Critical Habitat Exposure Analyses

Supplemental to comments provided by Alison Willy on June 24, 2021

The *Nordic Aquafarms California LLC Samoa Peninsula Land-based Aquaculture Project Numerical Modelling Report* (GHD 2020a) clearly shows that effluent from the Project discharged into coastal marine water will enter Humboldt Bay (Figure 1). The modeling in GHD 2020a is incomplete, because only a unidirectional, southbound current was modeled. In the vicinity of the outfall pipe, strong currents shift from a southbound current to a northbound current. Although the modeling is incomplete, a preliminary inquiry into effluent impacts on critical habitat for listed species is possible. The full range of discharge distribution should be analyzed using existing data on local currents. Once the effluent distribution has been fully analyzed and explained, the effects of the effluent on the primary constituent elements of critical habitat and the physical or biological features essential for conservation listed species should be determined. In the meantime, effects to primary constituent elements of critical habitat can be partially described.

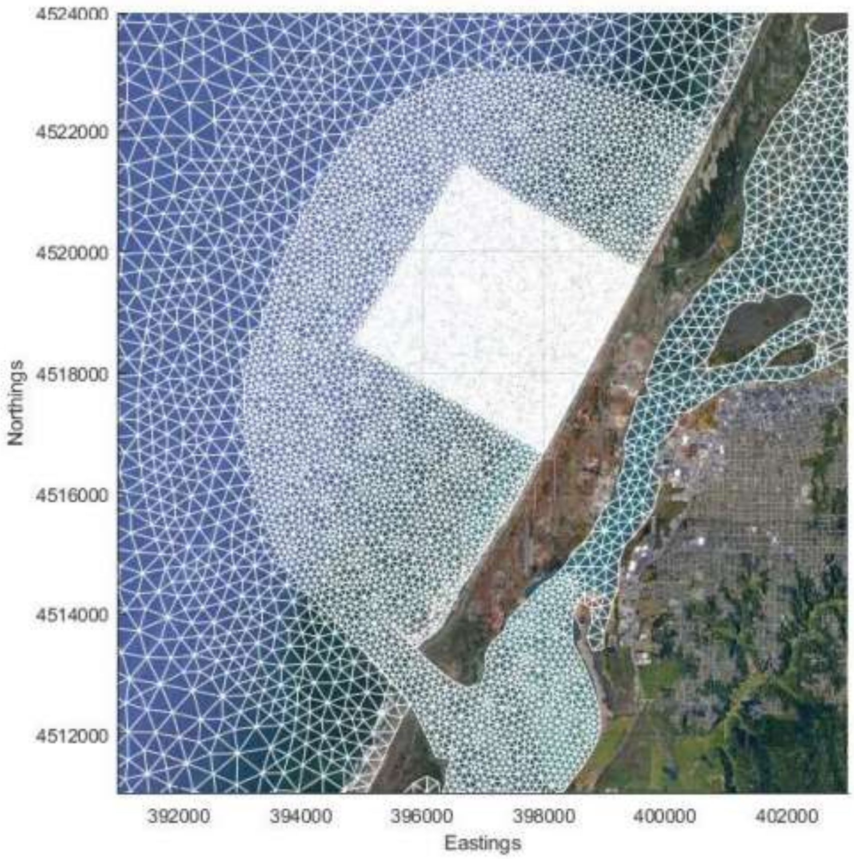

Figure 1. Excerpt from Figure 7 of the *Nordic Aquafarms California LLC Samoa Peninsula Land-based Aquaculture Project Numerical Modelling Report* (GHD 2020a)

Green Sturgeon Critical Habitat

Critical habitat for the Southern DPS of green sturgeon (green sturgeon) includes both Humboldt Bay and the marine waters off the coast of Samoa Peninsula (NOAA Fisheries 2009). The coastal marine waters from Humboldt Bay to Coos Bay (OR) have a high conservation value for survival and recovery of the green sturgeon. Tributaries to Humboldt Bay that are included in the green sturgeon critical habitat designation are: Elk River, Eureka Slough, Freshwater Creek, Freshwater Slough, Bannon Slough, Jacoby Creek, Liscom Slough, Mad River Slough, McDaniel Slough, Rocky Gulch/Washington Gulch, Salmon Creek, an unnamed tributary, and White Slough.

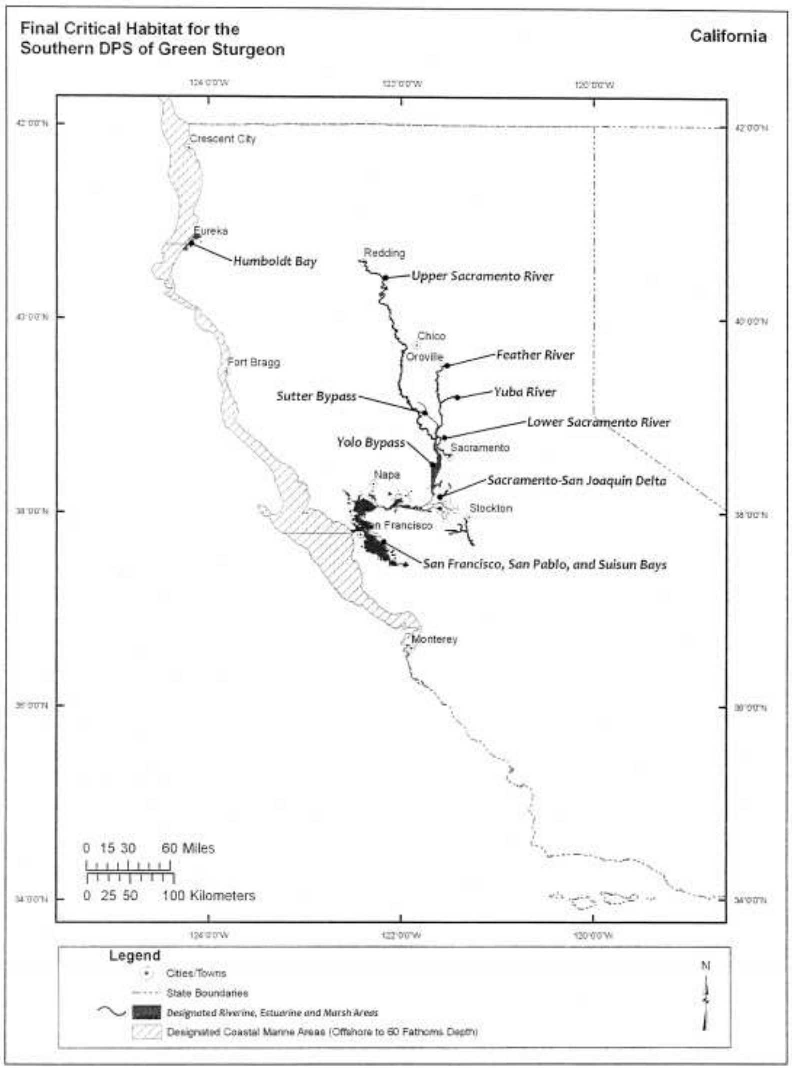

Figure 2. Map of Final Critical Habitat for the Southern DPS of Green Sturgeon, clearly showing Humboldt Bay and the Coastal Marine Waters Included in the October 9, 2009, Critical Habitat Designation.

The primary constituent elements of nearshore coastal marine critical habitat areas that are essential for the conservation of green sturgeon are: (i) Migratory corridor—a migratory pathway for the safe and timely passage within marine and between estuarine and marine habitats; (ii) Water quality—nearshore marine waters with adequate dissolved oxygen levels and acceptably low levels of contaminants (*e.g.*, pesticides, organochlorines, elevated levels of heavy metals) that may disrupt the normal behavior, growth, and viability of sub-adult and adult green sturgeon; (iii) Food resources—abundant prey items for sub-adults and adults, which may include benthic invertebrates and fishes (NOAA Fisheries 2009). Both water quality and food resources are likely to be adversely affected by effluent from the Project.

The primary constituent elements of estuarine critical habitat areas that are essential for the conservation of green sturgeon are: (i) Food resources—Abundant prey items within estuarine habitats and substrates for juvenile, subadult, and adult life stages. (ii) Water flow—Within bays and estuaries adjacent to the Sacramento River (*i.e.,* the Sacramento-San Joaquin Delta and the Suisun, San Pablo, and San Francisco bays), sufficient flow into the bay and estuary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds. (iii) Water quality—Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages. Humboldt Bay serves as important feeding, rearing, and migratory habitat for subadult and adult Southern DPS green sturgeon (NOAA Fisheries 2009). Food resources and water quality in Humboldt Bay are likely to be adversely affected by effluent from the Project.

Chinook Salmon and Steelhead Critical Habitat

Critical habitat for the California Coast Chinook Evolutionarily Significant Unit (Chinook salmon) and Northern California Steelhead Distinct Population Segment (steelhead) was listed concurrently on September 2, 2005 (NOAA Fisheries 2005). It can easily be seen that the Eureka Plain Hydrologic Unit of critical habitat (Figure 3) overlaps with the modeled discharge of the analyzed southbound current (Figure 1). It can also be easily ascertained that Elk River and Salmon Creek are likely to be exposed to higher rates of effluent discharge than Freshwater Creek, Jacoby Creek, Mad River, and Eel River.

When modeling is completed that includes northbound longshore flows and an incoming tide, the Mad River section of the Eureka Plain Hydrologic Unit (seen in Figure 3) and the Mad River Hydrologic Unit (Figure 4) some level of effluent will be seen to enter these critical habitat units. At this point, incomplete modeling is yielding and incomplete answer.

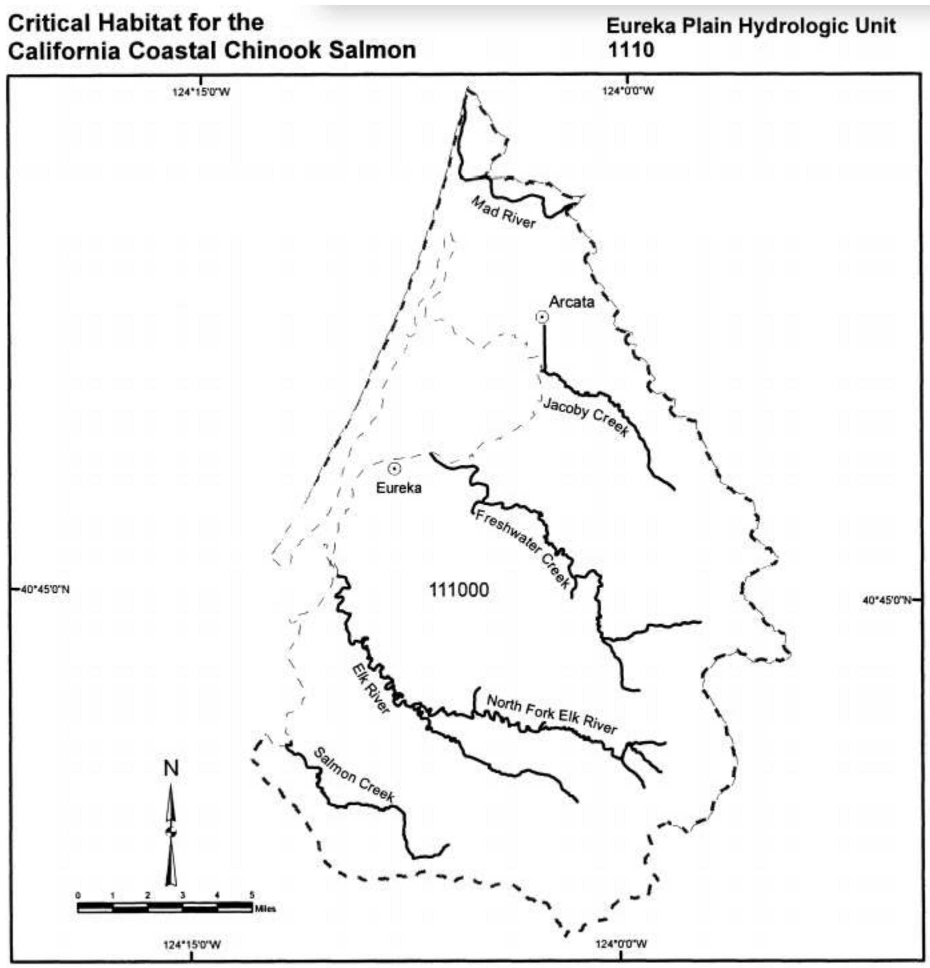

Figure 3. Eureka Plain Hydrologic Unit, map from page of 52543 of *Endangered and Threatened Species; Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California* (NOAA Fisheries 2005) The Eureka Plain Hydrologic Unit is also critical habitat for steelhead, as is shown on page 52558 of NOAA Fisheries 2005.

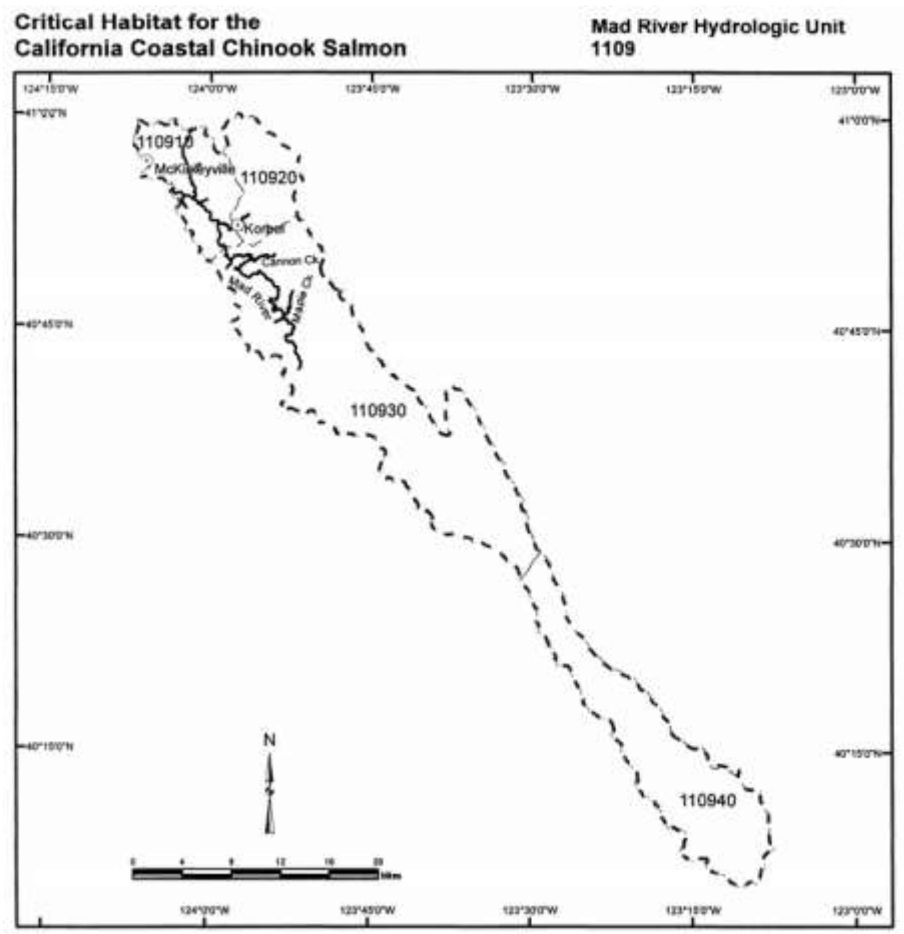

Figure 4. Mad River Hydrologic Unit, map from page of 52542 of *Endangered and Threatened Species; Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California* (NOAA Fisheries 2005). The Mad River Hydrologic Unit is also critical habitat for steelhead, as is shown on page 52557 of NOAA Fisheries 2005.

In addition to not considering actual current conditions in the vicinity of the outfall pipe. No modeling has been presented that addresses effluent distribution during upwelling and storm events. The area analyzed in the modeling does not adequately address the full potential distribution of effluent. A consideration of storm conditions and upwelling should be included in order to determine the impact of effluent on critical habitat in the Eel River (Figure 5).

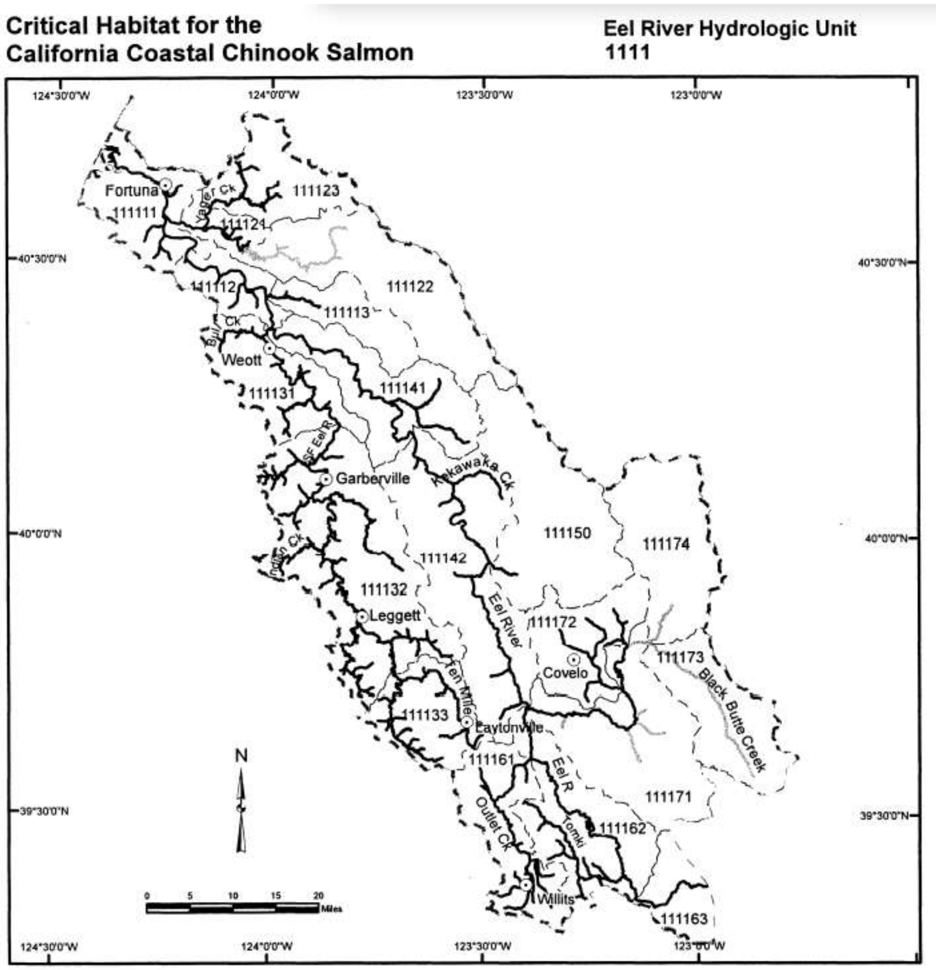

Figure 5. Eel River Hydrologic Unit, map from page of 52544 of *Endangered and Threatened Species; Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California* (NOAA Fisheries 2005) The Eel River Hydrologic Unit is also critical habitat for steelhead, as is shown on page 52559 of NOAA Fisheries 2005.

The primary constituent elements of the Eureka Plain, Mad River, and Eel River Hydrologic Units affected by effluent from the project are as follows:

> "4. Estuarine areas free of obstruction with 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 features are essential to conservation because without them juveniles cannot reach the ocean in a timely manner and use the variety of habitats that allow them to avoid predators, compete successfully, and complete the behavioral and physiological changes needed for life in the ocean. Similarly, these features are essential to the conservation of adults because they

provide a final source of abundant forage that will provide the energy stores needed to make the physiological transition to fresh water, migrate upstream, avoid predators, and develop to maturity upon reaching spawning areas.

5. Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels. As in the case with freshwater migration corridors and estuarine areas, nearshore marine features are essential to conservation because without them juveniles cannot successfully transition from natal streams to offshore marine areas."

Effluent from the project will reduce the water quality for juvenile salmonids in the estruarine and nearshore marine ecosystems. Oxidizing agents in the effluent, from fish processing and sanitization, are likely to reduce the macroalgae substrate that supports the aquatic invertebrates and fishes juvenile salmonids depend upon for growth and survival.

The fish treatment drugs Parasite-S, Formalin-F, and Formacide-B (Formalin) may diminish salmonid prey in the effluent stream and in critical habitat in the Mad River, Humboldt Bay, and the Eel River harming individual fish and potentially causing significant reductions in local salmonid numbers. A risk analysis for loss of salmonid prey species should be conducted to determine Project effects to Chinook salmon and steelhead critical habitat, as well as individual and population-level effects to these species.

Coho Salmon Critical Habitat

Designated Critical Habitat; Central California Coast and Southern Oregon/ Northern California Coasts Coho Salmon Coho (NOAA Fisheries 1999a): "is designated to include all river reaches accessible to listed coho salmon between Cape Blanco, Oregon, and Punta Gorda, California. Critical habitat consists of the water, substrate, and adjacent riparian zone of estuarine and riverine reaches (including off-channel habitats) in hydrologic units and counties identified in Table 6 of this part. Accessible reaches are those within the historical range of the ESU that can still be occupied by any life stage of coho salmon."

The importance of the Eel River and Mad River for survival and recovery were specifically addressed in the May 6, 1997, listing of the coho salmon. Above concerns and comments relative to critical habitat and food resources for Chinook salmon and steelhead apply to the coho salmon critical habitat. Essential features of coho salmon critical habitat include adequate: (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions. Water quality, water temperature, cover/shelter, and food will all be adversely affected by effluent from the project.

Eulachon Critical Habitat

Critical habitat for the Southern Distinct Population Segment of the Eulachon includes the Mad River (NOAA Fisheries 2011). The Mad River Critical Habitat Unit extends from the mouth of the Mad River upstream to the confluence with the North Fork Mad River. When modeling is completed that includes northbound marine currents and an incoming tide, effluent from the Project will be shown to enter eulachon critical habitat in the Mad River.

The physical or biological features essential for conservation of the eulachon include nearshore and offshore marine foraging habitat with water quality and available prey that supports eulachon juveniles and adult survival. The listing of eulachon critical habitat states: "The components of the nearshore and offshore marine foraging essential feature include: Food: Prey items, in a concentration that supports foraging leading to adequate growth and reproductive development for juveniles and adults in the marine environment. Eulachon larvae and juveniles eat a variety of prey items, including phytoplankton, copepods, copepod eggs, mysids, barnacle larvae, and worm larvae (Barraclough, 1967; Barraclough and Fulton, 1967; Robinson et al., 1968a, 1968b). Eulachon adults feed on zooplankton, chiefly eating crustaceans such as copepods and euphausiids (Hart, 1973; Scott and Crossman, 1973; Hay, 2002; Yang et al., 2006), unidentified malacostracans (Sturdevant, 1999), and cumaceans (Smith and Saalfeld, 1955). Water Quality: Water quality suitable for adequate growth and reproductive development. The water quality requirements for eulachon in marine habitats are largely unknown, but they would likely include adequate dissolved oxygen levels, adequate temperature, and lack of contaminants (such as pesticides, organochlorines, elevated levels of heavy metals) that may disrupt behavior, growth, and viability of eulachon and their prey."

Juvenile and adult eulachon are dependent upon good water quality and nearshore and offshore marine foraging habitat for their survival. Eulachon depend upon very small marine invertebrates (copepods, euphausiids, cumaceans, mysids, barnacle larvae, and worm larvae) that are likely to be highly sensitive to drugs used by Nordic to reduce parasites on farmed fish. The fish treatment drugs Parasite-S, Formalin-F, and Formacide-B (Formalin) may diminish eulachon prey in the effluent stream and in critical habitat in the Mad River, harming individual fish and potentially causing significant reductions in local eulachon numbers. A risk analysis for loss of eulachon prey species should be conducted to determine Project effects to eulachon critical habitat, as well as individual and population-level effects to the species.

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