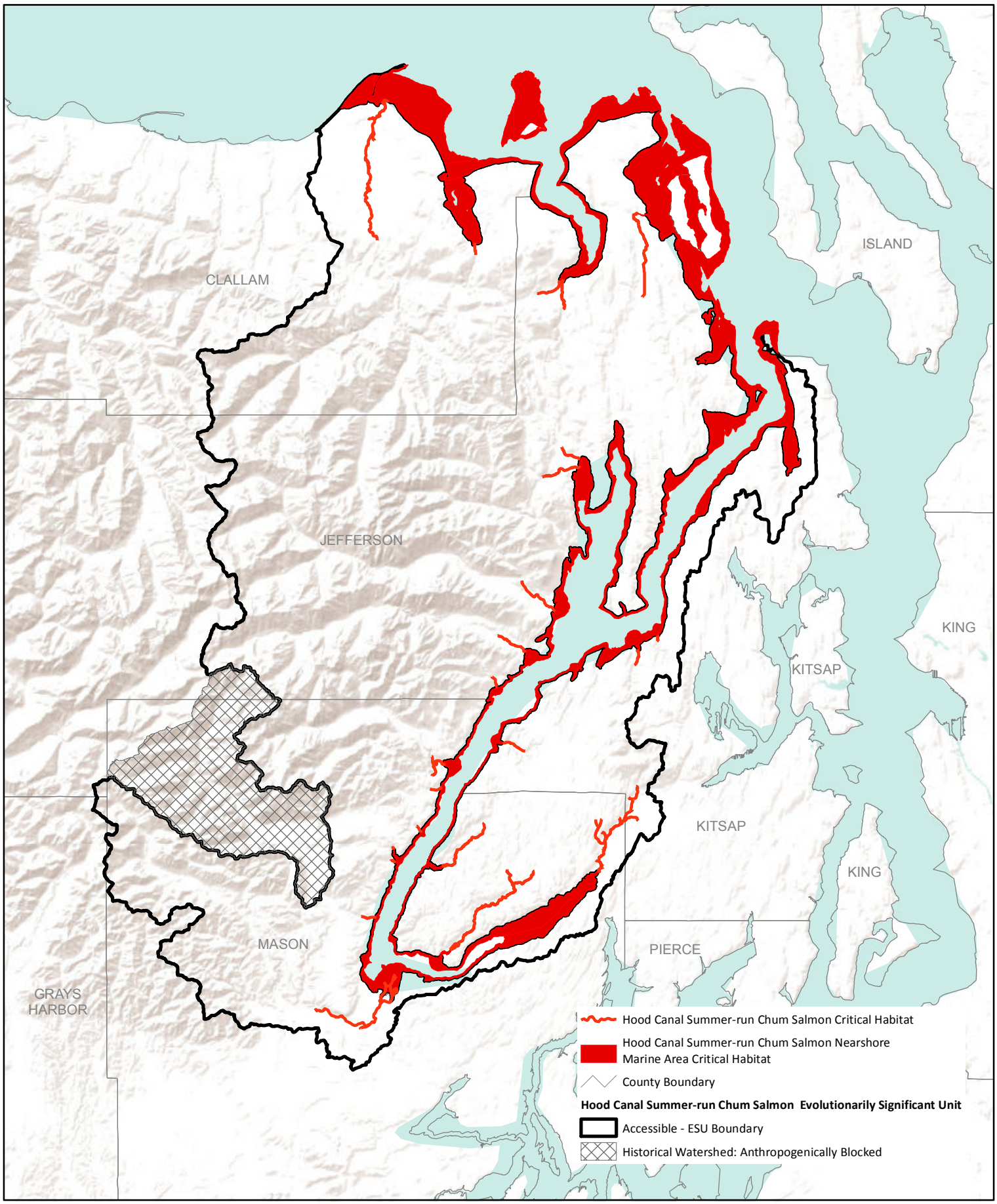
More Information

- **NOAA West Coast Regional Office Chum Salmon ESU Information**
- **NOAA West Coast Regional Office Biological Status Reviews for Chum Salmon**
- **NOAA Critical Habitat Information**

Updated: July 19, 2017

NOAA FISHERIES

Critical Habitat
Hood Canal Summer-run Chum Salmon



0 20 Miles

See Federal Register Notice for detailed description of critical habitat (70 FR 52630)

DOC-NOAA Fisheries-West Coast Region

5-year reviews		various
Other Steelhead *Federal Register* notices	various	various

- **NOAA West Coast Regional Office Steelhead Trout Species Information**
- **NOAA's National Marine Sanctuaries Encyclopedia**
  - **Gulf of the Farallones Sanctuary Rainbow (Steelhead) Trout Species Card**
- **Critical Habitat Information**
- **U.S. Fish and Wildlife Service Steelhead Species Profile**

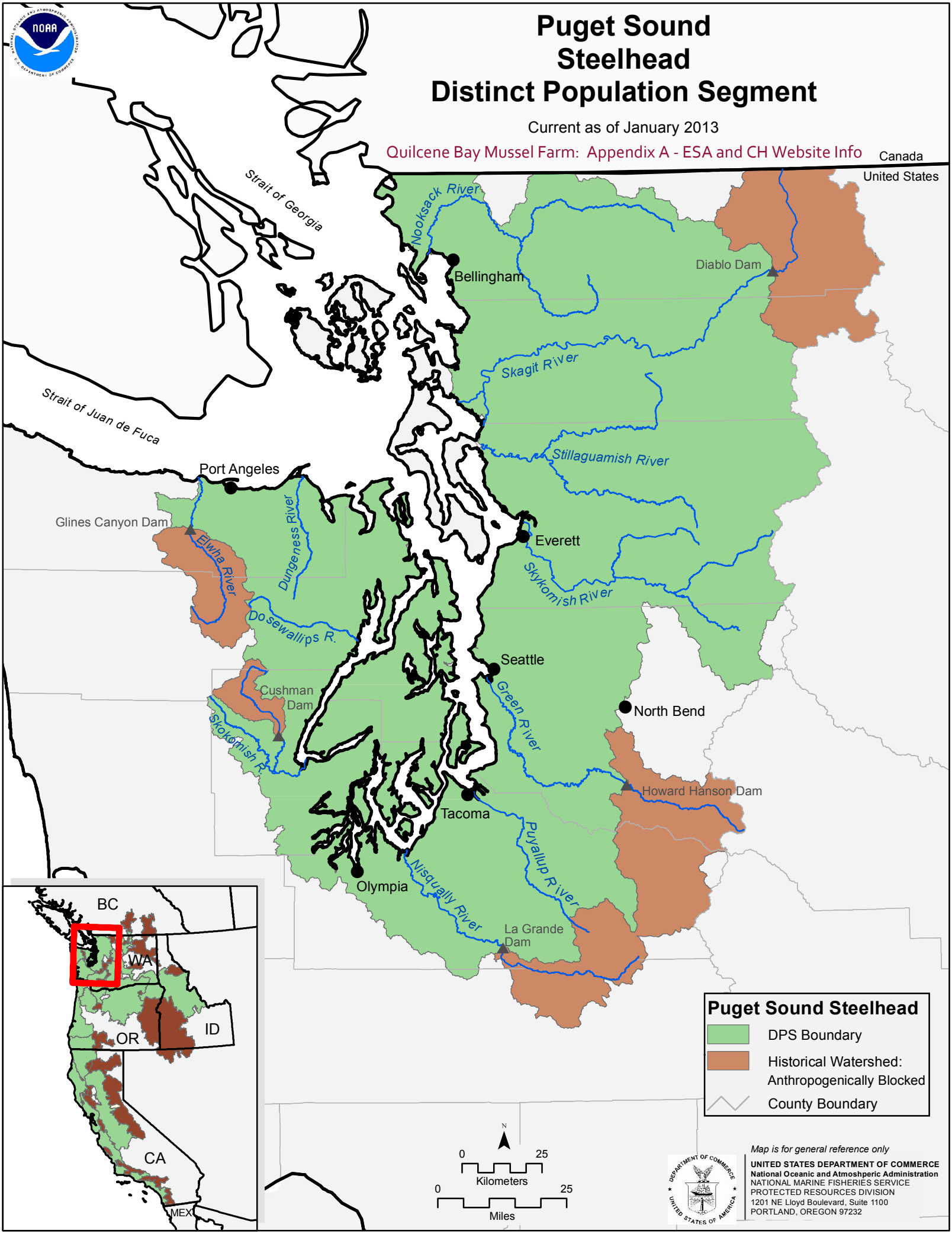
Updated: February 24, 2016

http://:www.nmfs.noaa.gov/pr/species/fish/steelhead-trout.html

Puget Sound Steelhead Distinct Population Segment

Current as of January 2013

Quilcene Bay Mussel Farm: Appendix A - ESA and CH Website Info

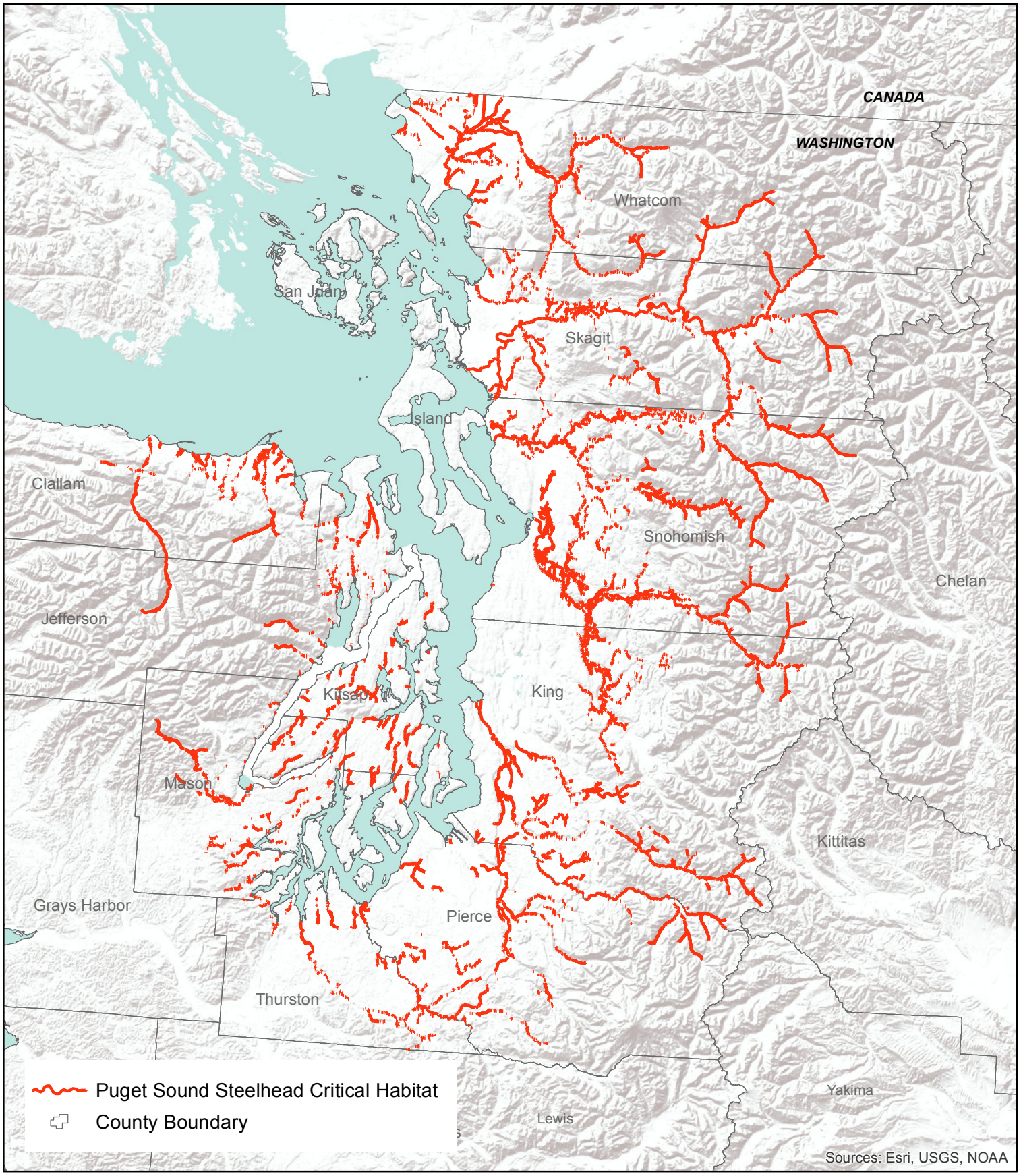


Map is for general reference only

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmoshperic Administration
NATIONAL MARINE FISHERIES SERVICE
PROTECTED RESOURCES DIVISION
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OREGON 97232

NOAA FISHERIES

Final Critical Habitat
Puget Sound Steelhead



N

0 3.5 7 14 Miles

See Federal Register notice for detailed description of critical habitat (81 FR 9252, February 24, 2016)
DOC-NOAA Fisheries-West Coast Region

Eulachon *(Thaleichthys pacificus)*

Status | Species Description | Habitat | Distribution | Population Trends | Threats | Conservation Efforts | Regulatory Overview | Taxonomy | Key Documents | More Info

Status

ESA Threatened - Southern DPS

Eulachon Range Map
(click for larger view PDF)

Species Description

Weight: 2.5 ounces (70 g)

Length: 8.5 inches (21.5 cm)

Appearance: brown to blue on their backs and on top of their heads, lighter to silvery white on the sides, and white belly; large canine teeth on the bone in the roof of the mouth (**"vomer"**) and 18 to 23 rays in their anal fin and a sickle-shaped **"adipose fin"**

Lifespan: unknown

Diet: spend 3-5 years in saltwater before returning to freshwater to spawn

Behavior:

Did You Know?

- **The common name "candlefish" derives from the fact that it is so fat during spawning, with up to 15% of total body weight in fat that, when caught, dried, and strung on a wick, it could be burned like a candle.**
- **The name "eulachon" is from the Chinookan language.**

Eulachon (commonly called smelt, candlefish, or hooligan) are a small, anadromous fish from the eastern Pacific Ocean. They are distinguished by large canine teeth on the bone in the roof of the mouth (**"vomer"**) and 18 to 23 rays in their anal fin. Like Pacific salmon they have an **"adipose fin"**; it is sickle-shaped. The paired fins are longer in males than in females. All fins have well-developed breeding tubercles (raised tissue "bumps") in ripe males, but these are poorly developed or absent in females. As adults, they are brown to blue on their backs and on top of their heads, lighter to silvery white on the sides, and white on the ventral surface. Their backs may have fine, sparse speckling. They feed on plankton but only while at sea.

Eulachon typically spend 3 to 5 years in saltwater before returning to freshwater to spawn from late winter through mid spring. During spawning, males have a distinctly raised ridge along the middle of their bodies. Eggs are fertilized in the water column. After fertilization, the eggs sink and adhere to the river bottom, typically in areas of gravel and coarse sand. Most eulachon adults die after spawning. Eulachon eggs hatch in 20 to 40 days. The larvae are then carried downstream and are dispersed by estuarine and ocean currents shortly after hatching. Juvenile eulachon move from shallow nearshore areas to mid-depth areas. Within the Columbia River Basin, the major and most consistent spawning runs occur in the mainstem of the Columbia River as far upstream as the Bonneville Dam, and in the Cowlitz River.

Habitat

Eulachon occur in nearshore ocean waters and to 1,000 feet (300 m) in depth, except for the brief spawning runs into their natal (birth) streams. Spawning grounds are typically in the lower reaches of larger snowmelt-fed rivers with water temperatures ranging from 39 to 50°F (4 to 10°C). Spawning occurs over sand or coarse gravel substrates.

Critical Habitat
In October 2011, NMFS **designated critical habitat for the threatened southern DPS** (76 FR 65323). The **proposed critical habitat** (76 FR 515) was published in January 2011.

Distribution

Eulachon are endemic to the eastern Pacific Ocean, ranging from northern California to southwest Alaska and into the southeastern Bering Sea. In the continental United States, most eulachon originate in the Columbia River Basin. Other areas in the United States where eulachon have been documented include the Sacramento River, Russian River, Humboldt Bay and several nearby smaller coastal rivers (e.g., Mad River), and the Klamath River in California; the Rogue River and Umpqua Rivers in Oregon; and infrequently in coastal rivers and tributaries to Puget Sound, Washington.

Population Trends

Eulachon abundance exhibits considerable year-to-year variability. However, nearly all spawning runs from California to southeastern Alaska have declined in the past 20 years, especially since the mid 1990s. From 1938 to 1992, the median commercial catch of eulachon in the Columbia River was approximately 2 million pounds (900,000 kg) but from 1993 to 2006, the median catch had declined to approximately 43,000 pounds (19,500 kg), representing a nearly 98% reduction in catch from the prior period. Eulachon returns in the Fraser River and other British Columbia rivers similarly suffered severe declines in the mid-1990s and, despite increased returns during 2001 to 2003, presently remain at very low levels. The populations in the Klamath River, Mad River, Redwood Creek, and Sacramento River are likely **"extirpated"**, or nearly so.

Threats

- Habitat loss and degradation, particularly in the Columbia River basin
  --Hydroelectric dams block access to historical eulachon spawning grounds and affect the quality of spawning substrates through flow management, altered delivery of coarse sediments, and siltation. The release of fine sediments from behind a U.S. Army Corps of Engineers sediment retention structure on the Toutle River has been negatively correlated with Cowlitz River eulachon returns 3 to 4 years later and is thus implicated in harming eulachon in this river system, though the exact cause of the effect is undetermined. Dredging activities in the Cowlitz and Columbia rivers during spawning runs may entrain and kill fish or otherwise result in decreased spawning success.
- Global climate change may threaten eulachon, particularly in the southern portion of its range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success.

Eulachon have been shown to carry high levels of chemical pollutants, and although it has not been demonstrated that high contaminant loads in eulachon result in increased mortality or reduced reproductive success; such effects have been shown in other fish species.

Conservation efforts include fishing restrictions and habitat improvements targeted to improve the status of eulachon, salmon, and other native species in Pacific Northwest streams.

In 1999, we were petitioned to list Columbia River eulachon under the ESA. In November 1999, NMFS issued a finding that the petition did not present substantial scientific information indicating the petitioned action may be warranted (64 FR 66601; November 29, 1999).

On November 8, 2007, NMFS received another petition to list southern eulachon under the ESA. The petition sought delineation of a southern eulachon **"Distinct Population Segment" (DPS)** extending from the U.S.-Canada border south to include populations in Washington, Oregon, and California. In March 2008, NMFS determined that the petition presented substantial scientific and commercial information indicating the petitioned action may be warranted, and initiated a status review.

In March 2010, NMFS listed the Southern DPS of eulachon as threatened under the ESA.

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii
Order: Osmeriformes
Family: Osmeridae
Genus: *Thaleichthys*
Species: *pacificus*

(All documents are in PDF format.)

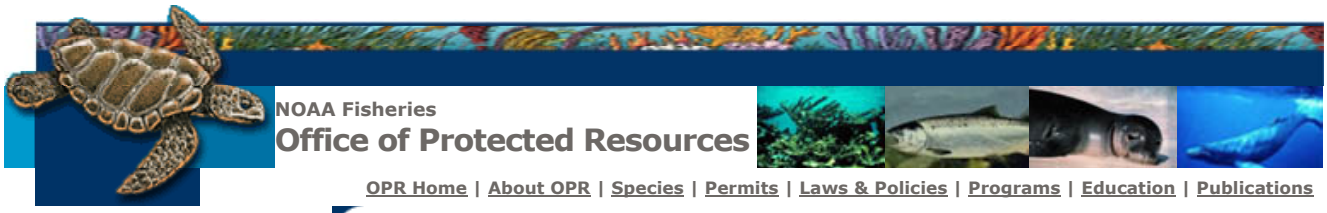
Title	*Federal Register*	Date
Notice of intent to prepare a recovery plan for the Southern DPS	78 FR 40104	07/03/2013
Final Rule to Designate Critical Habitat for the Southern DPS	76 FR 65323	10/20/2011
Proposed Rule to Designate Critical Habitat for the Southern DPS	76 FR 515	01/05/2011
Final Rule to List the Southern DPS as Threatened Under the ESA	75 FR 13012	03/18/2010
Proposed Rule to List the Southern DPS as Threatened Under the ESA	74 FR 10857	03/13/2009
Positive 90-Day Finding on a Petition to List Eulachon under the Endangered Species Act	73 FR 13185	03/12/2008
1999 Negative 90-Day Finding on a Petition to List Eulachon under the Endangered Species Act	64 FR 66601	11/29/1999

- **NMFS West Coast Regional Office Eulachon Information**

Updated: January 21, 2015

Quilcene Bay Mussel Farm: Appendix A - ESA and CH Website Info

This map is intended to serve the public as a general depiction of the final critical habitat designation for southern DPS eulachon. Every attempt has been made to ensure the accuracy of the information depicted; however, this map DOES NOT constitute a legal description of critical habitat. For exact legal descriptions of the areas designated as critical habitat (as well as the specific areas excluded from designation), please see the *Federal Register* notice in the Northwest Region's *Federal Register* Notices index.



NOAA Fisheries
Office of Protected Resources

Species
- Marine Mammals
  - Cetaceans
  - Pinnipeds
- Marine Turtles
- Marine & Anadromous Fish
- Marine Invertebrates & Plants
- Species of Concern
- Threatened & Endangered Species
  - Critical Habitat Maps

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Bocaccio *(Sebastes paucispinis)*

Status | Taxonomy | Species Description | Habitat | Distribution | Population Trends | Threats | Conservation Efforts | Regulatory Overview | Key Documents | More Info

Status
ESA Endangered - Puget Sound/ Georgia Basin DPS
ESA Species of Concern - Southern DPS (Northern California to Mexico)

Bocaccio video screenshot
(Sebastes paucispinis)
Photo: NMFS Southwest Fisheries Science Center

Taxonomy
Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii
Order: Scorpaeniformes
Family: Sebastidae
Genus: *Sebastes*
Species: *paucispinis*

Did You Know?

- Spines of bocaccio can be mildly poisonous and cause minor pain.
- Some bocaccio in a few localities have a golden color.

Species Description

Bocaccio are large Pacific coast rockfish that reach up to 3 feet (1 m) in length. They have a distinctively long jaw extending to at least the eye socket. Their body ranges in color from olive to burnt orange or brown as adults. Young bocaccio are light bronze in color and have small brown spots on their sides.

Rockfishes are unusual among the bony fishes in that fertilization and embryo development is internal, and female rockfish give birth to live larval young. Larvae are found in surface waters, and may be distributed over a wide area extending several hundred miles offshore. "Fecundity" in female bocaccio ranges from 20,000 to over 2 million eggs, considerably more than many other rockfish species. Larvae and small juvenile rockfish may remain in open waters for several months, being passively dispersed by ocean currents.

Larval rockfish feed on diatoms, dinoflagellates, tintinnids, and cladocerans, and juveniles consume copepods and euphausiids of all life stages. Adults eat demersal invertebrates and small fishes, including other species of rockfish, associated with kelp beds, rocky reefs, pinnacles, and sharp dropoffs. Approximately 50 percent of adult bocaccio mature in 4 to 6 years. Bocaccio are difficult to age but are suspected to live as long as 50 years.

Habitat
Bocaccio are most common between 160 and 820 feet (50-250 m) depth, but may be found as deep as 1,560 feet (475m). Adults generally move into deeper water as they increase in size and age but usually exhibit strong site fidelity to rocky bottoms and outcrops. Juveniles and subadults may be more common than adults in shallower water, and are associated with rocky reefs, kelp canopies, and artificial structures, such as piers and oil platforms.

Critical Habitat
Critical habitat was designated for yelloweye rockfish, canary rockfish, and bocaccio in the Puget Sound/ Georgia Basin in November 2014. NMFS proposed designation of critical habitat in August 2013. Download GIS critical habitat data for Puget Sound rockfish [zip].

Distribution
Bocaccio range from Punta Blanca, Baja California, to the Gulf of Alaska off Krozoff

Canary Rockfish *(Sebastes pinniger)*

Status

Species Description

Weight: 10 pounds (4 kg)

Length: up to 2.5 feet (77 cm)

Appearance: bright yellow to orange mottling over gray, as adults

Lifespan: up to 75 years

Diet: invertebrates and small fishes, as adults

Behavior: Rockfishes are unusual among the bony fishes in that fertilization and embryo development is internal and female rockfish give birth to live larval young

Canary Rockfish
(Sebastes pinniger)
Photo: NOAA Alaska Fisheries Science Center

Did You Know?

- **The genus name *Sebastes* is Greek for "magnificent" and the species name *pinniger* is Latin for "large-finned."**

Canary rockfish are large rockfish that reach up to 2.5 feet (77 cm) in length and 10 pounds (4 kg) in weight. Adults have bright yellow to orange mottling over gray, 3 orange stripes across the head, and orange fins. Animals less than 14 inches long have dark markings on the posterior part of the spiny dorsal fin and gray along the lateral line.

Rockfishes are unusual among the bony fishes in that fertilization and embryo development is internal and female rockfish give birth to live larval young. Larvae are found in surface waters and may be distributed over a wide area extending several hundred miles offshore. **"Fecundity"** in female canary rockfish ranges from 260,000 to 1.9 million eggs, considerably more than many other rockfish species. Larvae and small juvenile rockfish may remain in open waters for several months, being passively dispersed by ocean currents.

Larval rockfish feed on diatoms, dinoflagellates, tintinnids, and cladocerans, and juveniles consume copepods and euphausiids of all life stages. Adults eat demersal invertebrates and small fishes, including other species of rockfish, associated with kelp beds, rocky reefs, pinnacles, and sharp dropoffs. Approximately 50 percent of adult canary rockfish are mature at 14 inches (36 cm) total length (about 5 to 6 years of age). Canary rockfish can live to be 75 years old.

Habitat

Canary rockfish primarily inhabit waters 160 to 820 feet (50 to 250 m) deep but may be found to 1400 feet (425 m). Juveniles and subadults tend to be more common than adults in shallow water and are associated with rocky reefs, kelp canopies, and artificial structures, such as piers and oil platforms. Adults generally move into deeper water as they increase in size and age but usually exhibit strong site fidelity to rocky bottoms and outcrops where they hover in loose groups just above the bottom.

Distribution

Canary rockfish range between Punta Colnett, Baja California, and the Western Gulf of Alaska. Within this range, canary rockfish are most common off the coast of central Oregon.

Population Trends

Recreational catch and effort data from the mid-1970s to mid-1990s suggests possible declines in abundance. While catch data are generally constant over this time period, the number of angler trips increased substantially, and the average number of canary rockfish caught per trip declined. Taken together, these data suggest declines in the population over time. Currently there are no survey data being taken for this species, but few of these fish are currently caught by fishermen, suggesting a low population abundance. Canary rockfish used to be one of the three principal species caught in Puget Sound in the 1960s.

Threats

- fishing
- bycatch in other fisheries, including those for salmon
- adverse environmental factors, which led to recruitment failures

Conservation Efforts

Various state restrictions on fishing have been put in place over the years, including banning retention of canary rockfish in Washington in 2003. Because this species is slow growing, late to mature, and long-lived, recovery from these threats will take many years, even if the threats are no longer affecting the species.

Regulatory Overview

Based on recently obtained new genetic information that indicates that the Puget Sound/Georgia Basin population of canary rockfish is not genetically discrete from canary rockfish on the coast, **we published a final rule in January 2017 removing the Puget Sound/Georgia Basin DPS of canary rockfish from the Federal List of Threatened and Endangered Species list**. Because of the lack of discreteness in the Puget Sound/Georgia Basin canary rockfish population, we find that it does not meet the DPS criteria and therefore does not qualify for listing under the Endangered Species Act.

In April 2010, we listed the Puget Sound/ Georgia Basin DPS as Threatened.

On April 9, 2007, we received a petition from Mr. Sam Wright (Olympia, Washington) to list **"distinct population segments (DPSs)"** of canary rockfish, and 4 other rockfishes in Puget Sound, as endangered or threatened species under the ESA and to designate critical habitat. We found that this petition also did not present substantial scientific or commercial information to suggest that the petitioned actions may be warranted (72 FR 56986; October 5, 2007). On October 29, 2007, we received a letter from Mr. Wright presenting information that was not included in the April 2007 petition, and requesting reconsideration of the decision not to initiate a review of the species' status. We considered the supplemental information as a new petition and concluded that there was enough information in this new petition to warrant conducting status reviews of these rockfishes. The status review was initiated on March 17, 2008 (73 FR 14195).

In February 1999, we received a petition from Mr. Sam Wright of Olympia, Washington to list 18 species of marine fishes in Puget Sound, including this species, under the ESA. On June 21, 1999, we found that there was insufficient information concerning stock structure, status, and trends for this species to suggest that listing this species may be warranted (64 FR 33037).

Taxonomy

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii
Order: Scorpaeniformes
Family: Sebastidae
Genus: *Sebastes*
Species: *pinniger*

Key Documents

(All documents are in PDF format.)

Title	*Federal Register*	Date
Final Rule to Delist Puget Sound/Georgia Basin DPS of Canary Rockfish	82 FR 7711	01/23/2017
Proposed Rule to Delist Puget Sound/Georgia Basin DPS of Canary Rockfish	81 FR 43979	07/06/2016
Designation of Critical Habitat for Puget Sound/ Georgia Basin DPSs of Yelloweye Rockfish, Canary Rockfish, and Bocaccio	79 FR 68041	11/13/2014
Proposed Designation of Critical Habitat	78 FR 47635	08/06/2013
Status Review of 5 Rockfish Species in Puget Sound, WA		12/2010
Final Rule to List the Puget Sound/ Georgia Basin DPS as Threatened Under the ESA	75 FR 22276	04/28/2010
Proposed Rule to List the Puget Sound/ Georgia Basin DPS as Threatened Under the ESA	74 FR 18516	04/23/2009
2008: 90-Day Finding on a Petition to List 5 Rockfish Species in the Puget Sound Under the Endangered Species Act	73 FR 14195	03/17/2008
2007: 90-Day Finding on a Petition to List 5 Rockfish Species in the Puget Sound Under the ESA	72 FR 56986	10/05/2007
1999: 90-Day Finding on a Petition to List 18 Fishes in the Puget Sound Under the ESA	64 FR 33037	06/21/1999

More Information

- **NOAA Alaska Fisheries Science Center Canary Rockfish Information**
- **NOAA Northwest Fisheries Science Center: Status of the U.S. Canary Rockfish Resource in 2005**
- **Guide to Rockfishes (Scorpaenidae) of the Genera Sebastes, Sebastolobus, and Adelosebastes of the Northeast Pacific Ocean, 2nd Edition** (NOAA Tech Memo NMFS-AFSC-117)

Updated: February 3, 2017

Yelloweye Rockfish *(Sebastes ruberrimus)*

Status | Species Description | Habitat | Distribution | Population Trends | Threats | Conservation Efforts | Regulatory Overview | Taxonomy | Key Documents | More Info

Yelloweye Rockfish
(Sebastes ruberrimus)
Photo: NOAA OAR & Alaska Department of Fish and Game

Status

ESA Threatened - Puget Sound/ Georgia Basin DPS

Species Description

Weight: 40 pounds (18 kg)

Length: up to 3.5 feet (~1 m)

Appearance: orange-red to orange-yellow and may have black on their fin tips, their eyes are bright yellow

Lifespan: up to 118 years, among the longest lived of rockfishes

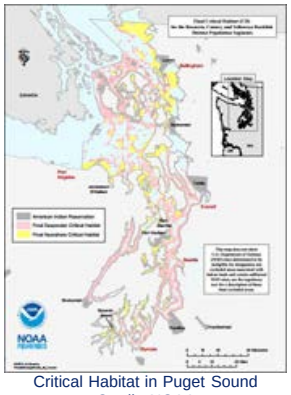
Diet: invertebrates and small fishes, as adults

Behavior: fertilization and embryo development is internal and female rockfish give birth to live larval young

Yelloweye rockfish are very large rockfish that reach up to 3.5 feet (~1 m) in length and about 40 pounds (18 kg) in weight. They are orange-red to orange-yellow in color and may have black on their fin tips. Their eyes are bright yellow. Adults usually have a light to white stripe on the lateral line; juveniles have 2 light stripes, one on the lateral line and a shorter one below the lateral line.

Rockfishes are unusual among the bony fishes in that fertilization and embryo development is internal and female rockfish give birth to live larval young. Larvae are found in surface waters and may be distributed over a wide area extending several hundred miles offshore. **"Fecundity"** in female yelloweye rockfish ranges from 1.2 to 2.7 million eggs, considerably more than many other rockfish species. Larvae and small juvenile rockfish may remain in open waters for several months being passively dispersed by ocean currents.

Larval rockfish feed on diatoms, dinoflagellates, tintinnids, and cladocerans, and juveniles consume copepods and euphausiids of all life stages. Adults eat demersal invertebrates and small fishes, including other species of rockfish, associated with kelp beds, rocky reefs, pinnacles, and sharp dropoffs. Approximately 50 percent of adult yelloweye rockfish reach maturity at around 40 to 50 cm total length and ages of 15 to 20 years. Yelloweye rockfish are among the longest lived of rockfishes, living up to 118 years old.



Critical Habitat in Puget Sound
Credit: NOAA

Did You Know?

- **Because of their very different coloration, juveniles and adults were considered separate species for a long time.**
- **Yelloweye rockfish are among the longest lived of rockfishes, living up to 118 years.**

Habitat

Juveniles and subadults tend to be more common than adults in shallower water, and are associated with rocky reefs, kelp canopies, and artificial structures such as piers and oil platforms. Adults generally move into deeper water as they increase in size and age, but usually exhibit strong site fidelity to rocky bottoms and outcrops. Yelloweye rockfish occur in waters 80 to 1560 feet (25 to 475 m) deep, but are most commonly found between 300 to 590 feet (91 to 180 m).

Critical Habitat
We designated **critical habitat** for the Puget Sound/ Georgia Basin DPSs of yelloweye rockfish on November 13, 2014.

Distribution

Yelloweye rockfish range from northern Baja California to the Aleutian Islands, Alaska, but are most common from central California northward to the Gulf of Alaska.

Population Trends

Recreational catch and effort data from the mid-1970s to mid-1990s suggests possible declines in abundance. While catch data are generally constant over time, the number of angler trips increased substantially, and there was a decline in the average number of rockfish caught per trip. Taken together, these data suggest declines in the population over time. Currently there are no survey data being taken for this species, but few of these fish are caught by fishermen, suggesting a low population abundance.

Threats

- fished directly
- caught as bycatch in other fisheries, including those for salmon
- adverse environmental factors led to recruitment failures

Conservation Efforts

Various state restrictions on fishing have been put in place over the years leading to the current ban on retention of yelloweye rockfish in Washington in 2003. Because this species is slow growing, late to mature, and long-lived, recovery from these threats will take many years, even if the threats are no longer affecting the species.

Regulatory Overview

In April 2010, we listed the Puget Sound/ Georgia Basin DPS as Threatened.

On April 9, 2007, we received a petition from Mr. Sam Wright (Olympia, Washington) to list **"distinct population segments (DPSs)"** of yelloweye rockfish, and 4 other rockfishes in Puget Sound, as endangered or threatened species under the ESA and to designate critical habitat. We found that this petition also did not present substantial scientific or commercial information to suggest that the petitioned actions may be warranted (72 FR 56986; October 5, 2007). On October 29, 2007, we received a letter from Mr. Wright presenting information that was not included in the April 2007 petition, and requesting reconsideration of the decision not to initiate a review of the species' status. We considered the supplemental information as a new petition and concluded that there was enough information in this new petition to warrant conducting status reviews of these rockfishes. The status review was initiated on March 17, 2008 (73 FR 14195).

In February 1999, we received a petition from Mr. Sam Wright of Olympia, Washington to list 18 species of marine fishes in Puget Sound, including this species, under the ESA. On June 21, 1999, we found that there was insufficient information concerning stock structure, status, and trends for this species to suggest that listing this species may be warranted (64 FR 33037).

Taxonomy

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii
Order: Scorpaeniformes
Family: Sebastidae
Genus: *Sebastes*
Species: *ruberrimus*

Key Documents

(All documents are in PDF format.)

Title	*Federal Register*	Date
Final Rule Amending the Listing Description for the Yelloweye Rockfish DPS	82 FR 7711	01/23/2017
Designation of Critical Habitat for Puget Sound/ Georgia Basin DPSs of Yelloweye Rockfish, Canary Rockfish, and Bocaccio	79 FR 68041	11/13/2014
Proposed Designation of Critical Habitat	78 FR 47635	08/06/2013
Status Review of 5 Rockfish Species in Puget Sound, WA		12/2010
Final Rule to List the Puget Sound/ Georgia Basin DPS as Threatened Under the ESA	75 FR 22276	04/28/2010
Proposed Rule to List the Puget Sound/ Georgia Basin DPS as Threatened Under the ESA	74 FR 18516	04/23/2009
90-Day Finding on a Petition to List 5 Rockfish Species in the Puget Sound Under the Endangered Species Act	73 FR 14195	03/17/2008
90-Day Finding on a Petition to List 5 Rockfish Species in the Puget Sound Under the ESA	72 FR 56986	10/05/2007
90-Day Finding on a Petition to List 18 Fishes in the Puget Sound Under the ESA	64 FR 33037	06/21/1999

More Information

- **NOAA Alaska Fisheries Science Center Yelloweye Rockfish Information**
- **Guide to Rockfishes (Scorpaenidae) of the Genera Sebastes, Sebastolobus, and Adelosebastes of the Northeast Pacific Ocean** (NOAA Tech Memo NMFS-AFSC-117)

Updated: February 3, 2017

Final Critical Habitat (CH) for the Bocaccio, Canary, and Yelloweye Rockfish Distinct Population Segments

This map does not show U.S. Department of Defense (DOD) sites determined to be ineligible for designation nor excluded areas associated with Indian lands and certain additional DOD sites; see the regulatory text for a description of these final excluded areas.

NOAA FISHERIES

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SECTION NAVIGATION

Endangered Species Main Page

Complete Profile (ECOS)

Marbled Murrelet

Scientific name: Brachyramphus marmoratus

Status: Threatened

Critical Habitat: Designated

Listing: In 1992, the Washington, Oregon, and California population of the marbled murrelet was federally listed as threatened. In October 2008, USFWS initiated a 12-month status review of the species as a result of a petition to delist. The 12-month finding concluded, in January 2010, that the murrelet needs continued protection and will retain its status as a threatened species.

Critical Habitat: Critical habitat was designated in 1996 and revised in 2011. The current designation consists of approximately 3,698,100 acres in Washington, Oregon, and California.

Historical Status and Current Trends

The marbled murrelet ranges from the Aleutian Islands and southern Alaska to central California. The largest portion of the population occurs in Alaska and British Columbia. The listed portion of the species range extends from the Canadian border south to central California. Loss of viable nesting habitat (older forest) is thought to be a primary factor responsible for declining marbled murrelet populations in Washington, Oregon, and California. In Washington, in the marine environment, this species occurs in the greatest numbers in the Straits of Juan de Fuca and San Juan Islands. Current estimates indicate that the population continues to decline in Washington at a rate of about 5% per year. It is unlikely that population numbers will increase rapidly due to the naturally low reproductive rate and the continued loss of nesting habitat. Recovery of the species is likely to take decades.

Habitat

The marbled murrelet is a small, robin-sized, diving seabird that feeds primarily on fish and

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RELATED PAGES

Section 7 Technical Assistance and Guidance

The Joint Base Lewis-McChord Sentinel Landscape

Joint Base Lewis-McChord (JBLM) supports military training while also hosting 90% of the remaining prairie habitat in the South Puget Sound. Through the Sentinel Landscapes Partnership, the Departments of Agriculture, Interior, and Defense work with a variety of partners to promote working lands, protect wildlife species and habitat, and ensure military readiness at the base.

Learn more about the JBLM Sentinel Landscape.

invertebrates in near-shore marine waters. It spends the majority of its time on the ocean, roosting and feeding, but comes inland up to 70 miles (113 kilometers) to nest in forest stands with old growth forest characteristics. These dense shady forests are generally characterized by large trees with large branches or deformities that are used as nest platforms. Murrelets nest in stands varying in size from several acres to thousands of acres. However, larger, unfragmented stands of old growth appear to be the highest quality habitat for marbled murrelet nesting.

Life History

Marbled murrelets nest from mid-April to late September. The sexually mature adult murrelet (at age 2 or 3 of an average 15-year lifespan) lays a single egg on a mossy limb of an old-growth conifer tree. Both sexes incubate the egg in alternating 24-hour shifts for approximately 30 days. Murrelet chicks are virtually helpless and rely on the adults for food. The adults feed the chick at least once per day, flying in (primarily at dawn and dusk) from feeding on the ocean, carrying one fish at a time. The young fledge from the nest in about 28 days and appear to fly directly to the sea upon leaving the nest. Marbled murrelets have a naturally low reproductive rate because they lay only one egg per nest and not all adults nest every year.

Reasons for Decline

The primary cause of marbled murrelet population decline is the loss and modification of nesting habitat in old growth and mature forests through commercial timber harvests, human-induced fires, and land conversions, and to a lesser degree, through natural causes such as wild fires and wind storms. In general, forest management practices that maximize timber production cut and replant forest stands every 40 to 60 years. Since it takes 100 to 250 years to grow marbled murrelet nesting habitat, this time frame frequently does not allow old-growth characteristics to develop, thus eliminating large areas from providing future nesting habitat. Continued harvest of old growth and mature forests also perpetuates the loss and fragmentation of remaining habitat. Changing the existing habitat by fragmenting the forest into small patches of suitable habitat surrounded by open space also affects the habitat quality. Increased forest fragmentation can reduce nesting success by allowing increased predation of nests by raptors (great horned owls, sharp-shinned hawks) and corvids (jays, ravens, crows). In the murrelet's marine habitat, oil spills and gill-net fishing also threaten the population. Recent oil spills off the coast of California and Oregon have contributed to direct mortality of marbled murrelets and other seabirds.

Conservation Measures

Although most murrelet nesting habitat on private lands has been eliminated by logging, suitable habitat remains on federal- and state-owned lands. Areas of critical habitat have been designated within the three-state area to protect habitat and promote the recovery of the species. Over the next 50 to 100 years, the protected areas on federal lands, which are generally managed under the Northwest Forest Plan, should provide for an increase in suitable nesting habitat. Although timber continues to be harvested, timber sale programs on federal lands require consultation with the U.S. Fish and Wildlife Service to review and assess the potential impacts of the timber harvests on the marbled murrelet. In 1997, the Fish and Wildlife Service approved a recovery plan for the marbled murrelet that specified actions necessary to halt the decline of the species in the three-state area.

Five-year reviews were completed for this species in 2004 and 2009.

References and Links

Northwest Interagency ESA Website: ESA and Streamlined Consultation documents, important references and links, and other materials Website

Status Reviews

Northwest Forest Plan—The first 20 years (1994-2013)
http://www.reo.gov/monitoring/reports/20yr-report/MAMU%20GTR_for%20posting_26May2015.pdf

Status Review of the Marbled Murrelet in Alaska and British Columbia. USGS 2006.
http://pubs.usgs.gov/of/2006/1387/

Survey Protocol

Inland Survey Protocol: Methods for Surveying Marbled Murrelets in Forests: A Revised Protocol for Land Management and Research. January 2003. Report

https://www.fws.gov/arcata/es/birds/MM/documents/2003%20PSG%20Murrelet%20Inland%20Sur

Other Marbled Murrelet Websites

U.S. Geological Survey: Patuxent Bird Identification Center
Northwest Forest Plan Information

U.S. Geological Survey: Patuxent Bird Identification Center
Northwest Forest Plan Information

Regional Ecosystem Office: Northwest Forest Plan Website

Regional Ecosystem Office: Northwest Forest Plan Website

USDA Forest Service, Pacific Region: Northwest Forest Plan Website

USDA Forest Service, Pacific Region: Northwest Forest Plan Website

Killer Whale (Orcinus orca) - Office of Protected Resources - NOAA Fisheries

Species
- Marine Mammals
  - Cetaceans
  - Pinnipeds
- Marine Turtles
- Marine & Anadromous Fish
- Marine Invertebrates & Plants
- Species of Concern
- Threatened & Endangered Species
  - Critical Habitat Maps

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Glossary
OPR Site Map

Search

Killer Whale *(Orcinus orca)*

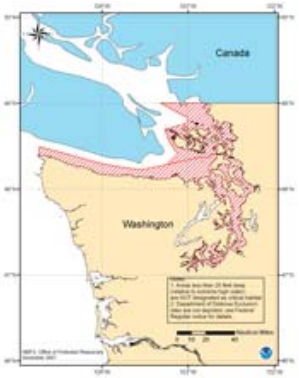
Status | Taxonomy | Species Description | Habitat | Distribution | Population Trends | Threats | Conservation Efforts | Regulatory Overview | Key Documents | More Info | Photos

Status

Killer whales are widely distributed around the world, but certain populations are listed as/protected under:
ESA Endangered - Southern Residents
MMPA Depleted - AT1 Transients
MMPA - all populations
CITES Appendix II - all populations

Killer Whales
(Orcinus orca)
Credit: NOAA

Killer Whale Range
(click for larger view PDF)



Southern Resident Killer Whale Critical Habitat
(click for larger view PDF)

Species Description

Weight: males can weigh up to 22,000 pounds (10,000 kg);
females can weigh up to 16,500 pounds (7,500 kg)

Length: males can reach 32 feet (10 m);
females can reach 28 feet (8.5 m)

Appearance: black on top with white undersides and white patches near their eyes; highly variable gray or white saddle behind the dorsal fin; these markings are unique across individuals and populations

Lifespan: up to 50-100 years:
males typically live for about 30 years, but can live as long as 50-60 years;
females typically live about 50 years, but can live as long as 100 years

Diet: varies (diet is often geographic or population specific), can include fish, marine mammals, sharks, and sea birds

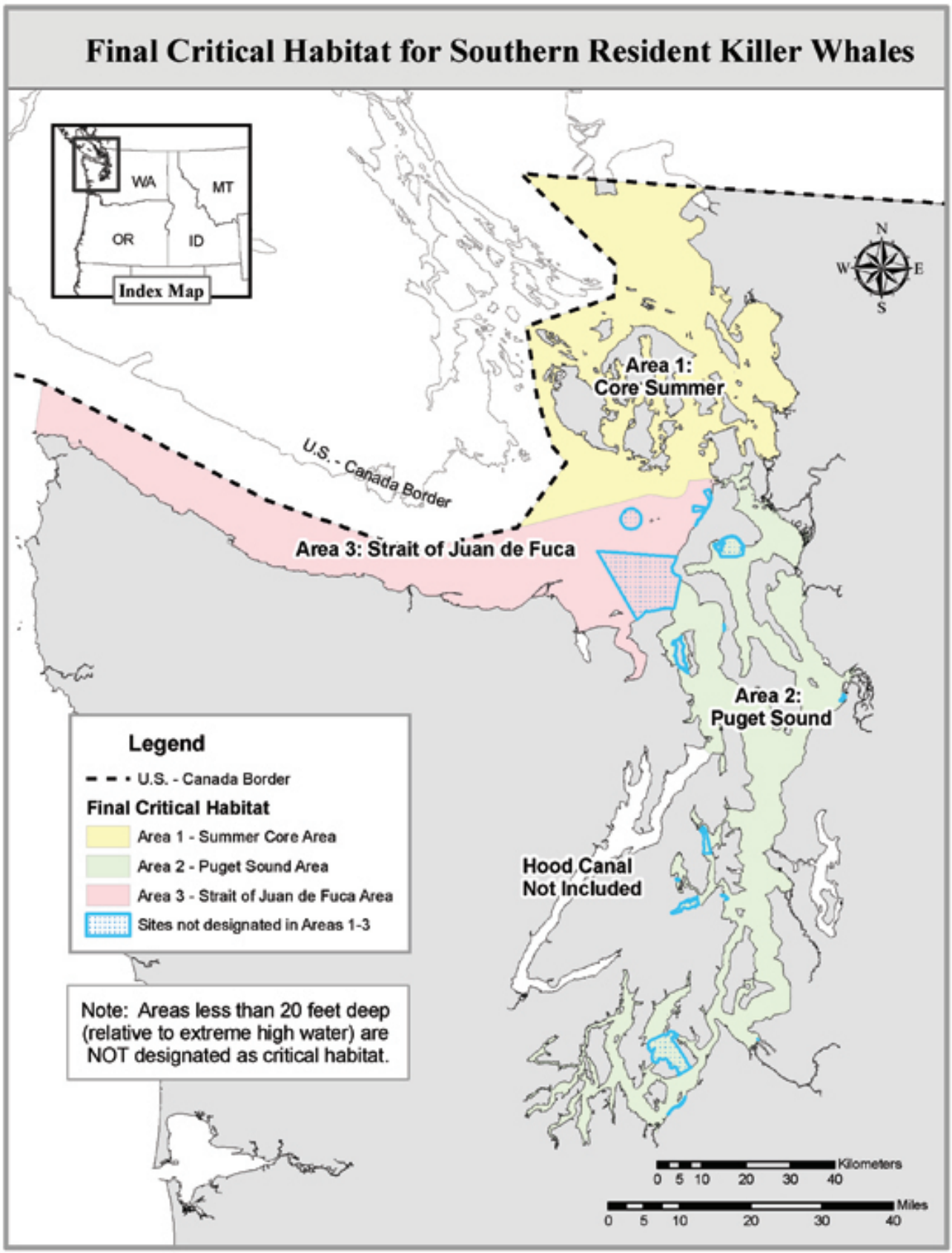
Behavior: highly social animals, living within matriarchal societies; rely on underwater sound for orientation, feeding, and communication; produce whistles and pulsed calls, used for communication and maintaining group cohesion

Killer whales most widely distributed marine mammals, found in all parts of the oceans; most abundant in colder waters, including Antarctica, the North Atlantic and Pacific Oceans. They also occur, though at lower densities, in tropical, subtropical, and offshore waters.

Killer whales are generally considered monotypic (belonging to one species). However, genetic studies and morphological evidence have led many cetacean biologists to now consider the existence of multiple species or subspecies of killer whales worldwide.[1]

Did You Know?

- Report highlights 10 years of research and conservation on Southern Residents
- Revision may be warranted for Southern Residents Critical Habitat.
- Killer whales can grow as long as 32 feet (10 m) and can weigh as much as 22,000 pounds (10,000 kg)!



http://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/killer_whales/esa_status/srkw-ch-bio-rpt.pdf

Appendix B

Penn Cove Shellfish
Environmental Code of Practice (ECOP)

Penn Cove Shellfish, LLC.

Environmental Code of Practice - Farm Plan

Revision Date: July 10, 2017

Penn Cove Shellfish, LLC

Environmental Farm Plan

Revision Date: July 10, 2017

Prepared By: **Penn Cove Shellfish, LLC**

Ian Jefferds, G.M.
P.O. Box 148
106 N. Sherman Road
Coupeville, WA 98239

360.678.4803
360.678.0266
www.penncoveshellfish.com

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List of Appendices

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1.0 Company Description

1.1 Overview

Penn Cove Shellfish was originally established as Penn Cove Mussels by the Jefferds family in June of 1975, in Coupeville Washington. In 1996 the company formed a joint venture with Coast Seafoods Company, America's largest oyster farm. In 2012, our partners at Coast Seafood were acquired by the Pacific Seafood Company, one of America's largest seafood companies. Today, this HAACP certified partnership is known and operated as Penn Cove Shellfish, LLC and is the oldest and largest mussel farm in the country.

It is our mission to be the premier provider of the finest sustainably farmed shellfish products in the market. Always fresh from the water, we grow, wet store, and distribute Penn Cove Mussels, Mediterranean Mussels, Manila Clams, Kumamoto Oysters and over 30 varieties of Pacific Oysters. We harvest customers' shellfish only after their orders are placed, ensuring them the absolute freshest Mussels, Clams and Oysters on the market!

1.2 Company Management

Penn Cove Shellfish is managed by a close team of members of the founding family and other employees who have made shellfish farming and sales their careers. The company is comprised of approximately 75 people in all the different realms required of the business, including the mussel seed and farming crew, the mussel harvest crew, the oyster and clam crew, the maintenance and engineering group, the sales and administrative staff, our distribution staff and our fabrication shop employees. Although everyone pitches in on a daily basis, the formal organizational structure is as follows:

General Manager:	Ian Jefferds
Asst. Manager:	Karen Jefferds
Farm Operations Manager:	Tim Jones
Quilcene Farm Manager:	Brad Woolf
Engineering Manager:	Eric Daigneault
Warehouse Supervisor	Rossy Flores
Penn Cove Harvest Foreman:	Brandon Sims

Beginning in 1975, Ian Jefferds worked with his parents to build the first mussel rafts in Penn Cove and to deliver the first crops of mussels while getting his degree in marine resource planning and assessment and a minor in marine biology and toxicology. After college and a few years working offshore in California and as a systems analyst in Ohio, Ian and his wife Karen returned to Whidbey Island and along with his younger brother Rawle, purchased the mussel farm from his father in 1986 so that he could be back on the water and have work to grow the business and its potential. The Jefferds and the rest of the crew at Penn Cove Shellfish are committed to preserving the ecological sustainability of the mussel farms they operate and the bays where they are located so to be able to carry on the company and natural legacy.

1.3 Environmental Policy

Penn Cove Shellfish, LLC Inc. is a member of the Pacific Coast Shellfish Growers Association (www.pcsga.org) and subscribes to the Environmental Policy and Code of Practice developed by the Association. A copy of this policy document is included in Appendix 1

We believe that Mother Nature likes us best and we work to return the favors which she provides. Management is very involved with water quality work groups such as the Island County Marine Resources Committee and C-CAN, the California Current Acidification Network, to conserve, protect and restore the resources which sustain our business and employees.

We also support the activities of the Pacific Shellfish Institute and other organizations that provide science based activities to reaffirm and develop new ways of maintaining and improving water quality and environmental sustainability.

Penn Cove Shellfish, LLC Inc. supports the concept of a conservation economy in which shellfish farming provides economic activity and valuable environmental services within the larger context of environmental sustainability. We work with our employees and the local community to preserve and protect the integrity of the marine ecosystem from which we derive our livelihoods.

1.4 Commitment to Farm Plan

Penn Cove Shellfish, LLC Inc. supports the concept and implementation of our environmental policy and Environmental Farm Plan. We will ensure that our company follows the plan to the best of our ability and ensure that new employees are trained in our Environmental Policy and Farm Plan measures.

Signed:

General Manager: _____ Date_____

Signed_____

Assistant Manager::_____ Date_____

Signed_____

Farm Operations Manager: _____ Date_____

Signed_____

Penn Cove Farm Manager: _____ Date_____

Signed_____

Quilcene Farm Manager: _____ Date_____

Signed_____

Warehouse Supervisor:_____ Date_____

Signed_____

Engineering Manager: _____ Date_____

Signed_____

2.0 Environmental Management System

2.1 Interactions in the Marine Environment

A) Schedule and method for monitoring farmsite(s) to assess presence of other species

Penn Cove Shellfish has been fortunate that the company's areas of operations have limited impacts from invasive species. A colonial tunicate of the Didemnum species is sometimes evident during our mussel harvest in Quilcene Bay however the lower salinity in Penn Cove appears to be a limiting factor and it is not evident there. We have collected samples for routine inspection the Washington Department of Fish and Wildlife as requested. Daily inspection is an ongoing process during harvest as product removed from the grow-out lines go over conveyor belts prior to separating and washing.

B) Promote and support protection of upland areas surrounding shellfish growing waters.

Management has been and remains heavily involved with the Northwest Straits Committee, the Island County Marine Resources Committee and the Island County Beach Watchers to promote conservation, restoration and protection of the water sheds affecting Whidbey Island and especially Penn Cove. Throughout the year, we provide farms tours for many conservation groups, school classes, regulatory agency staff, and visitors during our Mussel Festival; these tours provide us an outreach opportunity for education about the value of clean water and its importance to the sustainability of our farm operations and the jobs which it provides. We also support the different shellfish celebrations sponsored by the Pacific Coast Shellfish Growers Association and several different shellfish restaurant groups which benefit Puget Sound restoration.

C) Interactions with threatened or endangered species

We have no endangered species present on our farm site however we have a many Bald Eagles which remain on the Threatened list. Bald Eagle numbers have been steadily on the rise on Whidbey Island and they take the opportunity to prey on the many species of diving ducks which frequent the mussel rafts on our farm site. The do not nest on the farm site.

2.2 General Management Principles

A) Compliance with Applicable regulations and permit requirements.

Penn Cove Shellfish complies with all applicable regulations and has permits for the farm activities which take place there. A flow chart with a list of the permits necessary has been attached for review. Penn Cove Shellfish also undergoes annual third party audits which confirm compliance with all regulations.

B) Enhancement of growing area function and promotion of environmental protection

Raft culture of mussels provides many essential ecosystem services to the health of our farm sites in Penn Cove and Quilcene Bay. The physical nature of the mussel farm somewhat resembles an undersea forest and it provides the necessary elements of food and safety that an upland forest has so that the biodiversity of the area is much greater than the surrounding aquatic lands. Many species subsist within the three dimensional space encompassed by the farm. The rafts on the farm create roosting sites for marine avian species; haul out sites for harbor seals, harborage for salmon smolts heading seaward, food supplies of many amphipod species surround the mussel lines which are then preyed upon by several species of perch, gunnels, herring and smelt.

From a water quality improvement standpoint, the National Research Council (the principal operating agency of the National Academy of Sciences) has stated that "Nutrient over-enrichment is a significant problem for the coastal regions of the United States." Nutrient pollution is exacerbated by excess nitrogen and phosphates in marine waters. Sources of excess nutrients would include point source pollution like that from waste water treatment plants and non-point source pollution like pet wastes, lawn and garden fertilizers, farm animal wastes, and farm fertilizers found in runoff. Examples of its effects here in the US would include the dead zone at the mouth of the Mississippi River each spring, Chesapeake Bay, and Hood Canal here in Washington State.

Shellfish farming also has an beneficial impact to submerged aquatic vegetation such as eel grass habitat. Pew Oceans Commission has stated that "Filter-feeding mollusks can clarify the water by consuming plankton in aquatic systems, significantly improving water quality." By reducing the level of nutrients found in Puget Sound you allow more light penetration in marine waters so that eel grass might thrive more readily. In fact, Woods Hole Oceanographic Institution is on record as stating that, "Shellfish are by far the most cost-effective strategy to control pollution."

The Environmental Protection Agency "notes that mollusks are filter feeders and, in some cases, are recommended not only as a food source, but also as a pollution control technology in and of themselves." The capacity for shellfish farms to consume dense phytoplankton blooms which result from over nutrification also provide relief of this cause of anthropogenic caused ocean acidification.

C) Reducing impacts on new farm operations

Siting of a new mussel farm site is the key to successful and sustainable farming there. Key factors when siting a mussel farm are based on geographical, physical, biological and social elements. The geographical and physical elements may also affect the biological and social elements, especially when considering depth and current; water quality parameters such as temperature, salinity, DO levels, pH, exposure to wind and the proximity to shore. The biological elements include presence of predators, presence of endangered or threatened species, history of disease, and natural phytoplankton production. Lastly siting must consider any potential use conflicts of the area including altering the view shed which may create aesthetic concerns amongst some nearby homeowners.

D) Minimizing waste

Penn Cove Shellfish has worked deliberately to reduce waste by developing a farming system which re-uses farming materials year after year so to not create more garbage for the land fill. Our Disc-Net-Line System of farming mussels re-uses the mussel line and mussel discs year after year. Our mussel discs are made from recycled plastic and have a life span proven to last beyond 10 seasons so far. At the warehouse, waste cardboard fiber is set aside for pickup to be recycled. Biodegradable materials are used whenever possible such as for our mussel socking and non-essential materials are moved to land based storage or disposal.

All solid wastes are taken from our vessels to our warehouse daily where it is then picked up and delivered to the Island or Jefferson County waste disposal facility on a weekly basis. Our firm works hard to prevent any synthetic materials being lost to the marine environment. Vessel and material storage design have been adapted to prevent such loss as well as through inspection by crews whenever they are on the water. All bags and tags, brought to water are accounted for pre- and post-harvest and the farm site is regularly monitored for materials that may present a hazard to the environment. Regular beach walks are conducted to recover any lost mussel discs and any and all waste found on the farm site and nearby beaches is removed for disposal. The company has also placed a bounty on lost mussel discs whereby anyone who finds them may trade them in for bags of mussels at their convenience.

E) Ensuring that Hazardous Materials do not escape into the marine environment

The use of hazardous materials is limited to fuel for the vessels to minimize and to prevent any contamination of the marine environment. The use "environmentally friendly", biodegradable cleaning agents and vegetable based food grade lubricants and hydraulic oil are part of the reasonable efforts made to ensure that responsible choices are made when purchasing potentially hazardous materials. Four stroke outboard motors are used to replace old 2-stroke motors so to exceed EPA regulations. Outboard motor and associated fuel/lube is maintained per manufacturer's specification and fuel is stored off-site when not in use. Solid waste from the vessels is taken to shore daily or pumped off at the pump out facility on a weekly basis.

An extensive spill plan has been created by the company to ensure that these materials do not enter the environment and the company has worked with regulatory agencies to improve spill legislation and geographic spill preparedness for our region.

F) Patrol for marine debris and waste

Beach walks are conducted after extreme tide or wind events and throughout the year to patrol the tide line in search of any and all waste materials which are then collected and disposed of at the county landfill.

G) Minimizing and re-use of wastewater.

Waste water is not generated on our farm sites and any that is created at our packing facility is treated in an approved design septic system or drained to a rain garden treatment basin, depending upon the type of waste water.

H) Use of motorized vessels

The farm sites are served by vessels as they are all located sub-tidally. During low tides, a Case tractor is used to access a designated intertidal area in order to bring product from the vessels to the loading area on shore. This tractor is maintained regularly to make sure that it does not leak fluids. Employees are instructed to only operate the vehicle in the designated use, non-sensitive area.

I) Energy Efficient machinery and vehicles

Several vessels are powered by energy efficient diesel powered hydraulic thrusters and skiffs are being converted to utilize efficient 4-stroke motors that meet ultra-low emission EPA and CARB requirements. New efficient hydraulic thruster systems are being fabricated to replace outboards used on any barges.

J) Oil and contaminant spill response

The company general manager, engineers. farm operations manager and crew supervisors have recent spill recovery experience following a fire and sinking of a derelict vessel and a subsequent diesel oil spill in Penn Cove in 2012 These staff worked with agency personnel and contractors during the spill recovery and are working to be certified as HAZWOPER technicians (24 hour). We have worked with agency personnel to improve spill response capacity and the Washington State Oil spill response plans for our farm regions: http://www.ecy.wa.gov/programs/spills/preparedness/GRP/wa_marine_grps.htm

Spill kits are maintained on harvest vessel and at our shore facilities. Crew is instructed on how to report a spill to the National Response Center: 1-800-424-8802 and the Washington Emergency Management

Division: 1-800-258-5990 OR 1-800-OILS-911 and numbers are posted in wheelhouse of the harvest barge, seed barge and transport vessels.

K) Maintenance of structures in navigable waters

The farm perimeters are marked with amber, 6-second flashing lights as per U.S. Coast Guard Private Aids to Navigation (PATON), requirements and are listed on USCG Navigation Charts.

L) Equipment and Maintenance schedules

Vehicles, vessels, and equipment are all inspected and serviced per the preventative maintenance and lubrication schedule established by the manufacturer or the hourly operations maintenance schedule. Service logs are kept aboard the vessels and offsite in the engineer's service log. Vehicles and outboard engines are serviced offsite at company maintenance facilities.

M) Communications with Upland users and other resource users

The company has a long history operating in the Penn Cove and Quilcene Bay farm areas and has mitigated operations schedules, practices and equipment to prevent complaints from nearby property owners. Company staff has worked to establish relationships and communicate with upland property owners through direct communications, through providing farm tour opportunities, through local education and outreach seminars such as Beach Watchers and the annual Sound Waters event, through involvement and support of local festivals such as the Penn Cove Mussel Festival and the Penn Cove Water festival, and others. The company hires local people and is now one of the largest private employers in Coupeville and Quilcene which helps integrate knowledge of practices and products produced into the community.

N) Reducing odors, noise and lights

The farm sites maintained by Penn Cove Shellfish, LLC Inc. are in rural and remote locations and, as such, effects on adjacent landowners have been minimized.

Safe vessel speed and boating practices are observed in near shore areas and staff are instructed and certified in safe boating procedures.

Crews do not normally work at night and lighting on vessels is directed downward to the work decks to prevent glare from reaching the shore. The crew is instructed on reducing noise while on the water and activities such as playing loud music are prohibited. Noise control is for equipment is provided by sound dampening material utilized to line equipment enclosures and by the use of hospital or critical grade mufflers on the engines powering the hydraulic systems. Quiet four-stroke outboard engines are being used to replace the old two-stroke engines.

Equipment subject to bio-fouling, such as predator nets are cleaned and dried on the water prior to them becoming heavily impacted so that odors do not occur at grow-out sites or storage areas.

O) Maintaining clean and orderly sites

All materials are accounted for and brought onsite only when needed and removed following their scheduled use. Farm sites are developed with similar materials and are laid out in an orderly fashion to reduce visual impacts.

All unnecessary materials are removed off-site. Equipment and necessary materials are secured before the end of each daily shift to prevent loss, and all equipment is accounted for by the crew supervisor.

Biodegradable materials are used whenever possible, and non-essential materials are moved to land based storage or disposal.

Mussel rafts are inspected regularly during harvest and monthly during inventory assessment and any dislodged materials are collected or re-installed.

P) Ecosystem Mitigation

Penn Cove Shellfish, LLC Inc. is very proactive in protecting the environment and works collectively with other agencies and neighbors to minimize human impact and mitigate change to the environment. See 2.2 (B).

Scientific information shows that the presence of shellfish in the ecosystem has significant benefits to water quality and ecosystem function. Information on this may be found on the PCSGA website http://www.pcsga.org/Research/index.html.

2.3 Pest, Predator and Disease Control

A) Minimizing the potential for disease and invasive species.

The Penn Cove Shellfish, LLC Inc. pest, predator and disease control systems are based on the Shellfish High Health Program guidelines that are endorsed by the Pacific Coast Shellfish Growers Association and recognized by the United States Department of Agriculture, Animal and Plant Health Inspection Service (U.S.D.A. - A.P.H.I.S.).

Only hatchery seed stock which is certified disease and pathogen free, OR natural set seed is used in our seeding operations. Penn Cove is the most prolific mussel settlement bay in the State of Washington and was chosen as a farm site partially for that reason.

Harvest crews have been trained in identification of invasive species such as green crab and will report any incidences immediately. Penn Cove also has an ongoing monitoring plan for the U.S. Army Corps of Engineers which involves looking for any settlement of naturalized Mediterranean mussels in Penn Cove amongst native blue mussel stocks.

B) Predator exclusion materials

Penn Cove Shellfish utilizes weighted net panels secured and suspended from perimeters of the mussel rafts during the migration season of the many species of diving ducks along the Pacific flyway. The ducks usually show up in the fall and leave in late spring. Netting is hung on the square and is sized to prevent the ducks getting trapped within it. The netting is removed from the rafts following the departure of the ducks, it is cleaned and dried on the rafts and then stored at the company facilities upland.

C) Biofouling

All bio-fouling is controlled by physical removal and deposit within the permitted grow-out area. The benthos is monitored on an occasional basis, usually when checking moorings, to ensure that there are no negative impacts caused by biological accretion on the seafloor. The company operations in Penn Cove

have actually been shown to enhance the area beneath the rafts as it is primarily composed of anaerobic suspended silt, and the shell accretion over nearly 4 decades of farming there has created a solid substrate now capable of supporting a diverse biological community as compared to the areas away from the rafts which are devoid of any life.

D) Integrated Pest Management Program

Penn Cove Shellfish, LLC Inc. does not require an IPMP. Currently known pests in Penn Cove and Quilcene Bay are limited to Japanese Oyster Drills, Ceratostoma inornatum; Scoters, Melanitta Sp.; shore crabs, Hemigrapsus oregonensis; ghost shrimp, Callianassa californiensis; moon snails, Polinices lewisii; and various species of starfish Pistaer sp, Pycnapodia helianthoides; however, impacts due to these pests has not greatly impacted operations.

E) Appropriate predator control response

Predator exclusion netting is hung from the perimeter of the rafts during the fall migratory season for the many species of diving ducks which travel the Pacific Flyway. The predator nets are checked daily to insure that no openings have occurred to allow the ducks to pass through, and to remove any driftwood caught in them. The nets are removed in the late spring when ducks have returned north for the summer.

2.4 Hatchery and Nursery Operations

A) Inspection of transferred shellstock

All hatchery produced shellfish seed purchased is subject to transfer permits by the Washington State Department of Fisheries Biologist follow histological inspection of the broodstock for infectious disease by a certified fish/shellfish pathologist.

B) Use of antibiotics

Penn Cove Shellfish does not operate a hatchery.

C) Reducing hatchery impacts to flora and fauna

Penn Cove Shellfish does not operate a hatchery.

2.5 Secondary Nurseries: Seed Floats, Floating Upwell Systems (FLUPSY)

A) Impacts to the seafloor

Penn Cove Shellfish does not operate a hatchery.

B) Clean-up measures and mitigation

Penn Cove Shellfish does not operate a hatchery.

C) Avoiding light limitations

Penn Cove Shellfish does not operate a hatchery.

D) Preventing wildlife injury by paddle wheels

Penn Cove Shellfish does not operate a hatchery.

2.6 Seed Thinning and Transplant Operations

A) Operational Impact Prevention

Equipment design and practices similar to harvest operations have been implemented for mussel seed thinning and transplant operations so to limit potential social and biological impacts.

3.0 Appendices

List of Appendices

Appendix 1: Photos of Penn Cove and Quilcene Farm Operations

Appendix 2: Copy of DOH Shellfish Farm License

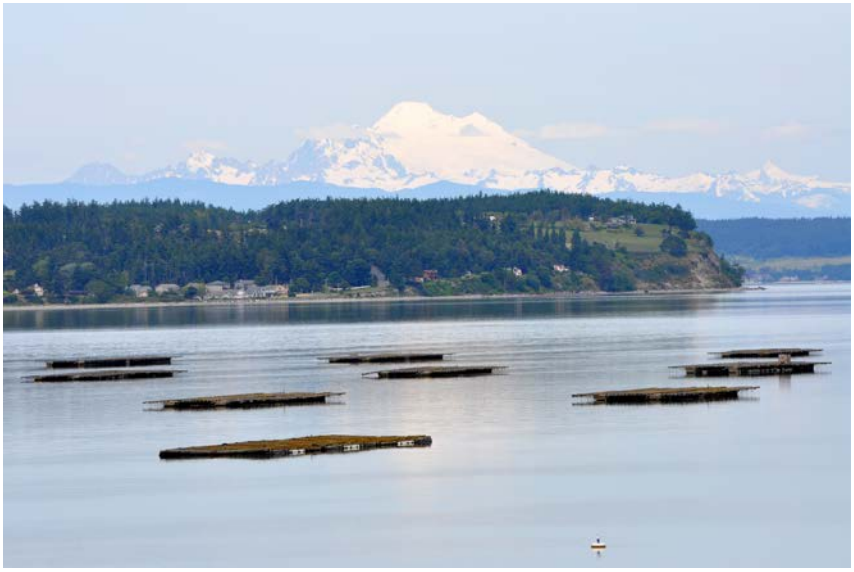
Appendix 3: Mussel Farm Site Maps

Appendix 4: Shellfish Aquaculture Permit Summary

Mussel Farm in Quilcene Bay

Mussel Line

Mussel Rafts in Quilcene Bay



Mussel Rafts in Penn Cove

Yacht Week Races in Penn Cove

Harvest Barge & Rafts in Penn Cove

Mussel Lines Suspended From Raft

Bald Eagle Leaving Raft Roost

Harbor Seals Hauled Out on Raft

Shore Birds Roosting on Raft

Bald Eagle Roosting on Raft

Penn Cove Shellfish Products

Shellfish Packing Warehouse

Appendix C

Essential Fish Habitat Assessment

APPENDIX C
ESSENTIAL FISH HABITAT ASSESSMENT

ACTION AGENCY

U.S. Army Corps of Engineers, Seattle District

LOCATION

The project area is within Quilcene Bay at the northern end of Hood Canal. The "project area" is defined as the 9 acres of aquatic lands where the proposed mussel rafts would be located at Township 19N, Range 2W, Section 5. The Biological Evaluation (BE) prepared for this project has a more detailed description of the project area.

PROJECT NAME

Quilcene Bay Mussel Farm (NWS-20 07-01412)

ESSENTIAL FISH HABITAT BACKGROUND

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires federal agencies to consult with the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS) on activities that may adversely affect Essential Fish Habitat (EFH). EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (NMFS 1999).

This assessment evaluates the impacts of the proposed project to determine whether it "may adversely affect" designated EFH for federally managed fisheries species in the proposed action area. The Quilcene Bay Mussel Farm BE describes conservation measures to avoid, minimize, or otherwise offset potential adverse effects of the proposed action on critical habitat for Endangered Species Act (ESA) listed species, which also includes habitat designated as EFH.

IDENTIFICATION OF EFH

Groundfish, coastal pelagic, and salmonid fish species that could have designated EFH in the action area are listed in Table C-1. Several of these species are not typically found in the action area due to lack of preferred habitat or occurrence in North Hood Canal. Assessment of the impacts on species that may occur in the action area is based on life-history stages described in Casillas et al. (1998) and PFMC (1998; 1999; 2014).

Table C-1 Species of Fish with Designated Essential Fish Habitat in the Project Area

Common Name	Scientific Name	Common Name	Scientific Name
Groundfish		**Groundfish (cont.)**	
arrowtooth flounder	*Atheresthes stomias*	Pacific sanddab	*Citharichthys sordidus*
big skate	*Raja binoculata*	petrale sole	*Eopsetta jordani*
black rockfish	*Sebastes melanops*	quillback rockfish	*Sebastes maliger*
bocaccio	*Sebastes paucispinis*	ratfish	*Hydrolagus colliei*
brown rockfish	*Sebastes auriculatus*	redbanded rockfish	*Sebastes babcocki*
butter sole	*Isopsetta isolepis*	redstripe rockfish	*Sebastes proriger*
cabezon	*Scorpaenichthys marmoratus*	rex sole	*Glyptocephalus zachirus*
California skate	*Raja inornata*	rock sole	*Lepidopsetta bilineata*
canary rockfish	*Sebastes pinniger*	rosethorn rockfish	*Sebastes helvomaculatus*
China rockfish	*Sebastes nebulosus*	rosy rockfish	*Sebastes rosaceus*
copper rockfish	*Sebastes caurinus*	rougheye rockfish	*Sebastes aleutianus*
curlfin sole	*Pleuronichthys decurrens*	sablefish	*Anoplopoma fimbria*
darkblotch rockfish	*Sebastes crameri*	sand sole	*Psettichthys melanostictus*
Dover sole	*Microstomus pacificus*	sharpchin rockfish	*Sebastes zacentrus*
English sole	*Parophrys vetulus*	shortspine thornyhead	*Sebastolobus alascanus*
flathead sole	*Hippoglossoides elassodon*	spiny dogfish	*Squalus acanthias*
greenstriped rockfish	*Sebastes elongatus*	splitnose rockfish	*Sebastes diploproa*
hake	*Merluccius productus*	starry flounder	*Platichthys stellatus*
kelp greenling	*Hexagrammos decagrammus*	striptail rockfish	*Sebastes saxicola*
lingcod	*Ophiodon elongatus*	tiger rockfish	*Sebastes nigrocinctus*
longnose skate	*Raja rhina*	vermilion rockfish	*Sebastes miniatus*
Pacific cod	*Gadus macrocephalus*	yelloweye rockfish	*Sebastes ruberrimus*
Pacific ocean perch	*Sebastes alutus*	yellowtail rockfish	*Sebastes flavidus*
Coastal Pelagic		**Salmonid Species**	
market squid	*Loligo opalescens*	Chinook salmon	*Oncorhynchus tshawytscha*
northern anchovy	*Engraulis mordax*	coho salmon	*Oncorhynchus kisutch*
jack mackerel	*Trachurus symmetricus*	pink salmon	*Oncorhynchus gorbuscha*
Pacific mackerel	*Scomber japonicus*		
Pacific sardine	*Sardinops sagax*		

Table C-3. Relative contribution (percent) of the top 48 species to overall variation in benthic community structure as measured by chord-normalized expected species shared (CNESS).

Species	Rank	Contribution	Cumulative contribution
Axinopsida serricata	1	5	5
Euphilomedes producta	2	4	9
Heteromastus filobranchus	3	4	13
Macoma carlottensis	4	3	17
Prionospio (Minuspio) lighti	5	3	20
Cossura bansei	6	3	23
Leitoscoloplos pugettensis	7	3	26
Euphilomedes carcharodonta	8	3	28
Euphausiacea	9	3	31
Nutricola lordi	10	2	33
Aricidea (Acmira) lopezi	11	2	36
Lumbrineris cruzensis	12	2	38
Parvilucina tenuisculpta	13	2	40
Pinnixa sp	14	2	42
Pectinaria californiensis	15	2	44
Nephtys cornuta	16	2	46
Eudorella pacifica	17	2	48
Hyperiidae	18	2	49
Paraprionospio pinnata	19	2	51
Exogone lourei	20	2	53
Mediomastus sp	21	2	54
Phyllochaetopterus limicolus	22	2	56
Phoronis sp	23	2	58
Galathowenia oculata	24	2	59
Rhepoxynius boreovariatus	25	1	61
Bathymedon pumilus	26	1	62
Scoletoma luti	27	1	63
Brisaster latifrons	28	1	65
Spiophanes berkeleyorum	29	1	66
Sigambra nr bassi	30	1	67
Levinsenia gracilis	31	1	68
Alvania compacta	32	1	70
Myriochele olgae	33	1	71
Decamastus gracilis	34	1	71
Pulsellum salishorum	35	1	72
Acila castrensis	36	1	73
Podarkeopsis perkinsi	37	1	74
Prionospio (Prionospio) jubata	38	1	75
Cossura pygodactylata	39	1	75
Calanoida	40	1	76
Chaetozone commonalis	41	1	77
Gammaropsis thompsoni	42	1	77
Rochefortia tumida	43	1	78
Compsomyax subdiaphana	44	1	79
Phyllochaetopterus prolifica	45	1	79
Astyris gausapata	46	1	80
Ennucula tenuis	47	1	81
Levinsenia oculata	48	1	81

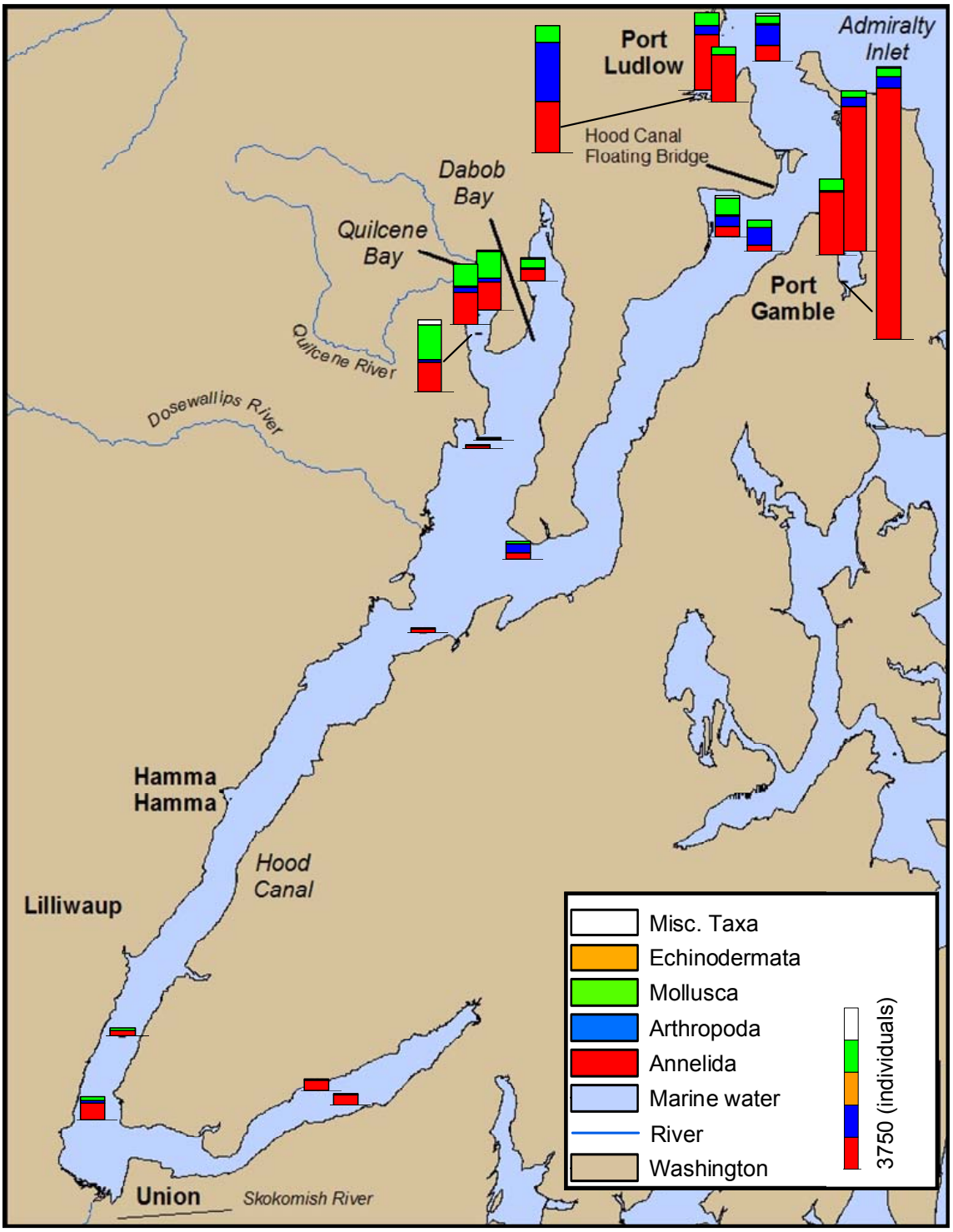


Figure C-1. Major taxa abundance measured at each station in Hood Canal for the 1999 PSAMP/NOAA Monitoring Program.

Species Presence in Action Area

The following discussion includes the species (by major group) with designated EFH that are likely to occur in the proposed action area.

Groundfish

Groundfish species most likely to occur in the action area include flatfish and rockfish. Rockfish are considered to have a "vulnerable" status in Puget Sound (Bargmann et al. 2011). Although the three ESA-listed species discussed in the BE are considered to be part of the deepwater assemblage which is dissimilar to the project area, there are species of rockfish in the nearshore sedentary assemblage that live in close association with rocky habitats at depths less than 120 feet (ft), including Puget Sound, Copper, Brown, and Quillback rockfish (Lowry et al. 2015). These four species are also the ones most frequently observed in the Puget Sound, based on historical records and recent sampling. Copper and Brown rockfish are the more common shallow water species in Puget Sound, and even increased during dive surveys between 1987 and 2015.

In terms of flatfish potentially present in the proposed action area, there is potential habitat for species that typically spawn and rear in sand and mudflat habitat (e.g., English sole, starry flounder). Larger flatfish (e.g., arrowtooth flounder, petrale sole, and sand sole) would likely occur in the deeper waters under the proposed mussel rafts. According to the Puget Sound Partnership (2008), populations of English sole, starry flounder, sand sole, and Pacific halibut have increased in the Puget Sound in recent years.

Lance and Jeffries (2009) reported high proportions of midshipman and flatfish (primarily starry flounder and English sole) in harbor seal diets within the Puget Sound. Diet data collected in the Nisqually River in 1988 and Gertrude Island in 1979, 1994, and 1995 were similar in composition and proportion to the 2008 values, which led to the tentative conclusion that groundfish populations within the Puget Sound have not seen significant shifts in abundance. However, no firm conclusion can be made since diet composition is not as accurate as abundance surveys.

Coastal Pelagic Species

The coastal pelagic species that has the most amount of information in North Hood Canal is the northern anchovy, although they are not a species of relative abundance there. Northern anchovy are a pelagic schooling fish that utilize open water for broadcast spawning during late spring and summer months (Penttila 2007). Penttila (2007) noted that northern anchovy may use nearshore habitats during other parts of their life histories. For example, young-of-the-year anchovies occur in the nearshore zone in the summer, presumably to feed on plankton. The northern anchovy was an important component of harbor seal diets in Hood Canal and San Juan Islands but not in northern Hood Canal (Lance and Jeffries 2009). Because of the similarities in life history and habitat requirements, analysis of EFH for coastal pelagic species will treat all four species as a single complex. These fish are limited to waters above the thermocline where sea surface temperatures range between 10 and 26 degrees centigrade, which varies seasonally and annually (PFMC 2014).

Salmonid Species

WDFW (2014) identified three distinct stocks of salmonids that have designated EFH in Quilcene Bay: summer chinook, summer run chum salmon and steelhead. As discussed in the BE, Coho salmon from Quilcene Bay are likely from hatchery releases. The streams that have documented presence of Chum salmon the Big Quilcene and Little Quilcene Rivers, both tributaries of Quilcene Bay at the northwestern end of Quilcene Bay. Coho were also documented in the Big Quilcene and Little Quilcene Rivers, originating from hatchery releases (WDFW 2014).

DESCRIPTION OF THE PROPOSED PROJECT

Penn Cove Shellfish proposes to expand an exisiting floating mussel aquaculture facility (Quilcene Bay Mussel Farm) along the southeastern shore of Quilcene Bay, within Jefferson County, Washington. The proposed 9-raft expansion of the mussel farm would be located on the northern end of Penn Cove Shellfish's tideland ownership.

The proposed expansion of the Quilcene Bay Mussel Farm would cultivate "Mediterranean" (also known as "Gallo") mussels (*Mytilus edulis galloprovincialis*). Penn Cove Shellfish has cultivated this species of mussel at its two existing farms within Quilcene Bay and Penn Cove since 1993.

The proposed project consists of 9 rafts clusters that would be 40 feet by 120 feet in dimension. Each raft cluster is comprised of three 40' x 40' raft units (BE Figure 2). There would be a 75 foot east-west separation between raft clusters, and a 250 foot north-south separation between raft clusters. The rafts themselves would occupy about 0.99 acres of subtidal habitat, located between -45 ft and -100 ft mean lower low water (MLLW). The 9-acre lease expansion area is located about 300 ft horizontal distance from the shoreline, and extends about 350 feet further offshore. The length of the lease expansion area parallels the shoreline for approximately 900 ft.

For a more detailed project description, see Section 2.1 of the BE.

SITE CHARACTERISTICS

Quilcene Bay is one of two inlets at the northern end of Hood Canal. Quilcene Bay extends 3.2 miles in a south to north direction, and is hydraulically connected to Dabob Bay and Hood Canal. The marine water of Quilcene Bay has a total surface area of 1,626 acres at 0.0 ft MLLW, with an intertidal area of approximately 808 acres. Relative to the deeper bays in Puget Sound, Quilcene Bay is a modereately shallow basin, with a mean depth of 60 ft and a maximum depth of 222 ft.

Quilcene Bay serves as a drainage basin for the Little and Big Quilcene Rivers and Indian George Creek watershed, an area dominated by silvicultural and rural residential land use. The primary direct freshwater inputs are from the Little and Big Quilcene Rivers and Indian George Creek (WDFW). A report by Ecology (Shull,2007) on water quality demonstrated that Quilcene Bay had some of the best conditions in all of Hood Canal in terms of near-bottom dissolved oxygen.

There is limited macroalgae in the project area and surrounding habitat. During a site inspection conducted 24 June, 2017, there was no marine vegetation on the beach at the Coast Hatchery parking site where the mussel rafts would be assembled for deployment). The project area has some amount of sea lettuce (*Ulva* sp.) and brown kelp (*Laminaria* sp.), although the majority of macroalgae occurs in the intertidal habitat of Quilcene on the northern shore. Survey show that attached *Laminaria* and *Ulva* were sparsely present only to depths of -10 ft MLLW and shoreward, but in none of the area where the raft-units would be located (BE Figure 6). There are no eelgrass beds in the action area (Ecology 2014).

A detailed description of existing conditions is presented in Section 3.0 of the BE.

POTENTIAL ADVERSE EFFECTS OF PROPOSED PROJECT

PFMC (2014) mapped Habitat Areas of Particular Concern (HAPC) along the Pacific Coast. HAPCs are areas of habitat within EFH that may be ecologically important, sensitive to human-induced environmental degradation, stressed by development, and rare. Section 3.0 of the BE describes, in detail, the potential impacts to habitat constituents important to ESA-listed species, which are similar to those for EFH species. The analyses presented in the BE that addresses elements specific to EFH includes: (1) water quality, (2) sediment quality, (3) macroalgae, (4) benthic community, (5) forage fish, and (6) migration corridor. Elements of the analysis presented in the BE are reiterated or cross referenced below.

Groundfish Species

Although potential effects were discussed in the BE in relation to habitat associated with ESA-listed rockfish species, the discussion is also relevant to habitat associated with other groundfish species (e.g., other rockfish, flatfish). Groundfish may occur in the project area or immediately offshore at any time of the year. Some groundfish species (e.g., copper rockfish) are known to be attracted to overwater structures (Cardwell and Fresh 1979). Based on detailed studies prepared for a limited-scope Environmental Impact Statement (EIS), the BE concluded that the proposed mussel raft would not significantly affect water quality, prey items, or nearshore areas free of obstruction.

In addition, the NMFS (2009) Biological Opinion for Nationwide Permit 48 for shellfish aquaculture (including mussel rafts) in Washington State also concluded that effects of operation activities would not likely impact benthic epifauna, the dominant food resource for groundfish. Therefore, the proposed action is not expected to adversely affect EFH for groundfish species.

Coastal Pelagic Species

The BE included an analysis of potential effects to forage fish (BE Section 3.5), of which one of the coastal pelagic species (northern anchovy) was included in the analysis. The northern anchovy, and other coastal pelagic species, are not present in Quilcene Bay. The proposed project is not expected to adversely affect EFH for coastal pelagic species because their prey (phytoplankton and zooplankton) availability is unlikely to be affected by the project. Overwater structures may increase the abundance of baitfish, but EFH for coastal pelagic species would not be significantly affected.

Salmonid Species

The primary constituent elements (PCEs) of designated critical habitat essential for the conservation of Chinook salmon within the action area include: an estuarine area free of obstruction and excessive predation; water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. These would be the same elements considered for EFH associated with other salmonids in the action area.

Similar to the discussion of ESA-listed salmonids in the BE, there are unlikely to be impacts to Chinook, coho, chum or pink salmon habitat found in the action area. Shellfish aquaculture has a short-term negative effect and long-term positive effect on water quality, and the proposed rafts do not pose a migrational obstruction for salmonids. Overall, the proposed action is expected to have an insignificant or beneficial effect on Pacific Coast salmon habitat in the project area.

CONSERVATION MEASURES

Implementing the conservation measures specified in Section 2.1.6 of the BE would avoid and minimize potential adverse effects of the proposed project. These measures are consistent with those outlined in the Penn Cove Shellfish (2017) Environmental Code of Practice, and additional relevant shellfish culture conservation measures adopted by the Corps from its consultation with the NMFS (2009; 2011) and USFWS (2009) on Nationwide Permit 48. Avoidance of potential impacts, where possible, is the first priority.

CONCLUSION

As described above, the proposed activity is not expected to cause adverse impacts on EFH parameters and should not reduce the overall value of the EFH of managed groundfish, coastal pelagic, or salmonid species.

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