Science, Service, Stewardship

2016 5-Year Review: Summary & Evaluation of **Eulachon**

National Marine Fisheries Service
West Coast Region
Portland, OR

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5-Year Review: Southern Distinct Population Segment of Eulachon

Species Reviewed	Distinct Population Segment
Eulachon (*Thaleichthys pacificus*)	*Eulachon*

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- Develop a research and monitoring plan to analyze how shifts in water temperature and flow from climate change will potentially affect spawn timing, location, and success.
- Conduct a cross-evaluation of restoration projects in Washington, Oregon, and California to assess how they might contribute to the recovery of eulachon.
- Develop a life-cycle model for eulachon to help evaluate effects of habitat restoration and how they contribute to eulachon recovery.
- Develop a research and monitoring plan to monitor and evaluate the causal mechanisms, e.g., shifts in the timing, magnitude, and duration of the hydrograph of the Columbia River caused by the hydropower system, and their effects on the migration and behavioral characteristics and effects on larval eulachon during their first weeks in the plume-ocean environment.

Listing Factor A Conclusion

We conclude that the risk to the species' persistence remains unchanged since the last status review.

Listing Factor B: Overutilization for commercial, recreational, scientific, or educational purposes

In 2014–2016, WDFW and ODFW reinstated a reduced Level-I eulachon fishery in the Columbia River, and select tributaries of the Columbia River. It was expected that a limited eulachon fishery would benefit eulachon recovery efforts by:

(1) Providing essential context for interpreting historical harvest data to better understand trends and variability in eulachon abundance
(2) Filling critical information gaps such as the length and age structure of spawning eulachon, as well as the temporal and spatial distribution of the run
(3) Supporting the cultural traditions of Northwest tribes who relied on eulachon as a seasonally important food source and valuable trade item
(4) Providing a limited public and commercial opportunity for eulachon harvest to maintain a connection between people and the eulachon resource. This connection is important to sustaining public engagement in eulachon conservation and recovery.

A commercial gill-net fishery opening occurred in the mainstem Columbia River on Mondays and Thursdays for seven hours each day from 10 February to 6 March in 2014, from 2–26 February in 2015, and from 1–25 February in 2016, for a total opening each year of 56 h (JCRMS 2014, ODFW 2015, 2016). Approximately 8.4, 7.5, and 2.2 metric tons of eulachon were commercially harvested in 2014, 2015, and 2016, respectively (ODFW 2014, 2015, 2016). Recreational sport fisheries were also permitted on the Cowlitz and Sandy rivers in 2014, which harvested an estimated 89.7 and 2.7 metric tons (Gustafson et al. 2016), respectively. Likewise, recreational dip-net fisheries operated on the Cowlitz and Sandy rivers in 2015. The Cowlitz River recreational dip-net fishery, which was open for two Saturdays in February 2015, harvested an estimated 131.4 mt of eulachon (ODFW 2015). Less than 100 pounds of eulachon were reported as taken in the recreational dip-net fishery in the Sandy River during 2015. Although landings are preliminary, recreational harvest was estimated at about 64 mt in the single day opening of the sport or recreational fishery on the Cowlitz River in 2016. A decision on opening a sport fishery on the Sandy River in 2016 is still pending as of 7 March 2016. Catch records were not maintained for eulachon recreational fisheries in the Columbia River Basin prior to 2014, although in the past it had been estimated at times to equal the historical commercial catch (WDFW and ODFW 2001).

The current California Code of Regulations for fishing in inland waters states that "Candlefish or Eulachon may not be taken or possessed."

British Columbia—the Fraser River commercial fishery for eulachon has essentially been closed since 1997, opening only briefly in 2002 and 2004, when 5.76 and 0.44 mt were landed, respectively (Gustafson et al. 2010). In regards to eulachon fishing opportunities on the Fraser River, DFO (2013, p. 28) stated that:

> First Nation Fisheries: First Nations access to eulachon for food, social and ceremonial (FSC) purposes is managed through a communal Aboriginal fishing licence on the Fraser River. In 2012, harvest opportunities targeting 50 pounds per Band on a case by case basis were provided for up to eight Bands. However, the target of 400 pounds total was exceeded; the total eulachon harvest in 2012 was 1,037 pounds.
>
> Recreational Fisheries: There were no recreational fisheries for eulachon on the Fraser River in 2012 [–2015].
>
> Commercial Fisheries: There were no commercial fisheries for eulachon on the Fraser River in 2012 [–2015].
>
> New Westminster Test Fishery: The New Westminster test fishery was not conducted in 2012 [–2015].
>
> Furthermore, DFO (2013, p. 28) stated that:
>
> Due to conservation concerns and the recovery process, only limited Fraser River FSC [food, social, and ceremonial] fisheries for eulachon will be considered on a case by case basis by the Lower Fraser area office for 2013.
>
> The Department is managing the LFA [lower Fraser area] eulachon fisheries to ensure harvests do not exceed 800 pounds in 2013. This limited harvest will provide access to First Nations for FSC purposes while maintaining conservation objectives.

Additional landings and effort statistics for most First Nations fisheries within the southern DPS of eulachon are unavailable. Recreational fishing for eulachon with dip nets, gillnets, minnow nets, or cast nets in fresh water, is prohibited throughout British Columbia.

Recommended Future Action

- Minimize impacts related to a directed fishery on eulachon by developing and implementing a biologically-based fishery management plan linked to subpopulation-specific viability criteria for the Klamath River and Columbia River subpopulations.

Listing Factor B Conclusion

We conclude that the risk to the species' persistence remains unchanged since the last status review.

Listing Factor C: Disease or Predation

Disease

Disease rates over the past five years are believed to be consistent with the previous review.

Predation

Status of Pinnipeds Populations in Oregon and Washington

Pinniped predation continues to remain a concern for listed species in Oregon and Washington due to a general increase in pinniped populations along the West Coast. For example, California sea lions have increased at a rate of 5.4% per year between 1975 and 2011 (NMFS 2015b), Steller sea lions have increased at a rate of 4.18% per year between 1979 and 2010 (Allen and Angliss 2014), and harbor seals likely remain at or near carrying capacity in Washington and Oregon (Jefferies et al. 2003, Brown et al. 2005, respectively, as cited in NMFS 2014).[5]

Columbia River Basin—in the Columbia River Basin, there has been a steady influx of pinnipeds (Figure 2), especially California sea lions, over the past 5 years with sharp increases in California sea lion presence in 2013 of 750 animals, 1,420 animals in 2014,[6] and 2,340 animals in 2015.[7]

As pinniped numbers have increased in the Columbia River Basin over the past 13 years (2002 through 2014 this steady influx of pinnipeds into the Columbia River may also represent a shift in

[5] The last population estimates of harbor seals in Washington (coastal population) and Oregon was in 2003 and 2005 (Jefferies et al. 2003, Brown et al. 2005, respectively, as cited in NMFS 2014), when the population growth rate was estimated at 7% (NMFS 2014).
[6] E-mail to Robert Anderson, NMFS, from Bryan Wright, ODFW, October 28, 2015.
[7] E-mail to Robert Anderson, NMFS, from Bryan Wright, ODFW, October 28, 2015.

the severity of predation to eulachon. For example, in 2015 WDFW[8] estimated, based on biomass reconstruction for eulachon consumption, that harbor seals were consuming an estimated 2,700,000 eulachon per day in the Columbia River estuary.

The information available since the last status review clearly indicates that predation by pinnipeds on eulachon has increased since the last status review.

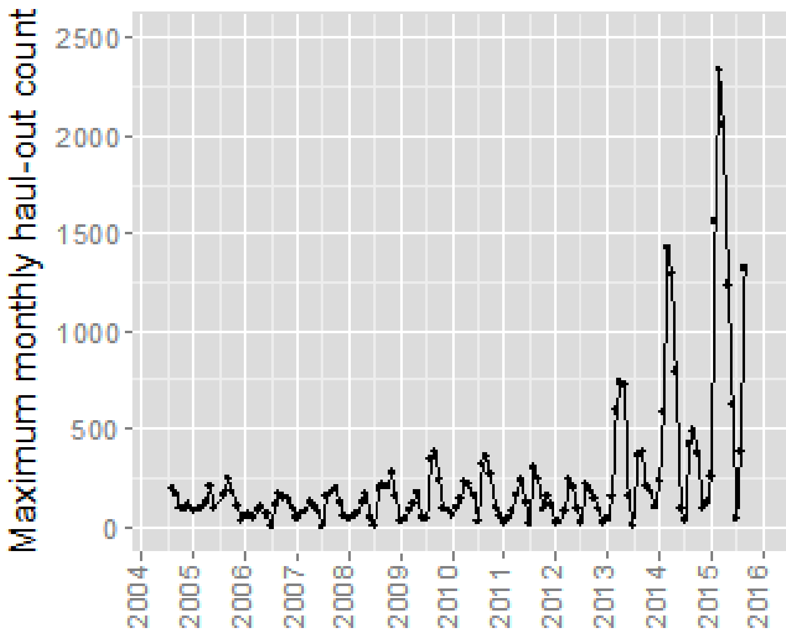

Figure 2. Estimated peak counts (spring and fall) of California sea lions in the East Mooring Basin in Astoria, Oregon, 2004 through 2015.[9]

Puget Sound—in Puget Sound, there has been a steady influx of pinnipeds, especially harbor seals (NMFS 2014), and Steller sea lions (Wiles 2015) over the past 5 years. Current information on abundance estimates of harbor seals (coastal and inland waters populations) are 32,000 animals (Jefferies 2013),[10] with approximately 11,036 of these animals in Puget Sound (inland waters population), compared to an estimated 8,949 animals in 1999 (Jefferies et al. 2003). The most recent population estimates of Steller sea lions indicate that the overall population was at 70,174 animals in 2010 (Wiles 2015), up from 18,313 animals in 1979. The effects of predation by marine mammals on the productivity and abundance of Puget Sound listed salmon and steelhead stocks has not been quantitatively assessed since 2003 (Scordino 2010).

[8] E-mail (forwarded) to Robert Anderson, NMFS, from Brent Norberg, NMFS, on February 19, 2015, from Steven Jefferies, WDFW, regarding sea lion counts in Astoria, Oregon.
[9] E-mail to Robert Anderson, NMFS, from Bryan Wright, ODFW, October 28, 2015.
[10] E-mail to Robert Anderson, NMFS, from Steven Jefferies, WDFW, October 26, 2015.

Recommended Future Actions

- Expand monitoring efforts in the Columbia River to assess predator-prey interactions between pinnipeds and eulachon.
- Complete life-cycle/extinction risk modeling to quantify predation rates by predatory pinnipeds on eulachon in the Columbia River.
- Expand research efforts in the Columbia River estuary on survival and run timing for adult eulachon migrating through the lower Columbia River.
- Expand monitoring efforts in Puget Sound to assess predator-prey interactions between pinnipeds and eulachon.

Listing Factor C Conclusions

Disease—we conclude that the risk to the species' persistence remains unchanged since the last status review.

Predation—we conclude that the risk to the species' persistence remains unchanged since the last status review.

Listing Factor D: Adequacy and Inadequacy of Regulatory Mechanisms and Protective Efforts

The BRT identified bycatch of eulachon in commercial fisheries as a moderate threat to all four populations in the Southern DPS. See Listing Factor E: Other Natural or Manmade Factors Affecting its Continued Existence for a detailed discussion regarding bycatch.

The only regulatory mechanism related to eulachon since the last status review are regulations issued by the California Department of Fish and Wildlife prohibiting the taking or possession of eulachon in California.

Recommended Future Action

Ensure appropriate and effective regulatory, response, restoration, and enforcement mechanisms are in place domestically and internationally for both planned and unplanned impacts. For planned impacts, project planning should ensure no net loss of eulachon critical habitat. Where natural or anthropogenic impacts do occur, an effective and complete response plan, including appropriate compensatory and site restoration, is executed.

Listing Factor D Conclusion

We conclude that the risk to the species' persistence remains unchanged since the last status review.

Listing Factor E: Other Natural or Manmade Factors Affecting its Continued Existence

Eulachon Bycatch—for additional information on bycatch see *Gustafson 2016 et al. Status Review Update of Eulachon (Thaleichthys pacificus) Listed under the Endangered Species Act: Southern Distinct Population Segment.*

Eulachon Bycatch in Ocean Shrimp Trawl Fisheries 2004–2014

Offshore trawl fisheries for ocean shrimp (*Pandalus jordani*) occur off the west coast of North America from the west coast of Vancouver Island (WCVI) to Cape Mendocino, California (Hannah and Jones 2007) and in British Columbia, Canada. *Pandalus jordani* is known as the smooth pink shrimp in British Columbia, ocean pink shrimp or smooth pink shrimp in Washington, pink shrimp in Oregon, and Pacific Ocean shrimp in California. Herein we use the common name "ocean shrimp" in reference to *P. jordani* as suggested by the American Fisheries Society (McLaughlin et al. 2005). The common name "pink shrimp" has been assigned by the American Fisheries Society to *Farfantepenaeus duorarum*, a commercial species in the South Atlantic and Gulf of Mexico (McLaughlin et al. 2005). Numerous publications have documented eulachon bycatch levels in shrimp trawl fisheries off the coasts of Washington, Oregon, California, and British Columbia (Hay et al. 1999a, b; Olsen et al. 2000; NWFSC 2008, 2009, 2010; Bellman et al. 2011; Al-Humaidhi et al. 2012; Gustafson et al. 2015a, b).

Canada—following recognition that large numbers of eulachon were occurring as bycatch in Queen Charlotte Sound shrimp fisheries (Hay and McCarter 2000, Olsen et al. 2000) and of a concurrent decline in central coast British Columbia eulachon stocks, DFO closed the Queen Charlotte Sound shrimp trawl fishery in 1999, which has remained closed (DFO 2014).

Washington, Oregon, and California—ocean shrimp fisheries began in California in 1952 and expanded into Oregon and Washington by the mid- to late-1950s (Frimodig et al. 2009). Ocean shrimp in commercial quantities are found from Point Arguello, California north to Queen Charlotte Sound, British Columbia, typically over well-defined beds of green mud or green mud and sand (Frimodig et al. 2009). Because ocean shrimp undergo a vertical diel migration, dispersing into surface waters during nighttime hours and returning to near-bottom aggregations in the daytime (Zirges and Robinson 1980, Frimodig et al. 2009), ocean shrimp vessels generally trawl in depths ranging from 91–256 m (50 to 140 fathoms) during daylight hours. Vessels that currently operate in the state-permitted ocean shrimp trawl fisheries in Washington, Oregon, and California range in size from 11.6–32 m (38–105 feet), with an average length of 19.9 m (65 feet), and can use single or double-rigged shrimp trawl gear.

The ocean shrimp season is open 1 April through 31 October in Washington, Oregon, and California and vessels deliver catch to shore-based processors. Total coastwide ocean shrimp landings have ranged from a low of 1,888 mt in 1957 to a high of 41,418 mt in 2014 (Gustafson et al. 2015b). The portion of the bycatch that is not marketable or for which regulations prohibit landing is discarded at-sea and all discarded eulachon in this fishery results in 100% mortality.

Currently, ocean shrimp vessels are required to use bycatch reduction devices (BRDs) that serve as deflecting grids to guide fin-fish towards an escape opening, which is usually on the top of the net. The primary goal of mandatory BRDs is to reduce bycatch of groundfish species, and more recently, protected species such as eulachon. BRDs became mandatory in California in 2002

(Frimodig 2008, Frimodig et al. 2009) and in Washington and Oregon in 2003. Current 2014–2015 regulations in Washington and Oregon, adopted by both states in 2012, require ocean shrimp trawl fishery BRDs to consist of a rigid panel or grate of narrowly spaced bars (usually constructed of aluminum) with no gaps between the bars exceeding 0.75 inches (19.1 mm). Approved BRDs for use in the ocean shrimp fishery in California include: (1) rigid- or semi-rigid grate excluders consisting of vertical bars with no gaps between the bars exceeding 2 inches (50.8 mm); (2) soft-panel excluders, usually made of a soft mesh material "with individual meshes no large than 6 inches;" and (3) fisheye excluders, which have a forward facing escape opening that is maintained by a rigid frame.

Gustafson et al. (2015b) reported observed and estimated bycatch of eulachon in ocean shrimp trawl fisheries for the years 2004, 2005, and 2007–2013. The observed tows were in waters shallower than 250 m and deeper than 80 m. The ocean shrimp trawl fishery did not carry WCGOP observers in 2006. Data sources and bycatch estimation methods for eulachon bycatch in west coast ocean shrimp fisheries in 2004–2013 are detailed in Gustafson et al. (2015b).

The WCGOP began observing eulachon bycatch in the Washington ocean shrimp fishery in 2010 and the estimated bycatch in terms of weight and numbers of eulachon has increased in each year up to 2013, while the percentage of total shrimp landings observed has fluctuated between just less than 10% to nearly 15% (Gustafson et al. 2015b). Total estimated bycatch of eulachon in the Washington ocean shrimp fisheries ranged from a low of over 64 thousand (95% CI; 23,361–132,532) fish in 2010 to a high of over 17.2 million (95% CI; 12,077,308–21,444,581) fish in 2013 (Gustafson et al. 2015b). Mean estimated total biomass of eulachon bycatch in the Washington fishery during this time period (2010–2013) ranged from 2.1–203.7 metric tons (mt) (Gustafson et al. 2015b).

Eulachon bycatch in the Oregon ocean shrimp fishery was estimated at well under a million individual fish (range of 146–845 thousand) from 2004–2011 (the fishery was not observed in 2006); however, estimated bycatch expanded dramatically in 2012 and 2013 to over 28.1 million (95% CI; 17,948,671–39,302,622 million) and 35.1 million (95% CI; 20,316,467–52,991,571), respectively (Gustafson et al. 2015b). Similarly, total weight of estimated eulachon bycatch in Oregon increased from 20.5 mt (95% CI; ~14.7–27.4 mt) in 2011 to nearly 428 mt (95% CI; ~285–588 mt) in 2012 and to over 540 mt (95% CI; ~348–759 mt) in 2013.

Bycatch ratios, measured as both kg of eulachon and numbers of fish, per metric ton of ocean shrimp observed also increased dramatically in both the Washington and Oregon ocean shrimp fisheries from 2011 to 2012, and remained high in 2013 (Gustafson et al. 2015b). Bycatch ratios were higher in Washington than in the Oregon fishery in both 2012 and 2013 (Gustafson et al. 2015b).

Eulachon bycatch in the California ocean shrimp fishery has followed a very different trajectory from that observed in Washington and Oregon during the last three years (2011–2013) of available data. Eulachon bycatch in California remained below 25,000 fish prior to 2008 (the fishery was not observed in 2006), rose dramatically in 2010 to over 267,000 (95% CI; 40,040–714,661) fish; fell to its lowest observed level of just 471 (95% CI; 197–826) fish in 2011, increased again dramatically in 2012 to over 337,000 (95% CI; 151,822–616,148) fish, and then fell to just over 16,000 (95% CI; 3,768–33,610) fish in 2013 (Gustafson et al. 2015b). Biomass of eulachon bycatch and bycatch ratios have shown similar fluctuations over the time period from 2010–2013 (Gustafson et al. 2015b). The tonnage of observed ocean shrimp and of fleet-wide landings were relatively stable over the last three to four years, indicating that yearly differences in eulachon distribution, or in the catchability of eulachon, likely contributed to the extreme fluctuations in eulachon bycatch in the California ocean shrimp fishery.

Combined WCGOP estimates of the weight and number of eulachon caught in the Oregon and California ocean shrimp trawl fishery as bycatch from 2004–2013 (except for 2006 when these fisheries were not observed) and in Washington from 2010–2013 are presented Gustafson et al. 2015b. Total estimated bycatch of eulachon in the Oregon and California ocean shrimp fisheries ranged from nearly 158,000 fish (95% CI; 11,642–492,844) in 2004 to a high of over 959,000 (95% CI; 238,075–2,147,772) fish in 2009. Estimated eulachon bycatch in the Washington ocean shrimp fishery in 2010 (its first year of observation) was nearly 65,000 fish and the total 2010 estimated eulachon bycatch for all three states combined was over 1,072,000 (95% CI; 532,268–1,891,424). Total three-state eulachon bycatch decreased to about 602,000 (95% CI; 394,343–875,107) fish in 2011. However, as seen earlier, eulachon bycatch increased dramatically in all three states in 2012, topping out at over 42.8 million (95% CI; ~26.9–59.1 million) individual eulachon. Bycatch increased again in Washington and Oregon, but not California in 2013 resulting in an estimated total eulachon bycatch for all three states combined of over 52.3 million (95% CI; ~32.4–74.5 million) fish. Estimated weight of these bycaught eulachon in 2013 was over 744 mt (95% CI; ~498–1,008 mt).

Recently, the WCGOP released updated data on observed bycatch of eulachon in Washington, Oregon, and California ocean shrimp trawl fisheries for 2014[11]. Approximately, 7.1%, 9.7%, and 15.5% of ocean shrimp landings were observed in the Washington, Oregon, and California sectors

[11] NWFSC, FRAM Division, Fisheries Observation Science, Annual Tables of Observed Bycatch of Protected Species, Eulachon observed bycatch (2002-2014). Available at: http://www.nwfsc.noaa.gov/research/divisions/fram/observation/data_products/protected_species.cfm

of this fishery during 2014. Over the past three years (2012–2014), the bycatch ratio (measured as the number of eulachon caught per mt of observed ocean shrimp), and the number of eulachon caught in this fishery, have declined in Washington, increased in Oregon, and fluctuated up and down in California. During 2014, approximately 968; 2,322; and 159 eulachon were caught per mt of observed ocean shrimp landings in Washington, Oregon, and California, respectively.

Ward et al. (2015) applied spatiotemporal models to both fishery-dependent observations of eulachon bycatch and eulachon fisheries-independent survey data to 1) estimate population trends of eulachon, 2) understand eulachon bycatch risk in shrimp fisheries, and 3) identify persistent bycatch hotspots that may be used in future management actions to reduce eulachon bycatch rates. Two spatial data sets for the period from 2007–2012 were examined: WCGOP catch data of shrimp and eulachon in the California, Oregon, and Washington ocean shrimp trawl fisheries and fishery-independent incidental eulachon catch in the WCBTS (Ward et al. 2015). Ward et al. (2015) found support for a greater than 40% annual increase in eulachon density based on the bycatch dataset and a greater than 55% annual increase based on the fisheries-independent survey dataset over the duration of the datasets. The later dataset also suggested that eulachon density was "substantially higher in 2012 than in any recent period" (Ward et al. 2015). These data also imply "that increases in bycatch [are] not due to an increase in incidental targeting of eulachon by fishing vessels, but because of an increasing population size of eulachon." Ward et al. (2015, their figures 4–5) also presented mapped representations of both the spatial distribution of eulachon bycatch risk and areas of highest bycatch encounters.

Ward et al. (2015) found that the coastal areas just south of Coos Bay, Oregon; between the Columbia River and Grays Harbor, Washington; and just south of La Push, Washington were consistent hotspots of eulachon bycatch across years.

The previously depressed and currently increasing abundance of the southern DPS of eulachon (James et al. 2014) are likely contributing to the increased levels of eulachon bycatch reported for 2012–2014. The dramatic increases in the level of eulachon bycatch in both the Washington and Oregon ocean shrimp trawl fisheries in 2012 and 2013 occurred in spite of regulations, enacted in 2012, requiring the use of BRDs with a minimum 19 mm (0.75 inch) bar spacing. It is unclear why bycatch ratios were highest in the Washington, intermediate in the Oregon, and lowest in the California sectors of the ocean shrimp trawl fishery in 2012 and 2013. However, the bycatch ratio increased in Oregon and decreased in Washington in 2014 compared to the previous two year period.

Although speculative, it may be that BRDs in the ocean shrimp trawl fisheries operate at greatly reduced efficiency when eulachon reach high densities. Winger et al. (2012, p. 91) stated that:

> Fish density is also expected to affect the performance of BRDs installed within the net. When large pulses of fish are encountered, devices such as selection windows, sorting grids, or separator panels may be temporarily masked by neighboring

> conspecifics. This reduces the probability of fish encountering the devices and thus reduces the potential sorting efficiency.

The Washington ocean shrimp fishery was also observed separately in 2011 and 2012 by a team of state-deployed fishery bycatch observers (Wargo et al. 2014). Wargo et al. (2014) reported a fleet-wide eulachon bycatch in the Washington state ocean shrimp fishery of "7.8 mt (17,132 pounds) for 2011 and 171 mt (378,011 pounds) for 2012." These bycatch estimates are approximately 30% and 10% greater than the estimates for the Washington ocean shrimp fishery as reported in the present document of 5.5 and 156.8 mt in 2011 and 2012, respectively. In the 2011 Washington ocean shrimp trawl fishery 24% of trips were observed by the state observers (Wargo et al. 2014), whereas the WCGOP observed 16.6% of the total ocean shrimp landings (Gustafson et al. 2015b). In 2012, 16% of trips were observed by the state observer program (Wargo et al. 2014) and 14.8% of shrimp landings were observed by the WCGOP (Gustafson et al. 2015b).

Prior to the mandated use of bycatch reduction devices (BRDs), 32–61% of the total catch in the Oregon ocean shrimp fishery consisted of non-shrimp biomass, including various species of smelt (Hannah and Jones 2007). Krutzikowsky (2001, p. 2) evaluated bycatch in this fishery and stated that:

> Bycatch discards in this fishery can range from relatively low to very high levels that can affect the efficiency and, possibly, the value of the fishery. Bycatch of Pacific whiting, *Merluccius productus*, in particular, can become high enough on the shrimp grounds to preclude efficient shrimping. … The majority of bycatch is discarded, such as … smelt Osmeridae sp. …

Reducing bycatch in this fishery has long been an active field of research (Hannah et al. 1996, 2003, 2011; Hannah and Jones 2000, 2003, 2007, 2012; Frimodig et al. 2009) and great progress has been made in reducing bycatch, particularly of larger-bodied fishes. Use of BRDs in offshore shrimp trawl fisheries, which was mandated beginning in 2002 in California and 2003 in Washington and Oregon has substantially reduced bycatch of fin fish in these fisheries (Hannah and Jones 2007, Frimodig et al. 2009). As of 2005, following required implementation of BRDs, the total bycatch by weight had been reduced to about 7.5% of the total catch and osmerid smelt bycatch was reduced to an estimated average of 0.73% of the total catch across all BRD types (Hannah and Jones 2007).

Although data on survivability of BRDs by small pelagic fishes such as eulachon are scarce, many studies on trawl net escape mortality for other fishes indicate that "among some species groups, such as small-sized pelagic fish, mortality may be high" and "the smallest escapees often appear the most vulnerable" (Suuronen 2005, p. 13–14). A recent workshop (Pickard and Marmorek 2007, p. 31–33) to determine research priorities for eulachon in Canada recommended the need to research the effectiveness of BRDs and the need to estimate mortality, not just bycatch. Partly in response to these concerns, Hannah and Jones (2012) used underwater video technology to examine behavior of eulachon when encountering rigid-grate BRDs in an ocean shrimp trawl net. The purpose of this research was to determine fish condition and survival following exclusion by the BRDs and the effectiveness of these types of BRDs at reducing mortality rates. Hannah and Jones (2012) stated that:

> Almost 80% of the large eulachon maintained an upright vertical orientation throughout their escape and exited the trawl in a forward-swimming orientation. Large eulachon maintained distance from the deflecting grid better than the other species encountered ($P < 0.001$) and typically showed no contact or only minimal contact with it (63%). Only about 20–30% of the large eulachon showed behaviors indicating fatigue, such as laying on or sliding along the grid.

Hannah and Jones (2012) concluded that:

> … data on behavior of large eulachon escaping from a shrimp trawl show that most have enough residual swimming ability to minimize their physical contact with the deflecting grid, maintain their vertical orientation and to continue actively swimming in a forward direction as they exit. This suggests that the use of deflecting grids in the ocean shrimp fishery is likely reducing eulachon mortality rates, as well as bycatch.

Hannah and Jones (2012) also noted that large eulachon are excluded at a higher efficiency than are small eulachon and behavior of eulachon in this study, both large and small, may have been influenced by the use of artificial video lighting.

In 2014 the ODFW conducted research on eulachon using light emitting diode (LED) lights attached to fishing gear (pink shrimp fishery) to assess the potential to reduce bycatch of eulachon associated with the ocean shrimp fishery. Researchers compared bycatch levels over 42 paired trials between lighted and unlighted trawl nets using double-rigged vessels that could tow paired shrimp trawl nets. When 10 green LED lights were placed along the trawl fishing line of ocean shrimp trawl nets with rigid-grate BRDs with 0.75 inch (19.1 mm) bar spacing installed and then were compared with identical trawls nets without lights, the bycatch of eulachon was reduced by 91%.

Summary on Bycatch

Although the use of bycatch reduction devices clearly are beneficial to eulachon, without a better understanding of bycatch as a proportion of eulachon in the marine environment, and its impact on recruitment, it is impossible to quantify the benefit. Nonetheless, NMFS acknowledges that the use of bycatch reduction devices, especially LED lights, represents a significant step in bycatch reduction and the threat bycatch poses to the persistence of eulachon.

Recommended Future Actions

- Develop and implement a biologically-based analysis on the long-term effects of bycatch from the ocean shrimp fishery on eulachon recruitment.
- Develop and implement a research and monitoring plan to better understand the relationship between habitat types shared between eulachon and pink shrimp in the California Current.
- Develop and implement a monitoring plan to help quantify the benefits by-catch reduction methods.
- Expand the use of LED lights to reduce bycatch of eulachon throughout the West Coast ocean shrimp fishery.

Listing Factor E Conclusion

We conclude that the risk to the species' persistence, albeit unquantifiable, has decreased since the last status review.

Efforts Being Made to Protect the Species

When considering whether to list a species as threatened or endangered, section 4(b)(1)(A) of the ESA requires that NMFS take into account any efforts being made to protect that species. Below is a summary of significant actions taken since the last status review to reduce the severity of threats to eulachon and improve habitat conditions for eulachon.

Ocean Shrimp Fisheries – Effective December 2010, the state of Oregon required all shrimpers fishing within the Oregon Fisheries Conservation Zone are required to use rigid-grate bycatch reduction devices. The state of Washington adopted rigid-grate BRD regulation effective in January 2012. The Oregon Fish and Wildlife Commission changed the administrative rules governing the use of BRDs in the pink shrimp fishery to reduce the bycatch of eulachon. The new rules require the use of rigid-grate BRDs with bar spacing no more than 1.0 inch starting in 2011, and 0.75 inch beginning in 2012. Current 2014–2015 regulations in Washington and Oregon, adopted by both states in 2012, require ocean shrimp trawl fishery BRDs to consist of a rigid panel or grate of narrowly spaced bars (usually constructed of aluminum) with no gaps between the bars exceeding 0.75 inches (19.1 mm). Approved BRDs for use in the ocean shrimp fishery in California include: (1) rigid- or semi-rigid grate excluders consisting of vertical bars with no gaps between the bars exceeding 2 inches (50.8 mm); (2) soft-panel excluders, usually made of a soft mesh material "with individual meshes no large than 6 inches;" and (3) fisheye excluders, which have a forward facing escape opening that is maintained by a rigid frame.

Oregon Department of Fish and Wildlife - In 2014 the ODFW conducted research on eulachon using LED lights attached to fishing gear (pink shrimp fishery) to assess the potential to reduce bycatch of eulachon associated with the ocean shrimp fishery. Researchers compared bycatch levels over 42 paired trials between lighted and unlighted trawl nets using double-rigged vessels that could tow paired shrimp trawl nets. When 10 green LED lights were placed along the trawl fishing line of ocean shrimp trawl nets with rigid-grate BRDs with 0.75 inch (19.1 mm) bar spacing installed and then were compared with identical trawls nets without lights, the bycatch of eulachon was reduced by 91%, with little or no effect on shrimp catch. Hannah et al. (2015, p. 60) stated that "How the addition of artificial light is causing these changes in fish behavior and bycatch reduction is not known," but the authors speculated that illumination of the trawl fishing line may possibly allow the fish to see the approaching net sooner and react in time to avoid being entrained, and "likely encouraged some species to also move downwards, perhaps exploiting a natural tendency to move towards the seafloor when threatened" (Hannah et al. 2015, p. 66). In 2015, all vessels in the Oregon shrimp fishery fleet were using light emitting diode lights in the fishery.

Department of Fisheries and Oceans, Canada – Since 1995 DFO has suspended commercial eulachon fisheries in the Fraser River; closed the shrimp fishery in Queen Charlotte Sound; adopted "eulachon action levels" by DFO management that warn of possible shrimp fishing closures when cumulative eulachon bycatch level is reached; and required BRDs installed in shrimp trawls to reduce eulachon by-catch.

Department of Fisheries and Oceans, Canada – First Nations Fisheries: Aboriginal harvest for food, social and ceremonial purposes is authorized by communal licenses in the lower Fraser River; a total of eight bands may apply for licenses for small amounts of eulachon.

Department of Fisheries and Oceans, Canada – Recreational Fisheries: The recreational fishery for eulachon is closed in the Fraser River area. Recreational fishing for eulachon with dip nets, gillnets, minnow nets, or cast nets in fresh water, is prohibited throughout British Columbia due to conservation concerns.

Department of Fisheries and Oceans, Canada – Commercial Fisheries: The commercial eulachon fishery remains closed in the Fraser River. However, there are currently 16 gill net (introduced) eulachon license eligibilities.

Elwha River – In 2000, as part of a comprehensive restoration effort in the Elwha River basin, the Elwha and Glines Canyon dams were acquired by the federal government. In 2014, both dams were removed. These restoration actions likely have indirect benefits to eulachon, especially in the lower reach of the Elwha River via material influx that support spawning and incubation of eulachon.

Department of Fisheries and Oceans, Canada – Beginning in 1995 DFO has suspended dredging in the Fraser River during the eulachon spawning season.

Habitat Restoration Projects – While not specific to eulachon, significant habitat restoration and protection actions at the Federal, state, tribal, and local levels have been implemented to improve degraded habitat conditions for Pacific salmon and steelhead stocks in the Pacific Northwest and California. While these efforts have been substantial and are expected to improve freshwater and estuarine habitat conditions for the targeted species, we do not yet have evidence demonstrating that these improvements in habitat conditions will yield similar benefits for eulachon. Nonetheless, these habitat restoration actions likely have yielded indirect benefits to eulachon, especially habitat restoration actions in estuarine habitats that provide material influx that support food web processes that may contribute to improvements in eulachon fitness and survival in estuarine and nearshore environments.

2.4 Synthesis

The ESA defines an endangered species as one that is in danger of extinction throughout all or a significant portion of its range, and a threatened species as one that is likely to become an endangered species in the foreseeable future throughout all or a significant portion of its range. Under ESA section 4(c)(2), we must review the listing classification of all listed species at least once every five years. While conducting these reviews, we apply the provisions of ESA section 4(a)(1) and NMFS's implementing regulations at 50 CFR part 424.

To determine if a reclassification is warranted, we review the status of the species and evaluate the five factors, as identified in ESA section 4(a)(1): (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; and (5) other natural or man-made factors affecting a species continued existence. We then make a determination based solely on the best available scientific and commercial information, taking into account efforts by states and foreign governments to protect the species.

The updated status review indicates that although eulachon abundance in monitored populations has generally improved, especially in the 2013–2015 return years, recent poor ocean conditions and the likelihood that these conditions will persist into the near future suggest that population declines may be widespread in the upcoming return years. Therefore, it is too early to tell whether recent improvements in the southern DPS of eulachon will persist or whether a return to the severely depressed abundance years of the mid-late 1990s and late 2000s will reoccur. The Northwest Fisheries Science Center (Gustafson et al. 2016) concluded, after reviewing the available new information that the biological risk category for this DPS has not changed since the time of the last status review.

Our analysis of the ESA section 4(a)(1) factors indicates that the collective risk to the persistence of eulachon has not changed significantly since our final listing determination in 2010; however, predation from an increase in pinniped populations in the Columbia River remains a concern, as do the impacts that climate change on ocean conditions poses to long-term recovery.

After considering the available information of its ESA section 4(a)(1) factors, in addition to new information on eulachon abundance, we conclude that the status of the southern DPS of eulachon has not improved significantly since it was last reviewed in 2010.

2.4.1 DPS Delineation

NMFS found that no new information that has become available since the previous status review that would justify a change in boundaries for the southern DPS of eulachon.

2.4.2 DPS Viability and Statutory Listing Factors

The Northwest Fisheries Science Center’s review of updated information does not indicate a change in the biological risk category of eulachon since the time of the last status review (Gustafson et al. 2016).

Our analysis of ESA section 4(a)(1) factors indicates that the collective risk to the eulachon’s persistence has not changed significantly since our listing determination in 2010. The overall level of concern remains the same.

3 · Results

3.1 Classification

Listing Status:

Based on the information identified above, we recommend that the southern DPS of eulachon remain classified as a threatened species.

DPS Delineation:

NMFS found that no new information that has become available since the previous status review that would justify a change in boundaries for the southern DPS of eulachon.

3.2 New Recovery Priority Number

NMFS revised the southern DPS of eulachon recovery priority number from 7 (NMFS 2009) to a new recovery priority number of 11 (NMFS 2015b) as listed in Table 4 of this document.

4 · Recommendations for Future Actions

In our review of the listing factors, we identified several actions critical to improving the information requirements needed to inform our assessment regarding the status of eulachon. We are currently in the process of finalizing a recovery plan for eulachon that will identifying additional actions that address the factors contributing to the existing threats for each subpopulation.

We are directing our efforts at subpopulation-level recovery criteria, the best available scientific information concerning DPS status, limiting factors and threats, and the likelihood of action effectiveness to guide our recommendations for future actions. NMFS is coordinating with the Federal, state, tribal, international, and local implementing entities to ensure that priority actions identified in the recovery plan are addressed to the extent practicable.

Additional recommended actions include:

- Expand eulachon spawning stock biomass surveys.
- Develop biological viability criteria for each subpopulation of eulachon.
- Develop and implement a fisheries-independent method to estimate at-sea abundance of eulachon.
- Develop and implement a method to identify eulachon core spawning areas for the Columbia River and Klamath River subpopulations.

5· References

5.1 Federal Register Notices

June 15, 1990 (55 FR 24296). Notice: Endangered and Threatened Species; Listing and Recovery Priority Guidelines.

November 20, 1991 (56 FR 58612). Notice of Policy: Policy on Applying the Definition of Species Under the Endangered Species Act to Pacific Salmon.

February 7, 1996 (61 FR 4722). Notice of Policy: Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act.

March 18, 2010 (75 FR 13012). Final Rule. Threatened Status for Southern Distinct Population Segment of Eulachon.

October 20, 2011 (76 FR 65324). Final Rule. Critical Habitat for the Southern Distinct Population Segment of Eulachon.

June 21, 2013 (78 FR 40104). Notice of intent to prepare a recovery plan.

February 6, 2015 (80 FR 6695). Notice of Initiation of 5-year Reviews: Endangered and Threatened Species; Initiation of 5-Year Reviews for 32 Listed Species of Pacific Salmon and Steelhead, Puget Sound Rockfishes, and Eulachon.

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National Marine Fisheries Service
5-Year Review
Southern DPS Eulachon

Conclusion:
Based on the information identified above, we conclude:

- The southern DPS of eulachon should remain listed as threatened

REGIONAL OFFICE APPROVAL

West Coast Assistant Regional Administrator, Protected Resources Division

Approve: [signature] Date: 1 April 2016

cc: Administrative File: 151412WCR2016PR00165