Critical Habitat for the Southern Distinct Population Segment of Eulachon

Final Biological Report

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OVERVIEW

Section 4 of the U.S. Endangered Species Act (ESA) requires the designation of critical habitat for threatened and endangered species. This report contains a biological analysis compiled by the Protected Resources Division of the National Marine Fisheries Service (NMFS) in support of designating critical habitat for the threatened southern Distinct Population Segment (DPS) of eulachon (*Thaleichthys pacificus*).

NMFS identified the geographical area occupied by the southern DPS to include rivers south of the Nass River in British Columbia, Canada, to and including, the Mad River in California. Within the United States portion of this geographical area, we identified16 specific areas as candidates for critical habitat designation. We have not identified any specific marine areas that meet the definition of critical habitat, nor have we identified any unoccupied areas that may be essential to the conservation of the southern DPS. This report summarizes the best available information on eulachon life history, distribution, and habitat use relevant to critical habitat designation. We used the assessment and findings provided in this report, in conjunction with other agency analyses (e.g., economic analyses), to support our critical habitat designation for the southern DPS of eulachon.

BACKGROUND

On March 18, 2010, we listed the southern Distinct Population Segment of Eulachon (*Thaleichthys pacificus*; hereafter, "southern DPS") as threatened under the Endangered Species Act (ESA) (75 FR 13012). During the public comment period on the proposed rule to list the southern DPS of eulachon, we requested and received some information on the quality and extent of eulachon freshwater and estuarine habitat (73 FR 13185: March 12, 2008). However, at the time of listing we concluded that critical habitat was not determinable because sufficient information was not available to: (1) determine the geographical area occupied by the species; (2) identify the physical and biological features essential to conservation; and (3) assess the impacts of a designation. During promulgation of the final rule to list eulachon, we were working to compile the best available information necessary to consider a critical habitat designation.

Following the publication of the final listing rule we researched, reviewed and summarized this best available information on eulachon, including recent biological surveys and reports, peer-reviewed literature, the NMFS status report for eulachon (Gustafson et al. 2010), the proposed rule to list eulachon (74 FR 10857, March 13, 2009), and the final listing determination for eulachon (75 FR 13012; March 18, 2010) and had discussions with and considered recommendations by state, Federal, and tribal biologists familiar with eulachon. We used this information to identify the geographical area occupied, and specific areas that may qualify as critical habitat for the southern DPS. We produced a draft Biological Report (NMFS, 2010a) to document our selection process of the geographic area occupied and the specific areas that qualify as critical habitat.

On January 5, 2011, we proposed critical habitat for the southern DPS of eulachon (76 FR 515) and we solicited public comment on the proposed designation of critical habitat for a total of 60 days. In addition, we solicited technical review of the draft Biological Report (NMFS 2010) by three independent experts selected from the academic and scientific communities.

We followed a five-step process to identify the specific areas that meet the definition of critical habitat:

(1) determine the geographical area occupied by the species,

(2) identify physical or biological habitat features essential to the conservation of the species,

(3) delineate specific areas within the geographical area occupied by the species on which are found the physical or biological features,

(4) determine whether the features in a specific area may require special management considerations or protections,

(5) determine whether any unoccupied areas are essential for conservation.

CRITICAL HABITAT UNDER THE ESA

Section 3(5)(A) of the ESA defines critical habitat as ‘‘(i) the specific areas within the geographical area occupied by the species, at the time it is listed . . . on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed . . . upon a determination by the Secretary that such areas are essential for the conservation of the species.’’

Section 4(a)(3)(B)(i) of the ESA precludes from designation any lands owned by, controlled by, or designated for the use of the Department of Defense that are covered by an integrated natural resources management plan that the Secretary [of Commerce] has found in writing will benefit the listed species.

Section 4(b)(2) of the ESA requires NMFS to designate critical habitat for threatened and endangered species “on the basis of the best scientific data available and after taking into consideration the economic impact, impact on national security, and any other relevant impact, of specifying any particular area as critical habitat.” In addition, “the Secretary may exclude any area from critical habitat if he determines that the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat, unless he determines that the failure to designate such an area as critical habitat will result in the extinction of the species concerned.”

Once critical habitat is designated, section 7 of the ESA requires Federal agencies to ensure that they do not fund, authorize, or carry out any actions that will destroy or adversely modify that habitat. This is in addition to the requirement under section 7 of the ESA that Federal agencies ensure their actions do not jeopardize the continued existence of listed species.

The following sections provide the best available biological information on eulachon and the best available scientific information relevant to identifying critical habitat under the ESA.

EULACHON DISTRIBUTION, LIFE HISTORY AND STATUS

The eulachon is a smelt in the Family Osmeridae. The Genus *Thaleichthys* has only one species and valid subspecies have not been described (McAllister 1963). The binomial species name is derived from Greek roots; *thaleia* meaning rich, *ichthys* meaning fish, and *pacificus* meaning of the Pacific (Hart 1973).

Freshwater Distribution

Eulachon are an anadromous fish, meaning adults spend most of their life in the ocean but migrate into fresh water to spawn. Although they spend 95 to 98 percent of their lives at sea (Hay and McCarter, 2000), current data only provides an incomplete picture concerning their saltwater existence. Their offspring hatch in fresh water but are carried to the estuary/ocean as larvae by the flow of the natal creek or river. The species is endemic to the northeastern Pacific Ocean, ranging from northern California to the southeastern Bering Sea in Bristol Bay, Alaska (McAllister 1963, Scott and Crossman 1973, Willson et al. 2006). This distribution coincides closely with the distribution of the coastal temperate rain forest ecosystem on the west coast of North America (with the exception of populations spawning west of Cook Inlet Alaska).

In the portion of the species' range that lies south of the U.S.–Canada border, most eulachon production originates in the Columbia River Basin. Within the Columbia River Basin, the major and most consistent spawning runs return to the mainstem of the Columbia River and the Cowlitz River (Gustafson et al. 2010). Spawning also occurs in other tributaries to the Columbia River, including the Grays, Elochoman, Kalama, Lewis, and Sandy rivers (WDFW and ODFW 2001). Historically, the only other large river basins in the contiguous United States where large, consistent spawning runs of eulachon have been documented are the Klamath River in northern California and the Umpqua River in Oregon. However, eulachon have been found both frequently and infrequently in several, but not all, coastal rivers in northern California (including the Mad River and Redwood Creek), Oregon (including Tenmile Creek south of Yachats, OR) and Washington (including the Quinault and Elwha Rivers) (Emmett et al. 1991, Willson et al. 2006).

Major eulachon production areas in Canada are the Fraser and Nass rivers (Willson et al. 2006). Numerous other river systems in central British Columbia and Alaska have consistent yearly runs of eulachon and historically supported significant levels of harvest (Willson et al. 2006, Gustafson et al. 2010). Many sources note that runs occasionally occur in many other rivers and streams, although these tend to be erratic, appearing in some years but not others, and appearing only rarely in some river systems (Hay and McCarter 2000; Willson et al. 2006).

Early Life History and Maturation

Eulachon eggs can vary considerably in size but typically are approximately 1 mm (0.04 in) in diameter and average about 43 mg (0.002 oz) in weight (Hay and McCarter 2000). Eggs are enclosed in a double membrane; after fertilization in the water, the outer membrane breaks and turns inside out, creating a sticky stalk that acts to anchor the eggs to the substrate (Hart and McHugh 1944, Hay and McCarter 2000). Eulachon eggs hatch in 20–40 days with incubation time dependent on water temperature (Howell 2001). Shortly after hatching, the larvae are carried downstream and dispersed by estuarine, tidal, and ocean currents. It is not known how long larval eulachon remain in the estuary before entering the ocean. Similar to salmon, juvenile eulachon are thought to imprint on the chemical signature of their natal river basins. However, because juvenile eulachon spend less time in freshwater environments than do juvenile salmon, researchers hypothesize that this short freshwater residence time may cause returning eulachon to stray between spawning sites at higher rates than salmon (Hay and McCarter 2000).

Once juvenile eulachon enter the ocean, they move from shallow nearshore areas to deeper areas over the continental shelf. Larvae and young juveniles become widely distributed in coastal waters, where they are typically found near the ocean bottom in waters 20–150 m deep (66-292 ft)(Hay and McCarter 2000) and sometimes as deep as 182 m (597 ft)(Barraclough 1964). There is currently little information available about eulachon movements in nearshore marine areas and the open ocean. However, eulachon occur as bycatch in the pink shrimp fishery (Hay et al. 1999; Olsen et al. 2000; NWFSC 2008; Hannah and Jones 2009), which indicates that the distribution of these organisms overlaps in the ocean.

Spawning Behavior

Eulachon typically spend several years in salt water before returning to fresh water to spawn from late winter through early summer. Spawning grounds are typically in the lower reaches of larger rivers fed by snowmelt (Hay and McCarter 2000). Willson et al. (2006) concluded that the age distribution of eulachon in a spawning run varies considerably, but typically consists of fish that are 2-5 years old. Eulachon eggs commonly adhere to sand (Langer et al. 1977) or pea-sized gravel (Smith and Saalfeld 1955), though eggs have been found on a variety of substrates, including silt, gravel to cobble sized rock, and organic detritus (Smith and Saalfeld 1955, Langer et al. 1977, Lewis et al. 2002). Eggs found in areas of silt or organic debris reportedly suffer much higher mortality than those found in sand or gravel (Langer et al. 1977).

The sexes must synchronize their activities closely, unlike some other group spawners such as herring, because eulachon sperm remain viable for only a short time, perhaps only minutes (Hay and McCarter 2000). Eulachon are semelparous, meaning that they spawn once and then die.

In many rivers, spawning is limited to the part of the river that is influenced by tides (Lewis et al. 2002), but some exceptions exist. In the Berners Bay system of Alaska, the greatest abundance of eulachon is observed in tidally-influenced reaches, but some fish ascend well beyond the tidal influence (Willson et al. 2006). Eulachon once ascended more than 160 km (100 mi) in the Columbia River system (Smith and Saalfeld 1955). There is some evidence that water velocity greater than 0.4 meters/second (1.3 ft/second) begins to limit the upstream movements of eulachon (Lewis et al. 2002).

Entry into the spawning rivers appears to be related to water temperature and the occurrence of high tides (Ricker et al. 1954; Smith and Saalfeld, 1955; Spangler, 2002).

Spawning generally occurs in January, February, and March in the Columbia River, the Klamath River, and the coastal rivers of Washington and Oregon, and April and May in the Fraser River. Eulachon runs in central and northern British Columbia typically occur in late February and March or late March and early April. However, attempts to characterize eulachon run timing are complicated by marked annual variation in timing. Willson et al. (2006) give several examples of spawning run timing varying by a month or more in rivers in British Columbia and Alaska.

Water temperature at the time of spawning varies across the distribution of the species. Although spawning generally occurs at temperatures from 4 to 7°C (39 to 45º F) in the Cowlitz River (Smith and Saalfeld, 1955), and at a mean temperature of 3.1°C (37.6º F) in the Kemano and Wahoo Rivers, peak eulachon runs occur at noticeably colder temperatures (between 0 and 2°C [32 and 36º F]) in the Nass River. The Nass River run is also earlier than the eulachon run that occurs in the Fraser River, which typically has warmer temperatures than the Nass River (Langer et al. 1977).

Prey

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). Adults and juveniles commonly forage at moderate depths (20 – 150 m [66 – 292 ft]) in nearshore marine waters (Hay and McCarter 2000). Eulachon adults do not feed during spawning (McHugh 1939, Hart and McHugh 1944).

Predators

Eulachon are very high in lipids (Iverson et al. 2002), and their historical large spawning runs made them an important part of the Pacific coastal food web. They have numerous avian predators, including sea birds such as harlequin ducks, pigeon guillemots, common murres, mergansers, cormorants, gulls, and eagles (Gustafson et al. 2010).

Marine mammals such as baleen whales, orcas, dolphins, pinnipeds, and beluga whales are known to feed on eulachon. Fish that prey on eulachon include white sturgeon, spiny dogfish, sablefish, salmon sharks, arrowtooth flounder, Pacific hake, salmon, Dolly Varden, Pacific halibut, and Pacific cod (Gustafson et al. 2010). In particular, eulachon and their eggs seem to provide a significant food source for white sturgeon in the Columbia and Fraser rivers (McCabe et al. 1993; Gustafson et al. 2010).

Status of Eulachon

On March 18, 2010, we listed the southern DPS of eulachon as threatened under the ESA (75 FR 13012). During our review of the status of eulachon, we determined that the species is comprised of at least two DPSs:

(1) A southern DPS consisting of populations spawning in rivers south of the Nass River in British Columbia, Canada, to, and including, the Mad River in California; and
(2) At least one (and perhaps several) additional DPS from the Nass River to the northern and western extent of the species' range.

We based the decision to list the southern DPS as threatened on an evaluation of its status and of existing efforts to protect the species. The current abundance of eulachon is low and declining in all surveyed populations throughout the DPS. Eulachon populations spawning in the Klamath River, lower Columbia River Basin, and Fraser River have declined substantially and the southern DPS will likely become endangered in the foreseeable future if ongoing threats are not addressed. Past and ongoing Federal, state, and local protective efforts (many of them habitat-based) have contributed to the conservation of the southern DPS, but these efforts alone do not sufficiently reduce the extinction risks faced by the southern DPS.

We identified and ranked specific threats for the Klamath River and lower Columbia River Basin portions of the southern DPS (Gustafson et al. 2010; 75 FR 13012, March 18, 2010). Future declines in the abundance of eulachon are likely to occur if these threats are not addressed. The top identified threats include:

(1) Climate change impacts on ocean conditions

(2) Eulachon bycatch

(3) Climate change impacts on freshwater habitat

(4) Dams / water diversions

(5) Water quality

(6) Dredging

(7) Predation

At the time that we listed the southern DPS of eulachon, we concluded that critical habitat was not determinable. Since then we have compiled and reviewed the best available information relevant to designating critical habitat. A summary of this information is presented below.

GEOGRAPHICAL AREA OCCUPIED BY THE SPECIES

The first step in designating critical habitat is to identify the geographical area occupied by the species at the time of listing. We interpret “geographical area occupied" in ESA section 3(3) to mean the range of the species at the time of listing and not every discrete location on which individuals of the species physically are located. In our March 2010 final ESA listing rule, and in the proposed critical habitat designation, we identified the range of the southern DPS of eulachon as extending from the Skeena River in British Columbia, Canada, to the Mad River in California (Gustafson et al. 2010). We cannot designate areas outside U. S. jurisdiction as critical habitat (see above), thus, we limited our consideration of the range of the southern DPS of eulachon to the geographical area from the international border with Canada to the Mad River in California. We did not attempt to further refine our identification of the “geographical area occupied by the species” at the time of listing because of the process we followed in the subsequent steps of our designation. As explained more fully below, we identified freshwater spawning and incubation sites as a “physical or biological feature essential to conservation” of the species. In determining the “specific areas” that contain those sites, we confirmed that eulachon were documented using the sites for spawning. Thus, our process of confirming that a specific area contains the essential features also allowed us to confirm that the area was indeed occupied. Given the highly migratory nature of eulachon and limited marine sampling, we do not know how far offshore the southern DPS of eulachon are distributed and thus how far offshore the geographical area occupied by the species extends. We consider the marine extent of the geographical area occupied by the species as undeterminable at this time.

PHYSICAL OR BIOLOGICAL FEATURES ESSENTIAL FOR CONSERVATION

Joint NMFS-U.S. Fish and Wildlife Service (USFWS) regulations at 50 CFR 424.12(b) state that in determining what areas are critical habitat, the agencies "shall consider those physical and biological features that are essential to the conservation of a given species and that may require special management considerations or protection." Features to consider may include, but are not limited to:

(1) Space for individual and population growth, and for normal behavior;
(2) Food, water, air, light, minerals, or other nutritional or physiological requirements;
(3) Cover or shelter;
(4) Sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally;
(5) Habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

Based on the best available scientific information, we developed a list of physical and biological features essential to the conservation of eulachon and relevant to determining whether occupied areas are consistent with the above regulations and the ESA section (3)(5)(A) definition of "critical habitat." The physical or biological features essential to the conservation of the southern DPS fall into three major categories reflecting key life history phases of eulachon:

(1) Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with

migratory access for adults and juveniles. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.

(2) Freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.

(3) Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. Eulachon prey on a wide variety of species including crustaceans such as copepods and euphausiids (Hay and McCarter 2000, WDFW and ODFW 2001), unidentified malacostracans (Sturdevant 1999), cumaceans (Smith and Saalfeld 1955) mysids, barnacle larvae, and worm larvae (WDFW and ODFW 2001). These features are essential to conservation because they allow juvenile fish to survive, grow, and reach maturity, and they allow adult fish to survive and return to freshwater systems to spawn.

The components of the freshwater spawning and incubation essential features include:

Flow: A flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) that supports spawning, and survival of all life stages. Most spawning rivers experience a spring freshet characteristic of rivers draining large snow packs or glaciers (Hay and McCarter 2000). In general, eulachon spawn at lower water levels before spring freshets (Lewis et al. 2002). In the Kemano River, Canada, water velocity greater than 0.4 m/s (1.3 ft/s) begins to limit upstream movements (Lewis et al. 2002). Sufficient flow may also be needed to flush silt and debris from spawning substrate surfaces to prevent suffocation of developing eggs.

Water Quality: Water quality suitable for spawning and viability of all eulachon life stages. Sublethal concentrations of contaminants affect the survival of aquatic species by increasing stress, predisposing organisms to disease, delaying development, and disrupting physiological processes, including reproduction. Adult eulachon can take up and store pollutants from their spawning rivers, despite the fact that they do not feed in fresh water and remain there only a few weeks (Rogers et al. 1990; WDFW and ODFW 2001). Eulachon have also been shown to avoid polluted waters when possible (Smith and Saalfeld 1955).

Water Temperature: Suitable water temperatures, within natural ranges, in eulachon spawning reaches. Water temperature between 4°C and 10°C (39º F and 50ºF) in the Columbia River is preferred for spawning (WDFW and ODFW 2001) although temperatures during spawning can be much colder in northern rivers (e.g., 0ºC - 2ºC [32ºF - 36ºF] in the Nass River; Willson et al. 2006). High water temperatures can lead to adult mortality and spawning failure (Blahm and McConnell 1971).

Substrate: Spawning substrates for eulachon egg deposition and development. Spawning substrates typically consist of silt, sand, gravel, cobble, or detritus (Gustafson et al. 2010). However, pea sized gravel (Smith and Saalfeld 1955) and coarse sand (Langer et al. 1977) are the most commonly used. Water depth for spawning can range from 8 cm (3 in) to at least 7.6 m (25 ft) (Willson et al. 2006).

The components of the freshwater and estuarine migration corridor essential feature include:

Migratory Corridor: Safe and unobstructed migratory pathways for eulachon adults to pass from the ocean through estuarine areas to riverine habitats in order to spawn, and for larval eulachon to access rearing habitats within the estuaries and juvenile and adults to access habitats in the ocean. Lower reaches of larger river systems (e.g., the Columbia River) are used as migration routes to upriver or tributary spawning areas. Out-migrating larval eulachon are distributed throughout the water column in some rivers (e.g., the Fraser River) but are more abundant in mid-water and bottom portions of the water column in others (e.g., the Columbia River; Smith and Saalfeld, 1955, Howell et al. 2001).

Flow: A flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) that supports spawning migration of adults and outmigration of larval eulachon from spawning sites. Most eulachon spawning rivers experience a spring freshet (Hay and McCarter 2000) that may influence the timing of spawning adult migration. In general, eulachon spawn at low water levels before spring freshets (Lewis et al. 2002). In the Kemano River water velocity greater than 0.4 m/s (1.3 ft/s) begins to limit upstream movements (Lewis et al. 2002).

Water Quality: Water quality suitable for survival and migration of spawning adults and larval eulachon. Adult eulachon can take up and store pollutants from their spawning rivers, despite the fact that they do not feed in fresh water and remain there only a few weeks (Rogers et al. 1990, WDFW and ODFW 2001). Eulachon avoid polluted waters when possible (Smith and Saalfeld 1955).

Water Temperature: Water temperature suitable for survival and migration. Eulachon run timing may be influenced by water temperature (Willson et al. 2006) and high water temperatures can increase adult mortality (Blahm and McConnell 1971). Given the range of temperatures that eulachon spawn in throughout their range, Langer et al. (1977) suggested that the contrast between ocean and river temperatures might be more critical than absolute river or ocean temperatures.

Food: Prey resources to support larval eulachon survival. Eulachon larvae need abundant prey items (especially copepod larvae; Hart 1973) when they begin exogenous feeding after the yolk sac is depleted. The eulachon yolk sac can be depleted between 6 and 21 days after hatching (Howell 2001), and larvae may be retained in low salinity, surface waters of the natal estuary for several weeks or longer (Hay and McCarter 2000), making this an important component in migratory corridor habitat.

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, including *Thysanoessa* spp. (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.

SPECIAL MANAGEMENT CONSIDERATIONS OR PROTECTION

Physical or biological features meet the definition of critical habitat if they "may require special management considerations or protection." Joint NMFS and USFWS regulations at 50 CFR 424.02(j) define “special management considerations or protection” to mean “any methods or procedures useful in protecting physical and biological features of the environment for the conservation of listed species.” We identified a number of activities that may affect the physical and biological features essential to the southern DPS of eulachon such that special management considerations or protection may be required. Major categories of such activities include: (1) dams and water diversions; (2) dredging and disposal of dredged material; (3) in-water construction or alterations; (4) pollution and runoff from point and non-point sources; (5) tidal, wind, or wave energy projects; (6) port and shipping terminals; and (7) habitat restoration projects. All of these activities may have an effect on one or more of the essential physical and biological features via their alteration of one or more of the following: stream hydrology; water level and flow; water temperature; dissolved oxygen; erosion and sediment input/transport; physical habitat structure; vegetation; soils; nutrients and chemicals; fish passage; and estuarine/marine prey resources.

In the following paragraphs, we describe the potential effects of certain activities on essential physical or biological features. This is not an exhaustive list of potential effects, but rather a description of the primary concerns and potential effects that we are aware of at this time and that should be considered in the analysis of these activities under section 7 of the ESA.

(1) Dams and Water Diversions: Physical structures associated with dams and water diversions may impede or delay passage of eulachon. The operation of dams and water diversions may also affect water flow, water quality parameters, substrate quality, and depth, and further compromise the ability of adult eulachon to reproduce successfully. Optimum flow and temperature requirements for spawning and incubation are unclear, but effects on water flow and associated effects on water quality (e.g., water temperature) and

substrate composition may affect adult spawning activity, egg viability, and larval growth, development, and survival. Many uncertainties remain about how large-scale hydropower development (e.g., the Federal Columbia River Power System) affects eulachon habitat.

(2) Dredging: Dredging activities, which include the disposal of dredged material, may affect depth, sediment quality, water quality, and prey resources for eulachon. Dredging and the in-river disposal of dredged material may remove, and/or alter the composition of, substrate materials at the dredge site, as well as bury them at the disposal site (potentially altering the quality of substrate for use as a spawning site). In addition, dredging operations and disposal of dredged materials may result in the re-suspension and spread of contaminated sediments, which may adversely affect eulachon migration and spawning, as well as larval growth and development. The effects of dredging and disposal activities on critical habitat would depend on factors such as the location, seasonality, scale, frequency, and duration of these activities.

(3) In-Water Construction or Alterations: This category consists of a broad range of activities associated with in-water structures or activities that alter habitat within rivers, estuaries, and coastal marine waters. The primary concerns are with activities that may affect water quality, water flow, sediment quality, substrate composition, or migratory corridors. Activities that may affect water quality include the installation of in-water structures (such as pilings) with protective coatings containing chemicals that may leach into the water. Activities that affect flow, sediment quality and substrate composition include those that result in increased erosion and sedimentation (such as road maintenance and construction, bridge construction, construction of levees and other flood control devices, construction or repair of breakwaters, docks, piers, pilings, bulkheads, and boat ramps) and those that directly alter substrates (such as sand and gravel mining or gravel augmentation). Activities that may affect migratory corridors include the construction of in-water structures, such as docks, piers, pilings, and ramps.

(4) Pollution and Runoff: The discharge of pollutants and runoff from point and non-point sources (including but not limited to: industrial discharges, urbanization, grazing, agriculture, road surfaces, road construction, and forestry operations) may adversely affect the water quality, sediment quality, and substrate composition of eulachon critical habitat. Exposure to contaminants may disrupt eulachon spawning migration

patterns, and high concentrations may be lethal to young fish (Smith and Saalfeld 1955). Excessive runoff may increase turbidity and alter the quality of spawning substrates.

(5) Tidal, Wind, or Wave Energy Projects: Tidal, wind, or wave energy projects generally require energy generating equipment and supporting structures to be anchored on the bottom. However, there are a wide range of designs currently being tested and potential impacts of individual projects will vary depending on the type of unit being deployed. Projects are typically proposed for location in coastal marine waters or coastal estuaries. Some designs may result in physical structures that impede or delay passage of eulachon. In addition, construction and maintenance of these energy projects may require in water construction or alterations, which would include the potential effects described above.

(6) Port and Shipping Terminals: The operation of port and shipping terminals poses the risk of leaks, spills, or pipeline breakage and may affect water quality. Vessel ballast water management (including the introduction of competitors or parasites) may also affect water quality. In addition, activities associated with the construction, operation, and maintenance of port and shipping terminals may affect water quality, sediment quality, and prey resources for larval eulachon. For example, dredging operations and in-water and shoreline construction activities associated with the construction and operation of port and shipping terminals may result in increased erosion and sedimentation, increased turbidity, and the re-suspension of contaminated sediments.

(7) Habitat Restoration Projects: Habitat restoration activities are efforts undertaken to improve habitat, and can include the installation of fish passage structures and fish screens, in-stream barrier modification, bank stabilization, installation of instream structures (e.g., engineered log jams), placement of gravel, planting of riparian vegetation, and many other habitat-related activities. Although the primary purpose of these activities is to improve natural habitats for the benefit of native species, these activities nonetheless modify the habitat and need to be evaluated to ensure that they do not adversely affect the habitat features essential to eulachon. While habitat restoration activities would be encouraged as long as they promote the conservation of the species, project modifications in the form of spatial and temporal restrictions may be required as a result of this designation.

SPECIFIC AREAS WITHIN THE GEOGRAPHICAL AREA OCCUPIED BY THE SPECIES

After determining the geographical area occupied by the southern DPS of eulachon, and the physical and biological features essential to their conservation, we next identified the specific areas within the geographical area occupied by the species that contain the essential features. All of the essential physical and biological features we identified within the freshwater and estuarine environment are within areas associated with spawning, or with migrations related to spawning events. In order to identify specific areas where the spawning sites and migration corridors occur, we relied on evidence of eulachon spawning and migration. To ensure that our selection of the specific areas was based on the best available information we developed two criteria to identify areas where spawning, and spawning migration, occurs. These criteria include sites that contain: (1) larval fish or pre-/post-spawn adults that have been positively identified and documented; or (2) commercial or recreational catches that have been documented over multiple years. Within the geographic area occupied by the southern DPS, there are 42 creeks and rivers with documented presence of eulachon (Gustafson et al. 2010). Of these, we identified 16 that meet at least one of the criteria for spawning.

We next considered the distribution of the essential features within these creeks or rivers. We again used evidence of eulachon spawning and spawning migration to delineate the extent of the specific areas where the spawning sites and spawning migration corridors are found. We relied on data from published literature, field observations (including river sampling with a variety of net types), opportunistic sightings, commercial and recreational harvest, and anecdotal information. Given the extremely limited sampling done for this species we chose to rely on the most recent information available to us to determine which areas were eligible for designation. For some creeks and rivers, opportunistic sightings are the only information that is available to identify the distribution of the essential features, and in these cases we relied on the best professional judgment of agency and tribal biologists familiar with the area to identify the extent of the essential features.

The 16 specific freshwater and estuarine areas which contain one or more of the essential physical or biological features are described below and maps of the specific areas appear in Figures 1-6. We have also included examples of some of the activities that occur within these areas that may require specific management considerations or protections.

(1) Mad River, CA: The Mad River is located in northwestern California. It flows for 150 km (95 mi) in a roughly northwest direction through Trinity and Humboldt Counties, draining a 1290 km² (497 mi²) watershed into the Pacific Ocean near McKinleyville, California. The river's headwaters are in the Coast Range mountains near South Kelsey Ridge.

Eulachon consistently spawned in large numbers in the Mad River as recently as the 1960s and 1970s (Moyle et al. 1995, Moyle 2002, Gustafson et al. 2010). However, in recent years eulachon numbers have declined, and they are now considered rare (Sweetnam et al. 2001). Based on observations by the California Department of Fish and Game (CDFG)[1] spawning occurs as far upstream as the confluence with the North Fork of the Mad River (Figure 2). The river below this point contains overlapping spawning and incubation sites and migration corridor features.

Several special management concerns exist for the Mad River. The river has one dam, Matthews Dam, about one third of the way down the river from its source (NMFS 2008). The operation of dams (and water diversions) may affect water flow, water quality parameters, substrate quality, and depth within eulachon habitat. Pollution and runoff are potential management concerns in the Mad River. Road building, gravel mining and timber harvest occur within the Mad River watershed and erosion from these activities has the potential to increase sediment deposition in aquatic environments (Gomi et al. 2005, Rashin et al. 2006). In addition, the removal of riparian vegetation (which also increases erosion), and urbanization may cause decreased water quality. Pollution and runoff from these activities can adversely affect the water quality, sediment quality, and substrate composition of eulachon critical habitat. Excessive runoff may increase turbidity and alter the quality of spawning substrates.

[1] S. Cananta, California Dept. of Fish and Game, pers. comm., October 29, 2009

(2) Redwood Creek, CA: Redwood Creek is located entirely in Humboldt County, in northwestern California. The creek flows into the Pacific Ocean near the town of Orick, California, which is also the only major population center within the Redwood Creek watershed. The basin is approximately 105 km (65 mi), and contains approximately 738 km^2 (285 mi^2), most of which is forested and mountainous terrain (Cannata et al. 2006).

Eulachon have been reported from Redwood Creek by a variety of sources (Young 1984, Ridenhour and Hofstra 1994, Moyle et al. 1995, Larson and Belchik 1998) and runs large enough to be noted in available local newspaper accounts occurred in 1963 and 1967. Eulachon returns to Redwood Creek have declined drastically in recent years, and they are now considered rare (Sweetnam et al. 2001). CDFG reported that during the early 1970s eulachon regularly spawned between the ocean and the mouth of Prairie Creek (the first major tributary on Redwood Creek; Moyle et al. 1995). During April 1973, a spawning run of eulachon were observed passing Tom McDonald Creek (CDFG, 1973), a tributary located approximately 19.4 km (12.1 miles) upstream from the mouth of Redwood Creek, indicating that this area contains the essential features of spawning and incubation, and a migration corridor (Figure 2). Spawning also occurred up Prairie Creek about 0.5 km (0.3 mi) (Moyle et al. 1995), sporadically up to the 1970s.

The main features of the lower reaches of Redwood Creek are the estuary/lagoon, the town of Orick, rural residential developments, agricultural and pasture lands, and flood control levees. The lower reach of Redwood Creek alternates between an open estuary and a closed coastal lagoon, depending on the season. During early summer a sand bar typically forms across the river mouth creating a lagoon. Rains during the fall season typically clear the sand bar away and open up the river mouth to the ocean (Cannata et al. 2006).

There are several activities occurring in the Redwood Creek watershed that could alter the essential features and therefore may require special management considerations or protection. Earthen levees were built in 1968 by the U.S. Army Corps of Engineers along the lower 5.5 km (3.4 miles) of Redwood Creek to protect the town of Orick and agricultural lands located in the valley flood plain. The flood control project included removal of all riparian vegetation growing between the levees; the main channel was also straightened and shortened. The levee system has had a profound effect on the estuary, including reducing the estuarine area and changing ecosystem processes such as water flow, water quality parameters, and substrate quality (Cannata et al. 2006). In addition, the removal of riparian vegetation (which also increases erosion) and urbanization may cause decreased water quality.

Pollution and runoff are potential management concerns in Redwood Creek. Road building, gravel mining, livestock grazing and large-scale timber harvest occur within the Redwood Creek watershed and erosion from these activities has potential to cause increased sediment deposition in the river and its tributaries.

(3) Klamath River, CA: The Klamath River basin drains approximately 25,100 km (9,691 mi^2) in southern Oregon and northern California, which makes it the second largest river in the State of California (after the Sacramento River). Historically, the Klamath River has been a major producer of anadromous fish, and it was the third most productive salmon and steelhead fishery in the continental United States prior to recent significant declines (Powers et al. 2005). There are four major tributaries to the lower Klamath River: the Trinity, Salmon, Scott, and Shasta rivers, with the Trinity River being the largest of the four.

Historically, large aggregations of eulachon consistently spawned in the Klamath River (Fry 1979, Moyle et al. 1995, Larson and Belchik 1998, Moyle 2002, Hamilton et al. 2005), and a commercial fishery occurred there in 1963 (Odemar 1964). During spawning, fish were regularly caught from the mouth of the river upstream to Brooks Riffle, near the confluence with Omogar Creek (Larson and Belchik 1998) indicating that this area contains the spawning and incubation, and migration corridor essential features (Figure 2).

The only reported commercial catch of eulachon in Northern California occurred in 1963 when a combined total of 25 metric tons (56,000 lbs) was landed from the Klamath River, the Mad River, and Redwood Creek (Odemar 1964). Since 1963, the run size has declined to the point that only a few individual fish have been caught in recent years. According to accounts of Yurok Tribal elders, the last noticeable runs of eulachon were observed in the Klamath River in 1988 and 1989 by Tribal fishers (Larson and

Belchik 1998). However, in January 2007, six eulachon were reportedly caught by tribal fishers on the Klamath River[2] and in February 2011, a small number of eulachon were reportedly caught by tribal fishers on the Klamath River (McCovey 2011). Larson and Belchik (1998), report that eulachon have not been of commercial importance in the Klamath in recent years and are unstudied as to their current run strengths.

Approximately 68 km (42 miles) of the lower Klamath River is bordered by the Yurok Indian Reservation. The lower Klamath River is listed as a National Wild and Scenic River from the mouth, upstream to just below Iron Gate Dam, for a total of 460 km (286 mi). Of these,19 km (12mi) are designated Wild, 39 km (24 mi) are designated Scenic, and 402 km (250 mi) are designated Recreational.

There are several activities occurring in the watershed that could alter the essential features and therefore may require special management considerations or protection. The Klamath River Basin is separated into two sections by a series of four hydroelectric dams (Iron Gate, J.C. Boyle and Copco 1 and Copco 2). The operation of dams and water diversions can affect water flow, water quality parameters, substrate quality, and depth. For example, the Trinity River Division (TRD) of the Central Valley Project diverts water from the Trinity River system and transports it, by means of dams, reservoirs, tunnels, and power plants, into the separate watershed of the Sacramento River for use in water-deficient areas to the south. Until recently, nearly 90% of the water in the Trinity River was exported to the Central Valley (Powers et al. 2005).

Much of the acreage in the lower Klamath River basin is managed by the U.S. Forest Service or by private timber companies for multiple purposes including timber production and road building (Powers et al. 2005). These activities have the potential to increase sediment loading to aquatic environments from harvest site erosion (Rashin et al 2006). In addition, soil disturbance and sediment delivery to streams are commonly associated with construction of roads and landings, slash burning, and log skidding (Gomi et al. 2005).

(4) Umpqua River/Winchester Bay, OR: The Umpqua River Basin consists of a 10,925 km² (4,220 mi²) drainage area comprised of the main Umpqua River, the North

[2] Dave Hillemeier, Yurok Tribe, pers. comm. June 23, 2008

Umpqua River, the South Umpqua River, and associated tributary streams (Snyder et al. 2006). The Umpqua River drains a varied landscape, from steep-sloped uplands, to low gradient broad floodplains. Upstream, the Umpqua River collects water from tributaries as far eastward as the crest of the Cascade Mountains.

Historically a large and consistent run of eulachon returned to the Umpqua River and both recreational and commercial fisheries occurred. The Umpqua River eulachon sport fishery was active for many years during the 1970s and 1980s, with the majority of fishing activity centered near the town of Scottsburg. A commercial fishery also harvested eulachon during that time. Approximately 1,800 to 2,300 kg (4,000 to 5,000 lbs) of eulachon were landed by two commercial fishermen in the Umpqua River during 31 days of drift gill net fishing from late December 1966 to mid-March 1967 (OFC 1970). Numbers of fish returning to the Umpqua seem to have declined in the 1980s and do not appear to have rebounded to previous levels. Johnson et al. (1986) list eulachon as occurring in trace amounts in their trawl and beach-seine samples from April 1977 to January 1986. Williams (2009) reported the results of seine collections conducted during March to November from 1995 to 2003 in Winchester Bay estuary on the Lower Umpqua River, which confirmed the presence of eulachon in four of the years in which sampling occurred.

Eulachon have been documented in the lower Umpqua River during spawning, from the mouth upstream to the confluence of Mill Creek, just below Scottsburg (Williams 2009). This indicates that the area downstream from this confluence contains the spawning and incubation, and migration corridor essential features (Figure 3). The towns of Reedsport, Gardiner, and Winchester Bay, are all located along this lower stretch of the river.

Many land uses in the Umpqua River Basin may affect the essential features and therefore may require special management considerations or protection. The upland portions of the lower Umpqua River watershed are mainly forested with coniferous forest stands that are utilized for timber production. Non-forested areas include agricultural lands and residential land, which are both concentrated in the area closest to the river (Snyder et al. 2006). Runoff from grazing, agriculture, road building and forestry operations can adversely affect the water quality, sediment quality, and substrate composition of eulachon habitat. Excessive runoff may increase turbidity and alter the quality of spawning substrates.

Within the Umpqua River, tidal wetlands have been filled and/or excavated to develop industrial, commercial, and residential sites. In addition, several tidal marshes and swamps have been diked and ditched to create agricultural lands (Snyder et al. 2006). These activities may affect eulachon essential habitat features by altering water quality, sediment quality, and substrate composition.

Dredging of the Umpqua River is periodically conducted to deepen the navigational channel, and in the past some of the dredged material has been deposited on tidal wetlands (Snyder et al. 2006). Dredging activities may affect depth, sediment quality, water quality, and prey resources for eulachon. Additional alterations to the natural morphology of the lower Umpqua River include channelization, channel straightening, and bank armoring, may affect eulachon essential habitat features by altering water flow and quality, and substrate quality.

(5) Tenmile Creek, OR: The Tenmile Creek watershed lies entirely within Lane County, Oregon and encompasses approximately 60 km^2 (23 mi^2) on the central Oregon Coast (Johnson 1999). The watershed is in a unique location, between the Cummins Creek and Rock Creek wilderness areas. The watershed is in a unique location, between the Cummins Creek and Rock Creek wilderness areas, which are protected from development.

Eulachon are regularly caught in salmonid smolt traps operated in the lower reaches of Tenmile Creek by the Oregon Department of Fish and Wildlife (ODFW). During previous sampling efforts, 80-90% of the eulachon captured in the traps were spawned out and several fish were found dead (Williams 2009). Given the timing of the sampling (February to May) it is very likely that spawning occurs regularly in Tenmile Creek. It is not known how far adult eulachon ascend the creek to spawn but the location of the ODFW trap (just upstream of the Highway 101 bridge) is the confirmed upstream extent of adult eulachon in spawning condition and we conclude that the specific area containing spawning and incubation sites extends upstream at least to this point (Figure 3).[3]

Although the Tenmile Creek watershed is bordered to the north and south by wilderness areas, there are activities that occur in the watershed that could alter the essential features and therefore may require special management considerations or protection. Homesteading, logging, and road building activities all occur throughout the Tenmile Creek watershed (Johnson 1999). Runoff from these activities may affect eulachon essential habitat features by altering the water quality, sediment quality, and substrate composition of eulachon essential habitat.

(6) Sandy River, OR: The Sandy River and its tributaries drain 508 mi^2 (1,316 km^2). Most of the headwaters of the Sandy River are within Clackamas County, while the lower mainstem of the river lies within Multnomah County. The Sandy River originates from glaciers on Mount Hood and flows for 90 km (56 mi), to join the Columbia River near the City of Troutdale (Sandy River Basin Watershed Council 1999). The segment of the Sandy River from Dodge Park to Dabney State Park was designated as a National Wild and Scenic River in October 1988.

The Sandy River is commonly used by eulachon during years of large spawning runs in the Columbia River system. Large commercial and recreational fisheries have occurred on the Sandy River in the past. The most recent commercial harvest in the Sandy River was in 2003 and resulted in a catch of 10, 400 kg (23,000 lbs). During spawning, eulachon extent in the Sandy River is typically upstream to the confluence with Gordon Creek at river km 21 (river mi 13) (Anderson 2009), indicating that this area contains the spawning and incubation and migration corridor essential features (Figure 4).

The Federal government owns or manages about 70 percent of the land within the Sandy River basin, while the remaining land is private (29 percent) or state (less than one percent) ownership (WRD 1991). Forests cover about 85 percent of the basin, and about three-fourths of this forested area is managed as part of the Mount Hood National Forest (Sandy River Basin Watershed Council 1999). The National Forest land includes the Salmon-Huckleberry and Mount Hood Wilderness Areas.

[3] B. Buckman, Oregon Dept. of Fish and Wildlife, pers. comm. October 23, 2009.

Lands in the lower portion of the Sandy River basin are generally privately owned and support timber production, agriculture, and residential uses. These land uses and their associated activities could alter the essential features of the habitat and therefore may require special management considerations or protection. The processes contributing to siltation in the watershed include landslides and surface erosion from timber harvest, cropland, range land, urban runoff, roads, and highway sanding (Sandy River Basin Watershed Council 1999). Runoff from these activities may adversely affect the water quality, sediment quality, and substrate composition of essential habitat features.

In general, channel modification activities in the watershed include roads and road culverts, stream-bank protection areas, channelization, and dikes/levees (Sandy River Basin Watershed Council 1999). These activities may affect eulachon essential habitat features by changing water flow, reducing water quality, and altering substrate quality.

(7) Lower Columbia River, OR and WA: The lower Columbia River and its tributaries support the largest known spawning run of eulachon. The mainstem of the lower Columbia River, provides spawning and incubation sites, and a major migratory corridor to spawning areas in the tributaries. Major tributaries of the Columbia River that have supported eulachon runs in the past include the Grays, Elochoman, Cowlitz, Kalama, and Lewis rivers in Washington and the Sandy River in Oregon (WDFW and ODFW 2001, Gustafson et al. 2010; the Columbia River tributaries are discussed below as separate specific areas).

Although direct estimates of adult spawning stock abundance in the Columbia River are unavailable, records of commercial fishery landings begin in 1888 and continue as a nearly uninterrupted data set through 2010 (Gustafson et al. 2010). A large recreational dipnet fishery, for which catch records were not maintained, took place concurrent with the commercial fishery (WDFW and ODFW 2001). However, the dipnet fishery took place almost entirely within the tributaries. During spawning, adult eulachon are found in the lower Columbia River from the mouth of the river to immediately downstream of Bonneville Dam (WDFW and ODFW 2008), indicating that the area contains the essential feature of migration corridors (Figure 4). Eulachon eggs have been collected, and spawning presumed, from river km 56 (river mi 35) to river km 117 (river mi 73) (Romano et al. 2002) indicating that this area contains the spawning and incubation essential feature. However, due to the limited range of the study the entire range of eulachon spawning in the mainstem of the Columbia River remains unknown (Romano et al. 2002). There have been reports of adult eulachon ascending the Columbia River beyond the Bonneville Dam site, both before and after construction of the Bonneville Dam, with some runs large enough to support recreational harvest (OFC 1953, Smith and Saalfeld 1955, Stockley 1981). Cascade Rapids at River Kilometer (RKm) 239 (River Mile [RM] 148.5) was a natural barrier to eulachon migration in the Columbia River (Oregon Fish Commission 1953, Gustafson et al. 2010). A ship lock constructed at Cascade Locks in 1896 allowed fish to circumvent the rapids and subsequently eulachon were reported as far upstream as Hood River, Oregon at RKm 272 (RM 169) (Smith and Saalfeld 1955). Following completion of Bonneville Dam, both Cascade Rapids and Cascade Locks were submerged, removing the rapids as a passage barrier. Currently, passage for anadromous fish at Bonneville Dam is maintained via fish ladders, but it is highly unlikely that eulachon can ascend them due to the high gradient and water velocities within. However, eulachon have been documented passing through the shipping locks at the dam (Oregon Fish Commission 1953). Eulachon have been reported upstream of the dam in several years, including significant numbers in 1945 and 1953 (Oregon Fish Commission 1953, Smith and Saalfeld 1955) and more recently in 1988 (Johnsen et al. 1988), 2003 (U.S. Army Corps of Engineers [USACE] 2003), and 2005 (Martinson et al. 2010).

The Columbia River, estimated to have historically represented half of the species' abundance, experienced a sudden decline in its commercial eulachon fishery landings in 1993-1994 (WDFW and ODFW 2001, JCRMS 2009). Commercial catch levels were consistently high (usually greater than 500 metric tons [550 tons] and often greater than 1,000 metric tons [1,100 tons]) for the three quarters of a century from about 1915 to 1992. In 1993, catches declined greatly to 233 metric tons (257 tons) and to an average of less than 40 metric tons (44 tons) between 1994 and 2000. From 2001 to 2004, the catches increased to an average of 266 metric tons (293 tons), before falling to an average of less than 5 metric tons (5.5 tons) from 2005 to 2008. Some of this pattern is due to fishery restrictions put in place due to the apparent sharp declines in the species abundance. Persistent low returns and landings of eulachon in the Columbia River from 1993 to 2000 prompted the states of Oregon and Washington to adopt a Joint State Eulachon Management Plan in 2001 that provides for restricted harvest management when parental run strength, juvenile production, and ocean productivity forecast a poor return (WDFW and ODFW 2001). Despite a brief period of improved returns in 2001-2003, the returns and associated commercial landings have again declined to the very low levels observed in the mid-1990s (JCRMS 2009) and the fishery operated at the most conservative level allowed in the Joint State Eulachon Management Plan from 2005 to 2010 (JCRMS 2009). All commercial and recreational fisheries for eulachon were closed in Oregon and Washington for 2011.

Aquatic habitats have been significantly modified in the lower Columbia River Basin by a variety of anthropogenic activities, including dams and diversions, dredging, urbanization, agriculture, silviculture, and the construction and operation of port and shipping terminals). These activities alter the essential habitat features of eulachon and therefore may require special management considerations or protection. The construction and operation of a complex of tributary and mainstem dams and reservoirs for power generation, navigation, and flood control have altered migratory corridors, water flow, substrate composition, and water quality, all of which are important for adult, larval, and egg life stages. In the Columbia River estuary, both the quantity and timing of instream flows have changed from historical conditions (Fresh et al. 2005). Jay and Naik (2002) reported a 16 percent reduction of annual mean flow over the past 100 years and a 44 percent reduction in spring freshet flows. Jay and Naik (2002) also reported a shift in flow patterns in the Columbia to 14 to 30 days earlier in the year, meaning that spring freshets are occurring earlier in the season. In addition, the interception and use of spring freshets (for irrigation, reservoir storage, etc.) have caused increased flows during other seasons (Fresh et al. 2005). It is unknown what effect these changes in hydrology may have on eulachon habitat.

Dredging in the mainstem Columbia River and tributaries is required to maintain adequate depth of navigation channels. Dredging activities, which include the disposal of dredged material, may affect depth, sediment quality, water quality, and prey resources for eulachon. Dredging and the aquatic disposal of dredged material can remove, and/or alter the composition of, substrate materials at the dredge site, as well as bury them at the disposal site, (potentially altering the quality of substrate for use as a spawning site).

Several types of in-water construction or alterations occur in the Columbia River and its tributaries including bridge and road construction and repair, construction or repair of breakwaters, docks, piers, and boat ramps, gravel removal or augmentation, pile driving and bank stabilization (LCFRB 2004a). These types of activities may affect eulachon essential habitat features by altering the water and sediment quality, substrate composition, and eulachon migratory corridors.

Pollution and runoff from urbanized areas, industrialized areas, and agricultural lands in the lower Columbia River Basin may affect eulachon essential habitat features by altering the water quality, sediment quality, and substrate composition.

The construction and operation of port and shipping terminals in the lower Columbia River pose the risk of leaks, spills, or pipeline breakage and may affect water quality. In addition, activities associated with the construction, operation, and maintenance of these projects may affect water quality, sediment quality, and prey resources for larval eulachon.

(8) Grays River, WA: The Grays River watershed is located in Pacific and Wahkiakum counties, in Washington State. The Grays River is a tributary of the Columbia River, which it enters near the town of Oneida, Washington. The Grays River watershed encompasses 322 km^2 (124 mi^2) (May and Geist 2007).

From 1980-1989 the annual commercial harvest of eulachon in the Grays River varied from 0-16 metric tons (0-35,000 lbs.). No commercial harvest has been recorded for the Grays River from 1990 to the present but larval sampling has confirmed successful spawning in recent years (2009; JCRMS 2009). During spawning, eulachon typically ascend the river approximately 17.3 km (10.8 miles) to the covered bridge near the unincorporated town of Grays River (Anderson 2009), indicating that this area contains the spawning and incubation and migration corridor essential features (Figure 4).

Approximately 95% of the Grays River basin is forested, and much of this land (approximately 73% of the entire basin) is used for commercial timber production

(LCFRB 2004b). Forestry operations have the potential to increase sediment loading to streams from harvest site erosion and to cause direct physical disturbance of stream channels and riparian zones (Rashin et al. 2006).

(9) Skamokawa Creek, WA: Skamokawa Creek is a tributary of the Columbia River located in southwest Washington. Skamokawa Creek drains a relatively small (161 km^2 [63 mi^2]) watershed that lies entirely within Wahkiakum County.

During April 2011, biologists from the Cowlitz Indian Tribe documented the presence of eulachon larvae in Skamokawa Creek, confirming eulachon spawning in this system (Cowlitz Indian Tribe, 2011). These biologists used a systematic sampling protocol to determine that the bridge crossing at Petersen Road (7.6 km [4.7 mi] upstream of the confluence with the Columbia River) was the likely upstream limit of spawning. We consider this recent information as the best available indicating that this area contains the spawning and incubation, and migration corridor essential features for eulachon.

(10) Elochoman River, WA: The Elochoman River is a tributary of the Columbia River in southwest Washington and it originates in the Willapa Hills. The watershed lies within Lewis, Cowlitz, and Wahkiakum counties and flows generally south to the Columbia River. The Elochoman watershed area is approximately 261 km^2 (101 mi^2) (LCFRB 2004c).

Eulachon spawn occasionally in the Elochoman River, although there is no history of commercial or recreational harvest of eulachon for the Elochoman River. Sampling of outmigrating larval eulachon by WDFW has confirmed spawning in the river 7 times in the last 15 years (JCRMS, 2011), most recently in 2011[4]. WDFW has observed spawning eulachon as far as 3.2 km (2 mi) up the lower Elochoman River to the Washington State Highway 4 bridge crossing (Anderson 2009). However, in April 2011, biologists from the Cowlitz Indian Tribe documented the presence of larval eulachon 8.3 km up the Elochoman River (to the Monroe Drive bridge crossing; Cowlitz Tribe 2011) indicating that a more extensive area contains the spawning and incubation, and migration corridor essential features. If eulachon ascend the river beyond this point, the water intake dam at

[4] Chris Wagemann, WDFW, personal communication, 4/18/2011

the old Beaver Creek Hatchery (located on the Elochoman River at river km 11.5 [river mi 7.1]) may be a barrier to any further upstream migration of eulachon (Wade 2002).

Forestry is the predominant land use in the Elochoman watershed (Wade 2002). Considerable logging occurred in the past without regard for riparian and instream habitat, resulting in sedimentation of salmonid spawning and rearing habitat (WDF 1990). There has been a significant decrease in vegetative cover in the Elochoman watershed, with potential impacts to runoff properties. High road densities are also a concern, with road densities greater than 3.1 km/km² (5 miles/mi²) throughout most of the watershed (LCFRB 2004c). Runoff from forestry operations, and the associated road building activities have the potential to affect eulachon essential habitat features and thus may require special management considerations or protections.

(11) Cowlitz River, WA: The Cowlitz River flows from its source on the west slope of the Cascade Mountains, through the towns of Kelso and Longview, WA, and empties into the Columbia River about 109 km (68 mi) upstream from the Pacific Ocean. The Cowlitz River drains approximately 6,400 km² (2,480 mi²) over a distance of 243 km (151 mi)(Dammers et al. 2002). Principle tributaries to the Cowlitz River include the Coweeman, Toutle, Tilton, and Cispus rivers.

The Cowlitz River is likely the most productive and important spawning river for eulachon within the Columbia River system (Wydoski and Whitney 2003). Spawning adults typically move upstream about 26 km (16 mi), to the town of Castle Rock, WA or beyond to the confluence with the Toutle River. Adults are regularly sighted from the mouth of the river to 55 km (34 mi) upstream (near the town of Toledo, WA). Eulachon are occasionally sighted as far as 80 km (50 mi) upstream, to the barrier dam at the Cowlitz Salmon Hatchery (WDFW and ODFW 2008; Anderson 2009), indicating that this area contains the essential features of spawning and incubation and migration corridor essential features (Figure 4).

The Cowlitz River currently has three major hydroelectric dams and several small-scale hydropower and sediment retention structures located on tributaries within the Cowlitz Basin. Mayfield Dam is located at river km 84 (river mi 52) and is a complete barrier to upstream migration of anadromous fish (LCFRB 2004d); although the salmon hatchery barrier dam at river km 80 (river mi 50) is a complete barrier to eulachon. The operation of dams and water diversions can affect water flow and quality, substrate quality, and depth.

Much of the habitat in the lower Cowlitz River (below the confluence with the Toutle River) was damaged and degraded by the May 18, 1980 eruption of Mt. St. Helen's, which sent a wave of coarse sandy material and debris all the way to the Columbia River. Large scale removal of this volcanic material in the Cowlitz River began in July 1980. Over 57 million m^3 (2 billion ft^3) of material were removed from the Cowlitz River within the first year after the eruption (Cowlitz County 1983). Dredging is still conducted in the lower Cowlitz River to maintain adequate depth for navigation purposes. Dredging activities, which include the disposal of dredged material, may affect depth, sediment quality, water quality, and prey resources for eulachon. Dredging and the aquatic disposal of dredged material can remove, and/or alter the composition of, substrate materials at the dredge site, as well as bury them at the disposal site (potentially altering the quality of substrate for use as a spawning site).

Grazing, agriculture, forestry, and commercial development are all land use activities that occur within the Cowlitz River watershed (LCFRB 2004d). Runoff from these activities may affect eulachon essential habitat features (and thus may require special management considerations or protections) by altering water quality, sediment quality, and substrate composition.

(12) Toutle River, WA: The Toutle River is a tributary of the Cowlitz River, and it occurs in portions of Lewis, Cowlitz, and Skamania Counties in southwestern Washington State. The Toutle River is one of the major tributaries of the lower Cowlitz River and their confluence occurs 32 km (20 mi) upstream of the mouth of the Cowlitz River, just north of the town of Castle Rock, Washington. The basin encompasses approximately 1,329 km^2 (513 mi^2) of mostly forested land. The Toutle River drains the north and west sides of Mount St. Helens and elevations in the watershed range from near sea level at the mouth to 2,550 m (8,365 ft) at the summit of Mount St. Helens. The watershed contains three main drainages: the North Fork Toutle, the South Fork Toutle, and the Green River.

Most of the North and South Fork were impacted severely by the 1980 eruption of Mount St. Helens and the resulting massive debris torrents and mudflows (LCFRB, 2004b).

During April 2011, biologists from the Cowlitz Indian Tribe documented the presence of eulachon larvae in the Toutle River, confirming eulachon spawning in this system (Craig Olds, Cowlitz Indian Tribe, personal communication, April 22, 2011). In the past, spawned out eulachon adults have been collected in the Cowlitz River near the mouth of the Toutle River. However, the recent surveys provide the first evidence of spawning in the Toutle River. The Cowlitz Tribe biologists captured eulachon larvae up to the bridge crossing at Tower Road, which is 10.6 km (6.6 mi) upstream from the confluence with the Cowlitz River. We consider this recent information as the best available indicating that this area contains the spawning and incubation, and migration corridor essential features for eulachon.

(13) Kalama River, WA: The Kalama River basin is a 531 km^2 (205 mi^2) watershed extending from the southwest slopes of Mount St. Helens to the Columbia River (LCFRB 2004e). The headwaters of the Kalama River begin in Skamania County, WA but the majority of the 72 km (45 mi) river flows within Cowlitz County. At river km 16 (river mi 10) a concrete barrier dam and fish ladder prohibit upstream movement of all anadromous fish with the exception of summer steelhead and spring Chinook (LCFRB 2004e).

The extent of spawning within the Kalama River is from the confluence with the Columbia River to the confluence with Indian Creek (Cowlitz Indian Tribe, 2011), indicating that this area contains the spawning and incubation, and migration corridor essential features. Although the last commercial harvest of eulachon in the Kalama River occurred in 1993, sampling for larval eulachon has confirmed spawning in the Kalama River as recently as 2011 (Cowlitz Indian Tribe, 2011).

Almost the entire floodplain of the lower Kalama River has been disconnected from the river by the construction of dikes and levees (LCFRB 2004e). The construction of U.S. Interstate-5 first cut off the lower floodplain, and then development on Port of Kalama property completed the channelization of the river. These activities may affect water flow and quality as well as substrate quality.

Approximately 96 percent of the Kalama River Watershed is forested and nearly the entire basin is owned and managed by private companies for commercial timber production (LCFRB 2004e). As a result of timber management activities, an extensive road network covers the forest lands within the watershed. Extensive industrial development has occurred within the historic floodplains of the lower 3.2 km (2 mi) of the Kalama River, especially to the west of Interstate 5 (LCFRB 2004e). Activities associated with forestry operations and industrial development, may affect eulachon essential habitat features (and thus may require special management considerations or protections) by altering water quality, sediment quality, and substrate composition.

(14) Lewis River, WA: The Lewis River enters the Columbia River 104 km (87 mi) upstream from the mouth of the Columbia, a few miles north of the town of Ridgefield, Washington. The majority of the 1,893 km^2 (731 mi^2) watershed lies within Clark, Cowlitz and Skamania Counties (LCFRB 2004f). Although generally not considered as large a eulachon run as the Cowlitz River, the Lewis River has produced very large runs periodically. Nearly half of the total commercial eulachon catch for the Columbia River Basin in 2002 and 2003 came from the Lewis River. Larval eulachon have been caught in the Lewis River during sampling efforts by WDFW and the Cowlitz Indian Tribe, (JCRMS 2009, Cowlitz Indian Tribe 2011). During spawning, eulachon typically move upstream in the Lewis River about 16 km (10 mi; to Eagle Island), but they have been observed upstream to the Merwin Dam (31.4 km [19.5 mi] from the mouth of the river) (WDFW and ODFW 2008; Anderson 2009). Larval eulachon have also been caught in the East Fork of the Lewis River, up to the confluence with Mason Creek, 9.2 km (5.7 mi) from the confluence with the mainstem of the Lewis River (Cowlitz Indian Tribe 2011). The capture of larval eulachon in the mainstem and east fork of the Lewis River indicates that these areas contain the spawning and incubation, and migration corridor essential features (Figure 4).

Merwin Dam was completed in 1931, and it presents a passage barrier to all anadromous fish, including eulachon (LCFRB 2004f). We are unable to find information to determine whether eulachon ascended the river beyond river km 31.4 (river mi 19.5) prior to construction of the dam. Flow in the lower North Fork of the Lewis River is controlled by releases from Merwin Dam, resulting in an altered hydrograph when compared to pre-dam conditions (LCFRB 2004f). Dam operation can affect eulachon essential habitat features by altering water flow and quality, substrate quality, and depth.

The bulk of the land within the lower Lewis River watershed is forested and managed for timber production (LCFRB 2004f). The lower 19.3 km (12 mi) of the Lewis River flow through a broad alluvial valley characterized by agriculture and residential uses. The river passes by the town of Woodland, WA, and this section is extensively channelized. Activities associated with forestry operations (including road building), residential development and industrial development may affect eulachon essential habitat features (and thus may require special management considerations or protections) by altering water quality, sediment quality, and substrate composition.

(15) Quinault River, WA: The headwaters of the Quinault River originate in the Olympic Mountains within Olympic National Park. The river then crosses into the Quinault Indian Reservation where it flows into Lake Quinault. Downstream of the lake, the Quinault River remains within the Quinault Indian Reservation for another 53 km (33 mi) to the Pacific Ocean. The total watershed area is 1,190 km^2 (460 mi^2) (Smith and Caldwell 2001).

Although there is currently no monitoring for eulachon in the Quinault River, WDFW and ODFW (2001, p. 12) reported that eulachon were noted in large abundance in the Quinault River in 1993. A noticeable number of eulachon make an appearance in the Quinault River, and to a lesser extent the Queets River, at 5–6 year intervals and were last observed in the Quinault River in the winter of 2004–2005[5]. There is very little information on eulachon spawning distribution in the Quinault River, but tribal fishermen targeting eulachon typically catch fish in the lower three miles of the river[6]. It is reasonable to conclude that this area contains the spawning and incubation, and migration corridor essential features (Figure 5).

Although eulachon are currently only occasionally recorded in the Quinault River, during the late 19th and early 20th century eulachon were regularly caught by members of

[5] L. Gilbertson, Quinault Indian Nation, pers. comm., June 27, 2008.
[6] L. Gilbertson, Quinault Indian Nation, pers. comm., October 26, 2009.

the Quinault Indian Tribe (Willoughby 1889, Olson 1936). Fish were typically taken in the ocean surf, although eulachon often ascended the river for several miles (Olson 1936). Olson (1936) reported that there was usually a large run of eulachon in the Quinault River every three or four years, and the run timing varied, usually occurring between January and April. The Washington Department of Fisheries annual report for 1960 (Starlund 1960) listed commercial eulachon landings in the Quinault River in 1936, 1940, 1953, 1958 and 1960. The commercial catches ranged from a low of 61 kg (135 lbs.) in 1960, to a high of 42,449 (93,387 lbs.) in 1953.

Nearly half of the watershed lies within Olympic National Park, under the jurisdiction of the National Park Service, while the Quinault Indian reservation comprises about one third (32%) of the watershed, including most of the area downstream of Lake Quinault (Quinault Indian Nation and U.S. Forest Service 1999). The U.S. Forest Service manages 13% of the watershed, and private landholdings comprise only 4% of the lands in the watershed (Smith and Caldwell 2001). The most common land use in the portion of the watershed that lies outside of the Olympic National Park is commercial timber production (Smith and Caldwell 2001). Activities associated with timber management (including road building) may affect eulachon essential habitat features (and thus may require special management considerations or protections) by altering water quality, sediment quality, and substrate composition.

(16) Elwha River, WA: The Elwha River mainstem is approximately 72 km (45 mi) long, and it drains 831 km^2 (321 mi^2) of the Olympic Peninsula. A majority of the drainage (83%) is within Olympic National Park (Elwha-Dungeness Planning Unit 2005). The historical condition of the river has been altered by two major hydroelectric developments: the Elwha Dam and the Glines Canyon Dam (located just upstream of the Elwha Dam).

In 2005, eulachon were observed in the Elwha River for the first time since the 1970s (Shaffer et al. 2007). Since 2005, adult eulachon have been captured in the Elwha River every year (2006-2010)[7]. Several of the fish captured in 2005 were ripe, or egg-extruding females, indicating that eulachon likely spawn in the Elwha River. The Elwha

[7] M. McHenry, Lower Elwha Klallam Indian Tribe, pers. comm., February 25, 2010.

Dam serves as a complete barrier to upstream fish migration and thus it is reasonable to assume that the spawning and incubation, and migration corridor essential features only extend to that point in the Elwha River (Figure 6). It is not known if eulachon ascended the Elwha River beyond river km 7.9 (river mi 4.9) prior to the construction of the Elwha Dam. However, the dam was built in an area where the Elwha River became constricted, with increased gradient and higher water velocities. Prior to dam construction, this area was likely a natural passage barrier for eulachon. For this reason, the area upstream of the current Elwha Dam site was not considered for inclusion as critical habitat.

The Elwha and Glines Canyon dams have dramatically altered channel conditions in the lower river (Haring 1999). The dams truncate the recruitment of riverbed sands and gravels to channel reaches downstream of each dam and, as a result, the average substrate size in the lower river is now dominated by large cobble (Elwha-Dungeness Planning Unit 2005). Historically this material would have been transported downstream supplying gravel and fine-grained sediments to the lower river. In addition, the timing and behavior of flows in the lower river have been significantly altered due to the combination of dam activity and significant changes to the historic channel configuration (Elwha-Dungeness Planning Unit 2005). These changes in water flow and associated effects on water quality and substrate composition may affect eulachon spawning activity, egg viability, and larval growth, development, and survival. As part of a comprehensive restoration of the watershed's ecosystem and its fisheries, the dams were acquired by the federal government in 2000 and removal began in September 2011. There have been several habitat restoration projects conducted on the lower Elwha River in the past, and there are major restoration projects planned once the dams are removed (Elwha-Dungeness Planning Unit 2005).

UPSTREAM EXTENT OF SPECIFIC AREAS

Each specific area extends from the mouth of the specific river or creek (or its associated estuary when applicable) upstream to a fixed location. We determined the upstream extent based on evidence of eulachon spawning or presence, or the presence of an impassable barrier. The boundary at the mouth of each specific area that flows directly into marine waters was defined by the demarcation lines which delineate ‘‘those waters upon which mariners shall comply with the International Regulations for Preventing Collisions at Sea, 1972 (72 COLREGS) and those waters upon which mariners shall comply with the Inland Navigation Rules'' (33 CFR 80.01). For those specific areas that do not have a COLREGS line delineated, the boundary at the mouth of those specific areas was defined as a line drawn from the northernmost seaward extremity of the mouth of the creek or river to the southernmost seaward extremity of the mouth (with the exception of the boundary at the mouth of the Elwha River, which was defined as a line drawn from the easternmost seaward extremity of the mouth of the river to the westernmost seaward extremity of the mouth). Our regulations state that ". . . Each critical habitat will be defined by specific limits using reference points and lines as found on standard topographic maps of the area. . ." (50 CFR 424.12 (c)). The COLREGS lines (where defined) were chosen as the downstream extent of freshwater and estuarine critical habitat because they are a clearly defined federal standard, separating marine and inland waters, which incorporates landmarks that are found on standard topographic maps.

LATERAL EXTENT OF SPECIFIC AREAS

We describe the lateral extent of critical habitat as the width of the stream channel defined by the ordinary high water line, as defined by the USACE in 33 CFR 329.11. The ordinary high water line on non-tidal rivers is defined as ''the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil; destruction of terrestrial vegetation; the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas'' (33 CFR 329.11(a)(1)). In areas for which the ordinary high-water line has not been defined pursuant to 33 CFR 329.11, we define the width of the stream channel by its bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain (Rosgen, 1996) and is reached at a discharge which generally has a recurrence interval of 1 to 2 years on the annual flood series (Leopold et al., 1992).

As discussed in previous critical habitat designations for Pacific salmon and steelhead (70 FR 52630; September 2, 2005) and North American green sturgeon (74 FR 52300; October 9, 2009), the quality of aquatic and estuarine habitats within stream channels and bays and estuaries is intrinsically related to the adjacent riparian zones and floodplain, to surrounding wetlands and uplands, and to non-fish-bearing streams above occupied stream reaches. Human activities that occur outside of designated critical habitat can destroy or adversely modify the essential physical and biological features within these areas. In addition, human activities occurring within and adjacent to reaches upstream or downstream of designated stream reaches or estuaries can also destroy or adversely modify the essential physical and biological features of these areas. This designation will help to ensure that federal agencies are aware of these important habitat linkages.

OCCUPIED AREAS NOT IDENTIFIED AS SPECIFIC AREAS

In the Pacific Ocean, we identified nearshore and offshore foraging sites as an essential habitat feature for the conservation of eulachon, and we determined that abundant forage species and suitable water quality are specific components of this habitat feature. However, we were unable to identify any specific areas in marine waters that meet the definition of critical habitat under section 3(5)(A)(i) of the ESA. Given the unknown but potentially wide distribution of eulachon prey items, we could not identify ‘‘specific areas’’ where either component of the essential features is found within marine areas believed to be occupied by eulachon. Moreover, prey species move or drift great distances throughout the ocean and would be difficult to link to any ‘‘specific’’ areas. In addition, we were unable to identify any special management considerations or protection that may be required for the nearshore and offshore foraging essential feature, and that would satisfy the requirements of 3(5)(A)(i) of the ESA.

UNOCCUPIED AREAS

Section 3(5)(A)(ii) of the ESA authorizes the designation of “specific areas outside the geographical area occupied at the time [the species] is listed” if these areas are essential for the conservation of the species. Regulations at 50 CFR 424.12(e) emphasize that the agency “shall designate as critical habitat areas outside the geographical area presently occupied by a species only when a designation limited to its present range would be inadequate to ensure the conservation of the species.”

Nearly all of the documented historical presence and production of the southern DPS of eulachon comes from within the geographical area occupied by the southern DPS at the time of listing, and no new information on this subject was received during the comment and peer review process of the Proposed Critical Habitat Designation (76 FR 515; January 5, 2011). Sightings of southern DPS eulachon from creeks or rivers outside of this area have been extremely infrequent, and have consisted of very few fish (Gustafson et al. 2010). Therefore, we do not consider these areas to be essential to the conservation of the southern DPS of eulachon and are not considering any unoccupied areas as critical habitat for the DPS.

EVALUATION OF THE CONSERVATION VALUE OF THE SPECIFIC AREAS

In some previous critical habitat designations (e.g., Pacific salmon, [70 FR 52630, September 2, 2005] and green sturgeon [74 FR 52300, October 9, 2009]) we evaluated the conservation value of specific areas to help inform the designation of critical habitat. Assessing the conservation value of specific areas involves evaluating the quantity and quality of habitat features, the relationship of the area to other areas within the DPS, and the significance to the DPS of the population occupying that area.

To evaluate the quantity and quality of features of the specific areas, we considered existing information on the consistency of spawning in each area, the typical size of runs in the area, and the amount of habitat available to and used by eulachon in the area. We found that eulachon habitat and habitat use varies widely among the areas, and may vary within the same area across different years. It is difficult to identify differences between the areas that could be driving variation in run size and frequency, and variation in habitat use. Eulachon spawn in systems as large as the Columbia River (largest river in the Pacific Northwest), and as small as Tenmile Creek (a watershed of 60 km^2 [23 mi^2]). While some rivers consistently produce large spawning runs of eulachon (e.g., the Columbia and Cowlitz Rivers), spawning can be sporadic in others (e.g. Grays, Kalama, Lewis, Sandy, and Quinault Rivers). Still other areas, either currently or in the past, produce small yet consistent runs of eulachon (e.g., Tenmile Creek and Elwha River).

Another factor we considered in evaluating the conservation value of the specific areas is the geographic distribution of the areas. Nearly the entire production of southern

DPS eulachon in the conterminous United States originates in the 16 specific areas we have identified. These specific areas are widely distributed across the geographic extent of the DPS. Compared to salmon, steelhead, and other anadromous fishes, these relatively small areas historically produced a very large biomass of eulachon. The loss of any one of these areas could potentially leave a large gap in the spawning distribution of the DPS, and the loss to eulachon production could represent a significant impact on the ability of the southern DPS to survive and recover. Utilizing a diversity of stream/estuary sizes across a wide geographic area can be a useful strategy to buffer the species against localized environmental catastrophes (such as the Mount St. Helens eruption of May 18, 1980). For the above reasons, we conclude that all of the specific areas have a high conservation value.

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Figure 1. Map of the specific areas within the geographical area occupied by southern DPS of eulachon, on which are found those physical or biological features essential to the conservation of the DPS. Only specific areas within the conterminous United States are shown.

Figure 2. Map of the specific areas within the Mad River, Redwood Creek, and Klamath River, California, on which are found those physical or biological features essential to the conservation of the DPS.

Figure 3. Map of the specific area within the Umpqua River, and Tenmile Creek, Oregon on which are found those physical or biological features essential to the conservation of the southern DPS of eulachon.

Figure 4. Map of the specific areas within the lower Columbia River Basin, including specific areas in the Columbia River and its tributaries, on which are found those physical or biological features essential to the conservation of the southern DPS of eulachon.

Figure 5. Map of the specific area within the Quinault River, Washington on which are found those physical or biological features essential to the conservation of the southern DPS of eulachon.

Figure 6. Map of the specific area within the Elwha River, Washington on which are found those physical or biological features essential to the conservation of the southern DPS of eulachon.

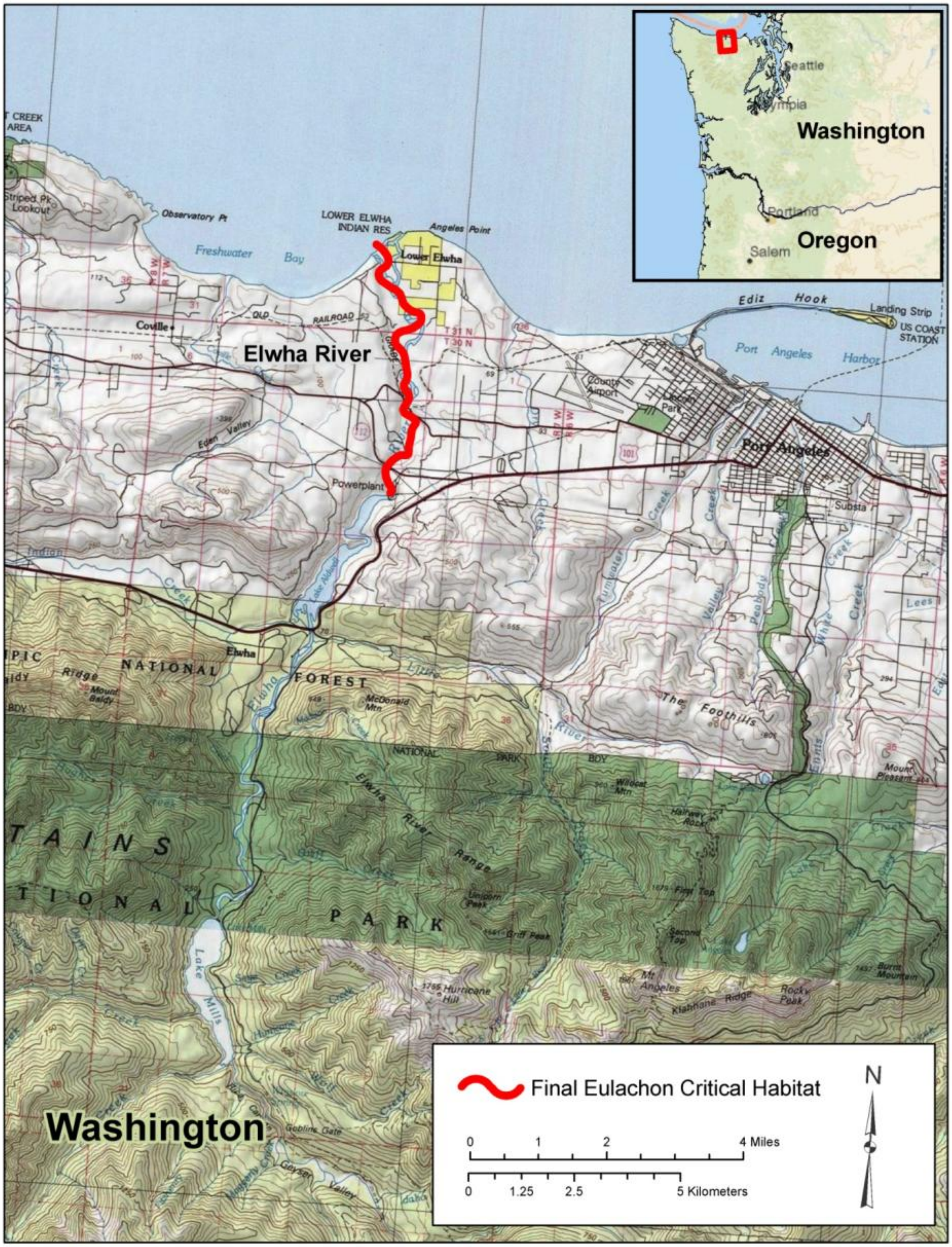

Table 1. Rivers and creeks, within the geographic area occupied by the southern DPS of eulachon at the time of listing where eulachon presence has been documented. Compiled from Hay and McCarter (2000), Hay (2002), Willson et al. (2006), and Moody (2008). Documented use of essential features (i.e., spawning and incubation sites, and migration corridors) is noted. Blank spaces indicate creeks and rivers where eulachon have been observed, but there is no documented evidence of spawning. See Gustafson et al. (2010) for full reference citations.

Specific Areas	Documented use[1] of Essential Physical or Biological Features		Reference
	Spawning	Migration	
California			
Mad River	X	X	Moyle et al. (1995); Moyle (2002)
Redwood Creek	X	X	Moyle et al. (1995); Moyle (2002)
Klamath River	X	X	Moyle et al. (1995); Moyle (2002)
Smith River			Moyle et al. (1995); Moyle (2002)
Oregon			
Winchuk River			Willson et al. (2006)
Chetco River			WDFW and ODFW (2008)
Pistol River			Willson et al. (2006)
Hunter Creek			Willson et al. (2006)
Rogue River			Roffe and Matte (1984)
Euchre Creek			Willson et al. (2006)
Elk River			Willson et al. (2006)
Sixes River			Reimers and Baxter (1976)
Coquille River			Gaumer et al. (1973); Kreag (1979)
Coos Bay/ River			Cummings and Schwartz (1971)
Umpqua River	X	X	OFC (1970); Johnson et al. (1986)
Tenmile Creek (lakes system)			Willson et al. (2006)
Siuslaw River			Willson et al. (2006)
Tenmile Creek	X	X	WDFW and ODFW (2008)
Yaquina River			Borgerson et al. (1991); Willson et al. (2006)
Clatskanie River			Williams (2009)
Sandy River	X	X	WDFW and ODFW (2008)
Tanner Creek			WDFW and ODFW (2008)
Hood River			Smith and Saalfeld (1955)
Washington			
Columbia River mainstem	X	X	Smith and Saalfeld (1955); WDFW/ODFW (2001, 2008)
Grays River	X	X	WDFW and ODFW (2001, 2008)
Skamokawa Creek	X	X	WDFW and ODFW (2001, 2008)
Elochoman River	X	X	WDFW and ODFW (2001, 2008)
Cowlitz River	X	X	Smith and Saalfeld (1955); WDFW/ODFW (2001, 2008)
Toutle River	X	X	WDFW and ODFW (2008)
Kalama River	X	X	WDFW and ODFW (2001, 2008)
Lewis River	X	X	WDFW and ODFW (2001, 2008)
Washougal River			WDFW and ODFW (2008)
Klickitat River			Smith and Saalfeld (1955)
Bear River			WDFW and ODFW (2001, 2008)
Naselle River			WDFW and ODFW (2001, 2008)
Nemah River			Smith (1941); WDFW and ODFW (2001, 2008)
Wynoochee River			WDFW and ODFW (2001, 2008)
Quinault River	X	X	WDFW and ODFW (2001, 2008)
Queets River			WDFW and ODFW (2001, 2008)
Quillayute River			WDFW and ODFW (2008)
Elwha River	X	X	Shaffer et al. (2007)
Puyallup River			Miller and Borton (1980)

[1]Documented Use Criteria: 1) Positive identification of larval fish or pre spawn/post spawn adults; or 2) a multi-year history of large runs, within the expected spawning window, that resulted in documented commercial or recreational catches.

Table 2. Summary of specific areas within the geographical area occupied by the Southern DPS of eulachon being considered for designation as critical habitat, with the number of river miles being considered, and the physical and biological features present.

Specific area	River kilometers/ miles containing features	Physical or biological features present	References on physical or biological features extent
1. Mad River	21.0/13.0	Migration, Spawning	Larson and Belchik 1998; Adults to North Fork Mad River, Steve Cannata pers. comm. 2009
2. Redwood Creek	19.7/12.2	Migration, Spawning	CDF&G 1973; to Tom McDonald Creek
3. Klamath River	17.2/10.7	Migration, Spawning	Larson and Belchik 1998; to Brooks Riffle
4. Umpqua River	39.0/24.2	Migration, Spawning	Williams 2009; to Scotsburg/Little Mill crk; Listed as common in the Umpqua River in Emmett et al. 1991
5. Tenmile Creek	0.4/0.2	Migration, Spawning	Bob Buckman pers. comm. 2009; to Highway 101 bridge
6. Sandy River	20.0/12.4	Migration, Spawning	Anderson 2009; to Gordon Creek confluence
7. Columbia River	230.5/143.2	Migration, Spawning	ODFW & WDFW 2008; to Bonneville Dam
8. Grays River	7.8 /4.8	Migration, Spawning	Anderson 2009; to the covered bridge at river mile 10.8
9. Skamokawa Creek	17.9/11.1	Migration, Spawning	Cowlitz Tribe 2011; to Petersen Road Bridge
10. Elochoman River	8.4/5.2	Migration, Spawning	Cowlitz Tribe 2011; to Monroe Drive Bridge
11. Cowlitz River	80.8/50.2	Migration, Spawning	WDFW and ODFW; Anderson 2009; to salmon hatchery below Mayfield Dam
12. Toutle River	10.5/6.6	Migration, Spawning	Cowlitz Tribe 2011; to Tower Road Bridge
13. Kalama River	12.6/7.8	Migration, Spawning	Cowlitz Tribe 2011; to Indian Creek confluence
14. Lewis River	31.1/19.3	Migration, Spawning	WDFW and ODFW 2008; Anderson,2009; to Merwin Dam
East Fork	9.2/5.7	Migration, Spawning	Cowlitz Tribe 2011; to Mason Creek
15. Quinault River	4.8/3.0	Migration, Spawning	Larry Gilbertson, pers. comm. 2009; approximately 3 miles upstream of river mouth
16. Elwha River	7.6/4.7	Migration, Spawning	Mike McHenry pers. comm. 2009