Richard Devlin
Chair
Oregon

Ted Ferrioli
Oregon

Guy Norman
Washington

Patrick Oshie
Washington

Northwest **Power** and **Conservation** Council

Bo Downen
Vice Chair
Montana

Jennifer Anders
Montana

Jim Yost
Idaho

Jeffery C. Allen
Idaho

March 10, 2020

MEMORANDUM

TO: **Fish and Wildlife Committee members**

FROM: **Mark Fritsch**

SUBJECT: **Briefing on Columbia River Eulachon**

BACKGROUND:

Presenters: Laura Heironimus, Washington Department of Fish and Wildlife, Robert Anderson, NOAA Fisheries.

Summary: Laura Heironimus and Robert Anderson will report on Columbia River Eulachon, including a brief overview of:

- run summary and forecast for Eulachon smelt, *Thaleichthys pacificus*;
- update on research and monitoring efforts; and
- recovery plan implementation priorities and Eulachon as an emerging priority.

Relevance: See Program language for Eulachon here. This information is relevant to our high-level indicators. It gives the region a status report on smelt populations and a preview for what is expected for smelt returns in the coming year. The Program is not currently funding any Eulachon work.

Background: The 2014 Program called for the Council, in collaboration with Bonneville, the Corps, NOAA Fisheries, and agencies and tribes, to help organize and facilitate a science/policy forum in 2015 to address the biological requirements of eulachon, combined with related inquiries into the relationship between flow, current hydropower dam operations, and the biological requirements of lamprey and sturgeon. The *Columbia River*

851 S.W. Sixth Avenue, Suite 1100
Portland, Oregon 97204-1348
www.nwcouncil.org

Steve Crow
Executive Director

503-222-5161
800-452-5161
Fax: 503-820-2370

Eulachon (smelt) *State of the Science and Science to Policy Forum* was held in August 2015. The goal was to report to the region on the state of the science, the reasonable next steps in the assessment process, and a recommendation for how to incorporate those steps into the recovery plan. The information generated from this forum was used to help inform NOAA's Eulachon Recovery Plan.

More Info:

- 2019 Smelt season – February Blog on Outdoor Line
- 2017 NOAA's Final Eulachon Recovery Plan
- March 2017 Eulachon Report to Council: presentation
- 2015 Eulachon Forum final report

Southern DPS Eulachon: Current Population Status

Laura Heironimus
Washington Department of Fish and Wildlife
Ridgefield, WA

WDFW Goals for 2020

- Monitor the 2020 Eulachon spawning run:
  - Evaluate sex ratios, age and size distribution, fecundity, run timing, and spatial distribution of adult Eulachon.
  - Evaluate egg and larval outflow in main channel.
  - Estimate minimum adult run size (Spawning Stock Biomass).
- Set research-level commercial and recreational fisheries:
  - Address monitoring questions
  - Provide sustainable fishing opportunity.
- Seek partnerships and funding for improved recovery and management efforts.

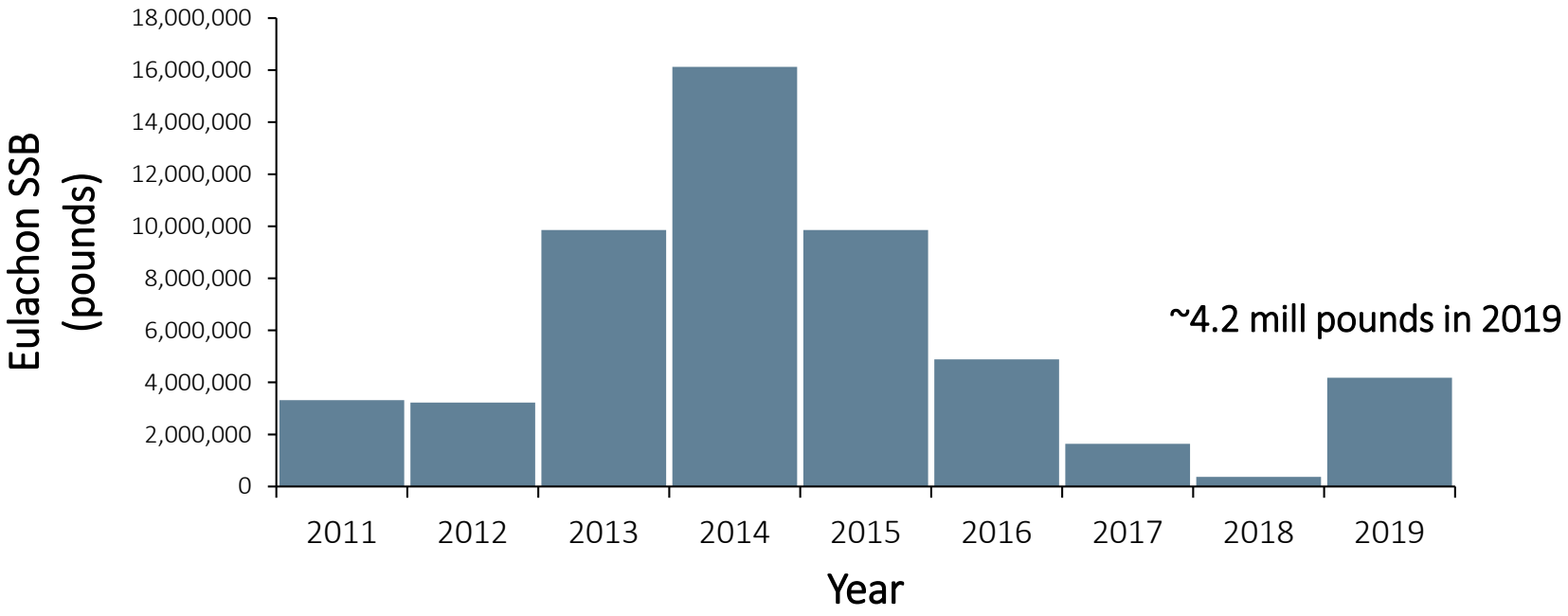
Current Monitoring

- WDFW
  - Sampling fishery and research caught adults in the Columbia and Cowlitz rivers
  - Plankton tows for eggs and larvae in mainstem Columbia River
  - Communicating throughout basin on smelt and predator presence

- Cowlitz Tribe
  - Efforts focused on Cowlitz River
  - Sampling adults, eggs, and larvae to evaluate and compare with mainstem collection.

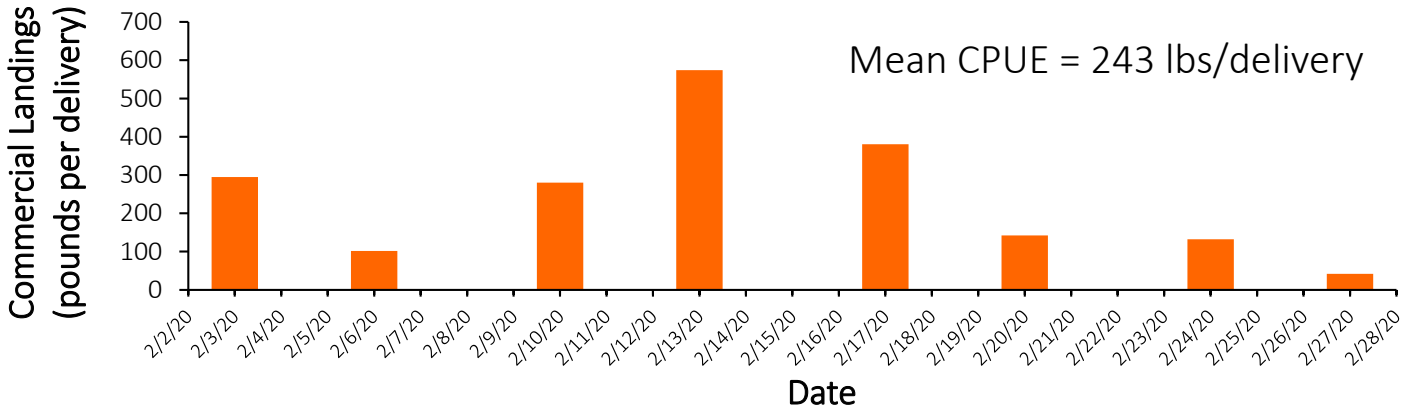
Run Size Estimate

Spawning Stock Biomass (SSB): An estimate of the minimum number of spawning adults needed to have produced the eulachon larval outflow observed.

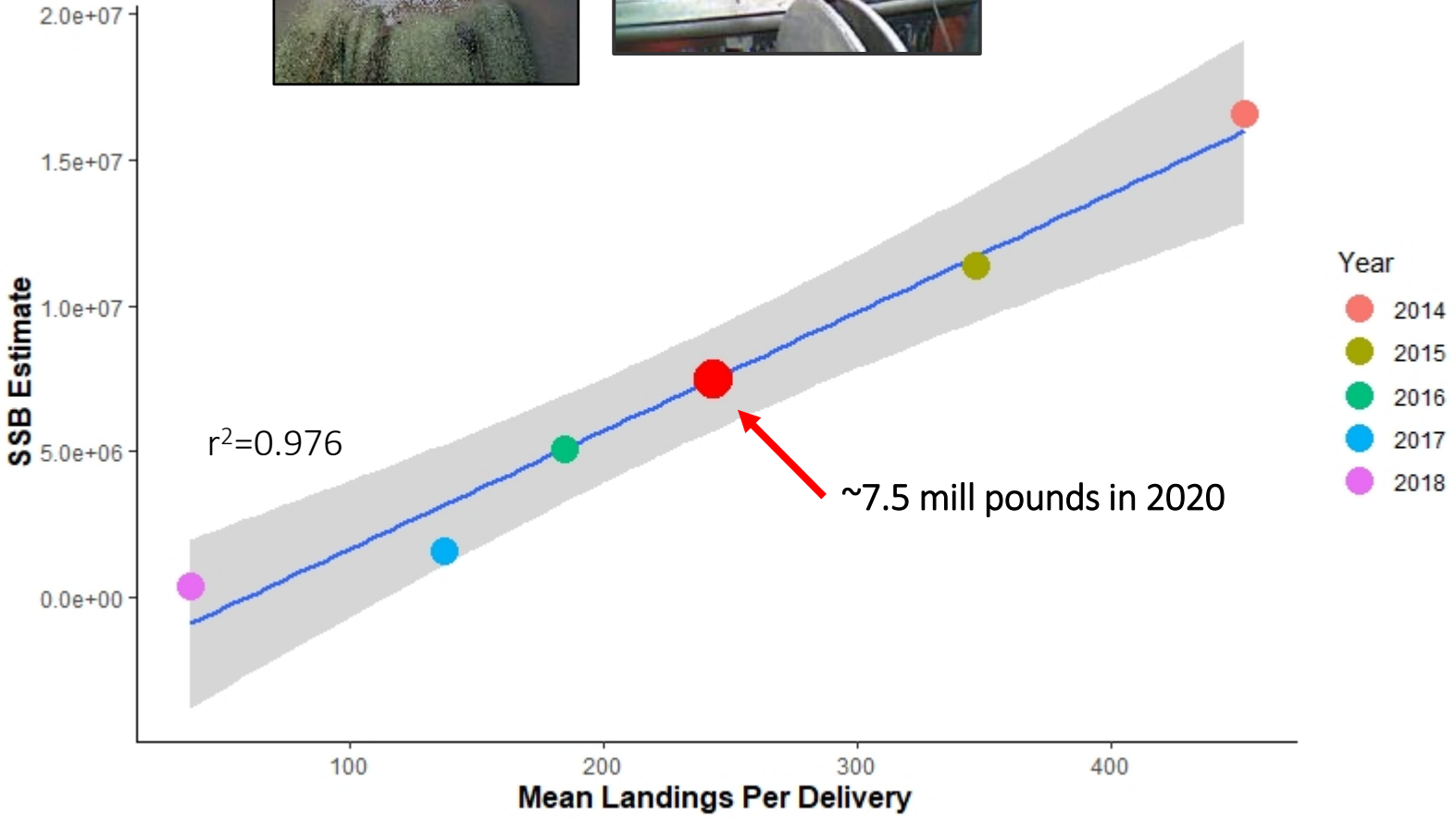


2020 Commercial Fisheries

- Research-level commercial fisheries
  - Eight fishing periods on Mondays and Thursdays, Feb 3-27, 2020.
  - 12 hr fishing periods, tidal dependent.
- Harvest/sales reported through commercial fish tickets.
- Important source of run status data:
  - Samplers collect biological data for Spawning Stock Biomass (SSB) estimate.
  - Landings per delivery (CPUE) provides a rough estimate of in-season run strength.



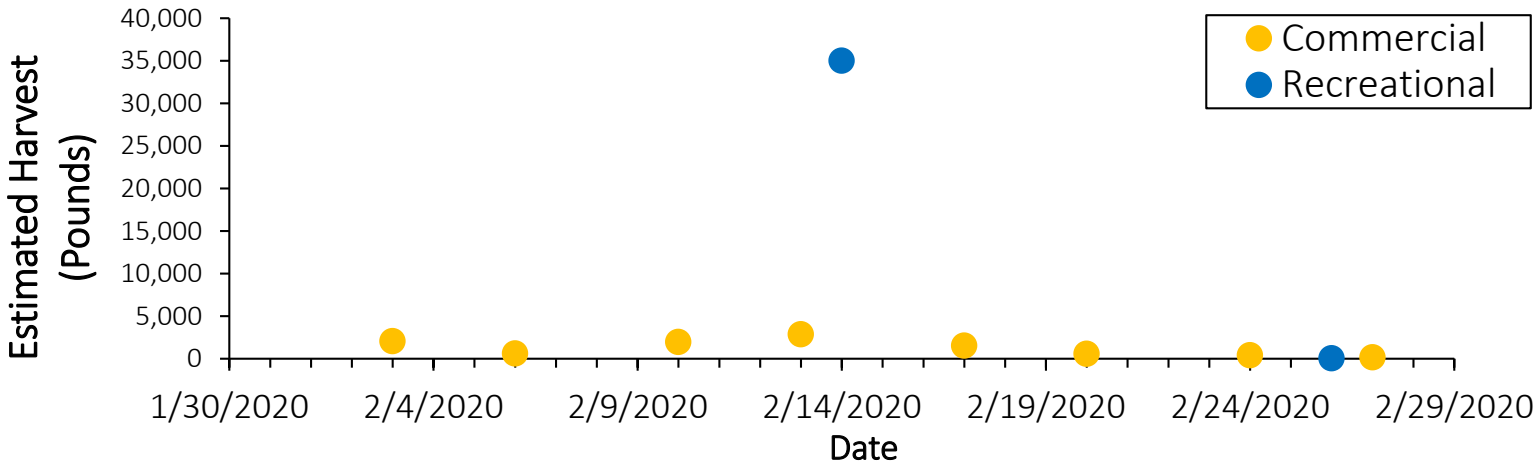
2020 Commercial Fisheries



2020 Recreational Fisheries

- Two days of sport fishing opened in Cowlitz River.
  - Five hour openers, 8am-1pm.
  - Friday, February 14th and Wednesday, February 26th.
- Harvest estimated by creel census.

2020 Harvest Totals



2020 Fisheries	Estimated Catch (lbs)	Estimated Harvest Rate
Recreational	35,040	0.4%
Commercial	10,150	0.1%
Tribal Subsistence	23,900	0.3%
Total	69,790	0.8%

**Preliminary estimates*

NOAA Fisheries:
2020 Eulachon Sampling Efforts

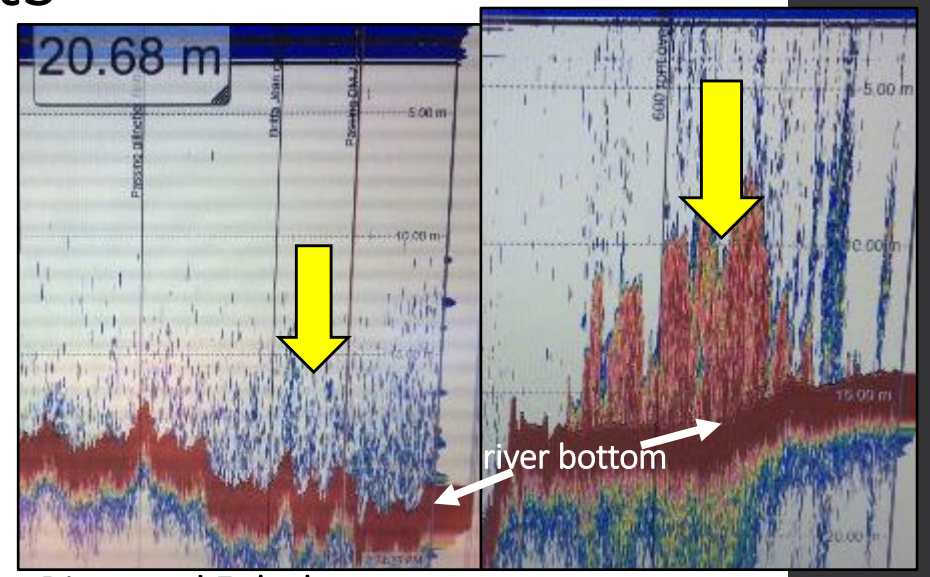
- Led by Dr. Jeannette Zamon, Research Fisheries Biologist, NWFSC
- Visual/acoustic surveys from Price Island (rkm 55) to Cowlitz River mouth (rkm 109) to search for large pre-spawning/spawning aggregations
- 14 days on the water, Jan 27- Mar 13
  - 6 days same time/place as commercial fishing effort
- 3 days of trawling (2 test, 1 focal)


Hinton on acoustic vessel

In partnership with Prof. John Horne (University of Washington) and cooperation with WDFW.

NOAA Fisheries:
2020 Preliminary Results

- Acoustics suggest eulachon present but dispersed in February (rkm 55-rkm 100)
  - Sampled with test trawl
- Qualitative relationship between dispersed echo return near active fishing, fishers' catch
- Highly mobile, small schools (< 10 m diameter, 10 m deep) 1st detected 10 Mar @rkm 90-100
- Schools seen w/acoustics in 2020 are orders of magnitude smaller than in 2013



Dispersed Eulachon (February)

Eulachon school (March)

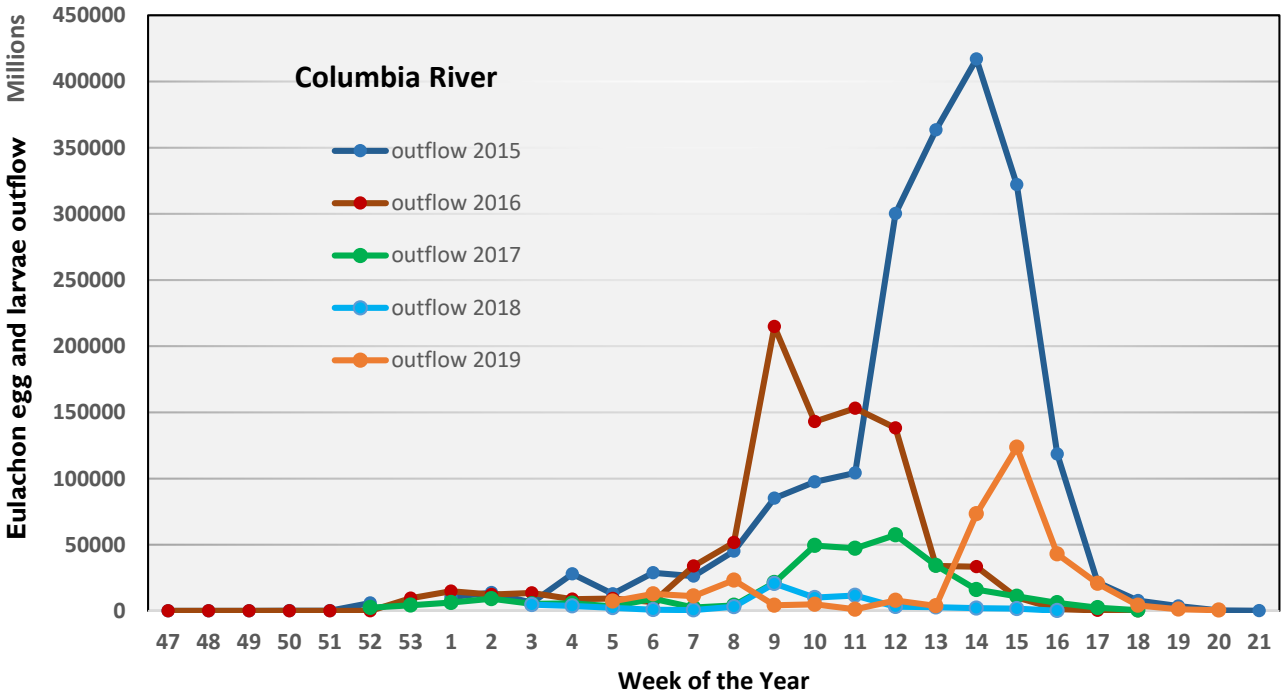
NOAA Fisheries:
2020 Preliminary Lessons Learned

- February, March showed different distributions/behavior
- Spawning adults still present in March
- To understand important **inter-annual and seasonal variation in eulachon run strength/timing**, as well as obtain a more precise estimate of SSB, it is **necessary to sample the entire spawning period** mid-November through mid-April (and into mid-May for larvae)
- Data complement eDNA/larval sampling by providing distribution, size, and spawning status information for adults specifically

Run Size Estimate

2020 Run Estimate

- Larval sampling will continue through mid-May.
- The 2020 SSB estimate will be calculated after larval sampling concludes.



Potential Research Opportunities

- Eulachon Technical Recovery and Implementation Team submitted applications for Section 6 grant funding to:
  - Expand SSB coverage within Columbia River through entire run period (November-May)
  - Assess coastwide spatial and temporal distribution of Eulachon spawning runs using environmental DNA
- Develop commercial test fisheries to achieve adult sampling across the entire run when run size is large enough to support limited harvest:
  - Support/improve current SSB estimates
  - Allow limited-opportunity fishery
  - Expand funding/research partnerships
  - Fill critical information gaps regarding eulachon biology

Science, Service, Stewardship

Eulachon Recovery Plan Implementation

Photo Credit: *Michele Cornelius*

March 17, 2020

Robert Anderson
National Marine Fisheries Service
West Coast Region

NOAA FISHERIES SERVICE

Eulachon Recovery Plan Implementation

- Recovery Plan Implementation Priorities
- Near-Term Research Priorities
- Implementation of Priorities

Eulachon Recovery Plan – Priority Actions

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

Eulachon Recovery Plan – Near-Term Research Priorities

Abundance and Productivity

- Conduct annual in-river spawning stock biomass surveys in spawning areas with a high-to-moderate spawning frequency to develop long-term, high resolution abundance estimations for each subpopulation of eulachon.
- Conduct a gap analysis to identify the data needs to develop an at-sea survey method to create a reliable index of eulachon abundance in the marine environment.
    - Develop and implement an at-sea survey method to create a reliable index of eulachon abundance in the marine environment.

Spawning Habitat

- Conduct a gap analysis to identify the data needs to develop a survey method to map eulachon spawning areas, with an emphasis on identifying high density spawning areas, for each subpopulation.
    - Implement a high resolution mapping survey to identify high density eulachon spawning areas for each subpopulation.

Subpopulation Structure

- Conduct a gap analysis to identify the data needs to develop a genetic mixed stock baseline analysis of eulachon spawning subpopulations.
    - Conduct a genetic baseline analysis of eulachon spawning subpopulations to determine subpopulation-population structure of eulachon throughout the range of the DPS.
- Conduct a gap analysis to identify the data needs to develop a genetic mixed stock baseline analysis of eulachon in the marine environment.
    - Conduct a genetic mixed stock baseline analysis of eulachon in the marine environment.
- Conduct a gap analysis to identify the data needs to develop a method to correlate in-river and marine abundance estimations of eulachon.
    - Conduct an analysis that correlates in-river and marine abundance estimations of eulachon.

Species-Ecosystem Interactions

- Conduct a gap analysis to identify the data needs to develop an ocean ecosystem indicators model of eulachon marine survival in the California Current Ecosystem.
    - Develop an ocean ecosystem indicators model of eulachon marine survival in the California Current Ecosystem to determine how short-term and long-term variability in ocean conditions affect eulachon abundance and productivity for each subpopulation.

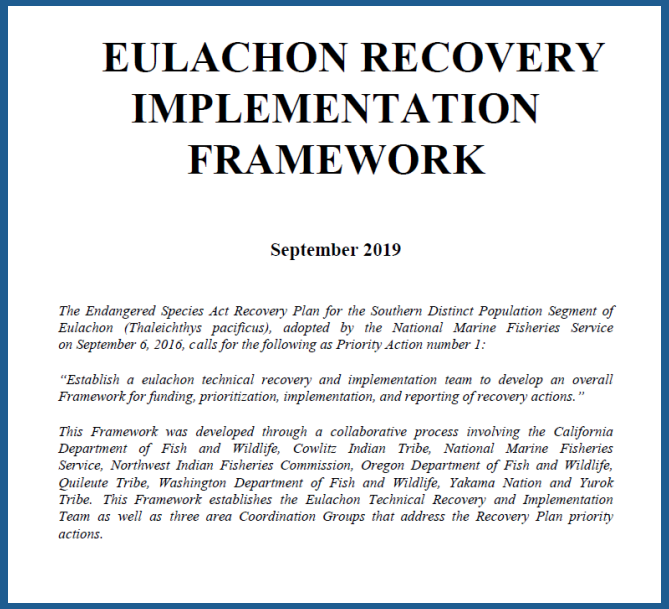
Subpopulation Viability Criteria

- Conduct a gap analysis to identify the data needs, e.g., age composition, length-weight relationship, intrinsic mortality rates, sex ratios, fecundity; necessary to parameterize a population viability analysis and develop abundance and productivity criteria for each subpopulation of eulachon.
    - Develop abundance and productivity criteria for each subpopulation of eulachon.

Eulachon Recovery Plan – Priority Actions

Establish a eulachon technical recovery and implementation team to develop an overall framework for funding, prioritization, implementation, and reporting of recovery actions.

- The Eulachon Technical Recovery and Implementation Team was established in September 2019, and the Eulachon Recovery Implementation Framework was finalized in September 2019. Team members include NMFS, WDFW, ODFW, CDFW, Yurok Tribe, Cowlitz Indian Tribe, Confederated Tribes of Warm Springs, Confederated Tribes and Bands of the Yakama Nation, Quileute Tribe, and the Lower Elwha Klallam Tribe.



EULACHON RECOVERY IMPLEMENTATION FRAMEWORK

September 2019

The Endangered Species Act Recovery Plan for the Southern Distinct Population Segment of Eulachon (Thaleichthys pacificus), adopted by the National Marine Fisheries Service on September 6, 2016, calls for the following as Priority Action number 1:

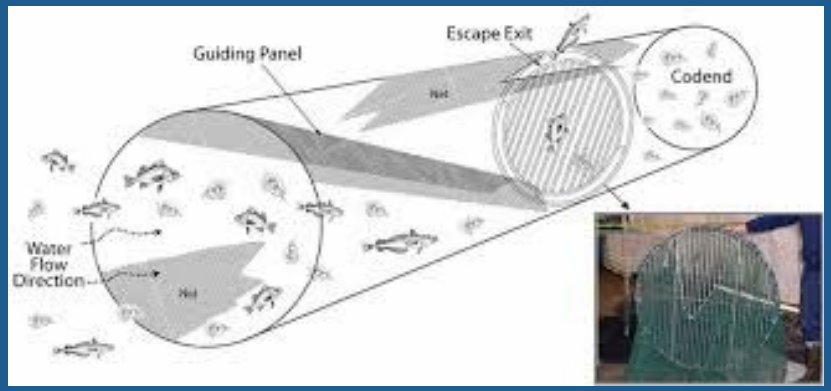
"Establish a eulachon technical recovery and implementation team to develop an overall Framework for funding, prioritization, implementation, and reporting of recovery actions."

This Framework was developed through a collaborative process involving the California Department of Fish and Wildlife, Cowlitz Indian Tribe, National Marine Fisheries Service, Northwest Indian Fisheries Commission, Oregon Department of Fish and Wildlife, Quileute Tribe, Washington Department of Fish and Wildlife, Yakama Nation and Yurok Tribe. This Framework establishes the Eulachon Technical Recovery and Implementation Team as well as three area Coordination Groups that address the Recovery Plan priority actions.

Eulachon Recovery Plan – Priority Actions

Continue to work with the ocean shrimp trawl fisheries and the states of California, Oregon, and Washington to implement actions, e.g., fleet-wide implementation of light emitting diode lights, rigid grate bycatch reduction devices, and additional gear-type or operational modifications, to further reduce bycatch of eulachon in the ocean shrimp trawl fisheries.

Using funding from the NOAA Section 6 Grant Program supports the states in management, research, monitoring, and/or outreach activities that have direct conservation benefits for species listed under the Endangered Species Act.



Since 2005 the states have required vessels to use rigid-grate bycatch reduction devices

- Starting in 2018, ODFW (OAR 635-005-0630) and WDFW (RCW 77.15.550) required lighting devices on the footrope of trawl nets

Eulachon Recovery Plan – Priority Actions

Continue to work with the states to implement a limited-opportunity eulachon fishery to: (1) provide essential context for interpreting historical harvest data to better understand trends and variability in eulachon abundance; (2) filling critical information gaps such as the length and age structure of spawning eulachon, as well as the temporal and spatial distribution of the run; (3) supporting the cultural traditions of Northwest tribes who rely on eulachon as a seasonally important food source; and (4) providing a limited public and commercial opportunity for eulachon harvest to maintain a connection between people and the eulachon resource. This connection is important to sustaining public engagement in eulachon conservation and recovery.

Columbia River Eulachon harvest rates, 2011-2019

		Non-Treaty Commercial		Tribal Subsistence		Non-Treaty Commercial + Tribal Subsistence		Recreational	
Year	Run (pounds)	Pounds	HR	Pounds	HR	Pounds	HR	Pounds	HR
2011	3,300,000	-	-	-	-	-	-	-	-
2012	3,200,000	-	-	-	-	-	-	-	-
2013	9,600,000	-	-	7,470	0.08%	7,470	0.08%	-	-
2014	16,600,000	18,560	0.11%	6,970	0.04%	25,530	0.15%	203880	1.23%
2015	11,400,000	16,550	0.15%	10,400	0.09%	26,950	0.24%	290770	2.55%
2016	5,100,000	4,820	0.09%	8,330	0.16%	13,150	0.26%	141050	2.77%
2017	1,600,000	5,090	0.32%	1,900	0.12%	6,990	0.44%	540	0.03%
2018	370,000	110	0.03%	-	0.00%	110	0.03%	-	-
2019	4,205,000	-	0.00%	23,660	0.56%	23,660	0.56%	-	-

Exploitation rates (2011-2019) for Eulachon fisheries in the Lower Columbia River mainstem and tributaries.

Eulachon Recovery Plan – Near-Term Research Priorities

Abundance and Productivity

- Conduct annual in-river spawning stock biomass surveys in spawning areas with a high-to-moderate spawning frequency to develop long-term, high resolution abundance estimations for each subpopulation of eulachon.

Subpopulation Structure

- Conduct a gap analysis to identify the data needs to develop a genetic mixed stock baseline analysis of eulachon spawning subpopulations.
  - Conduct a genetic baseline analysis of eulachon spawning subpopulations to determine subpopulation-population structure of eulachon throughout the range of the DPS.
- Conduct a gap analysis to identify the data needs to develop a genetic mixed stock baseline analysis of eulachon in the marine environment.
  - Conduct a genetic mixed stock baseline analysis of eulachon in the marine environment.
- Conduct a gap analysis to identify the data needs to develop a method to correlate in-river and marine abundance estimations of eulachon.
  - Conduct an analysis that correlates in-river and marine abundance estimations of eulachon.

Species-Ecosystem Interactions

- Conduct a gap analysis to identify the data needs to develop an ocean ecosystem indicators model of eulachon marine survival in the California Current Ecosystem.
  - Develop an ocean ecosystem indicators model of eulachon marine survival in the California Current Ecosystem to determine how short-term and long-term variability in ocean conditions affect eulachon abundance and productivity for each subpopulation.

Eulachon Recovery Plan – Near-Term Research Priorities

Abundance and Productivity

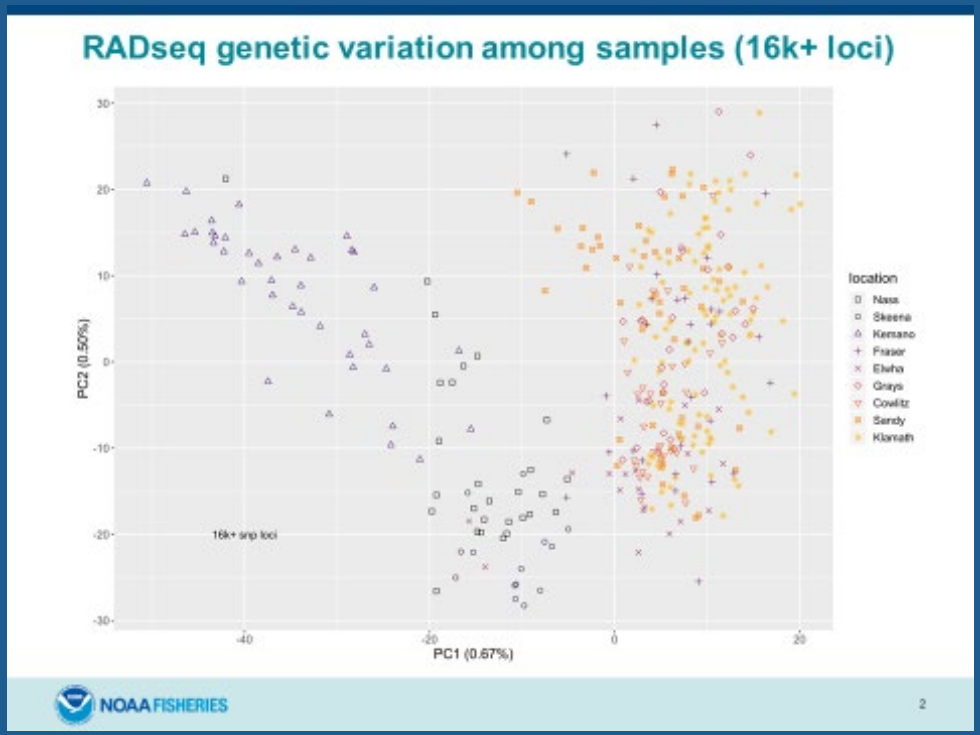
✓ Conduct annual in-river spawning stock biomass surveys in spawning areas with a high-to-moderate spawning frequency to develop long-term, high resolution abundance estimations for each subpopulation of eulachon.

- WDFW – Columbia River
- CIT – Cowlitz River
- LEKT – Elwha River, Dungeness River, Lyre River, and Morse Creek, WA
- NMFS-NWFSC – Acoustic Characterization and Sampling of Eulachon Aggregations in the Lower Columbia River

Eulachon Recovery Plan – Near-Term Research Priorities

Subpopulation Structure

- Conduct a gap analysis to identify the data needs to develop a genetic mixed stock baseline analysis of eulachon spawning subpopulations.
    - Conduct a genetic baseline analysis of eulachon spawning subpopulations to determine subpopulation-population structure of eulachon throughout the range of the DPS.
- Conduct a gap analysis to identify the data needs to develop a genetic mixed stock baseline analysis of eulachon in the marine environment.
    - Conduct a genetic mixed stock baseline analysis of eulachon in the marine environment.
- Conduct a gap analysis to identify the data needs to develop a method to correlate in-river and marine abundance estimations of eulachon.
    - Conduct an analysis that correlates in-river and marine abundance estimations of eulachon.



Eulachon Recovery Plan – Near-Term Research Priorities Northwest Fisheries Science Center Genetic Research

2018-2019 - Information on stock structure of eulachon is required in order to implement actions in the NMFS recovery plan, and to gain a better understanding of the population structure for species' recovery and management. The Protected Resources Division previously provided funds to the Northwest Fisheries Science Center's DNA lab to (1) produce an expanded coastwide baseline of eulachon genetic population structure for spawning populations using the SNP (single nucleotide polymorphism) panel originally developed by the Department of Ocean and Fisheries, Canada scientists in the Molecular Genetics Laboratory of the Pacific Biological Station, and (2) use this baseline to genetically assign at-sea sampled eulachon back to their river-of-origin. Analysis of the river-of-origin of bycatch of eulachon in U.S. shrimp and groundfish fisheries would allow scientists to better allocate at-sea risks in different regions of the marine environment to eulachon from individual river populations.

To date numerous new eulachon collections have been added to the SNP genetic baseline populations available from British Columbia, including the Cowlitz and Sandy rivers in the Columbia Basin, the Klamath River in northern California, and, the Elwha River on the Olympic Peninsula. Surprisingly, preliminary results reveal genetic similarity between Klamath and Fraser, using the DFO marker panel. **In these preliminary analyses, these two populations are closer to each other genetically than either is to the Elwha or the Columbia/Sandy/Cowlitz populations, even though they are geographically separated by nearly 800 km.** We test whether the existing SNP panel has ascertainment bias, being developed primarily with Canadian populations, by evaluating whether a broader panel of markers (produced by RAD sequencing) characterizes the Klamath River population in same way. The preliminary results obtained with the DFO marker panel may partly be due to the Klamath population not being he included in the original SNP panel development.

2020 – We will produce a genetic baseline of eulachon spawning subpopulations to determine population structure of eulachon throughout the range of the DPS. This baseline will then be used to genetically assign eulachon caught as bycatch in mixed-stock ocean-fisheries back to their spawning population of origin, which will provide us with a better analysis of bycatch risks for each subpopulation.

Eulachon Recovery Plan – Near-Term Research Priorities

Species-Ecosystem Interactions

- Conduct a gap analysis to identify the data needs to develop an ocean ecosystem indicators model of eulachon marine survival in the California Current Ecosystem.
  - Develop an ocean ecosystem indicators model of eulachon marine survival in the California Current Ecosystem to determine how short-term and long-term variability in ocean conditions affect eulachon abundance and productivity for each subpopulation.

Eulachon Recovery Plan – Near-Term Research Priorities

Master's Thesis - Sarah Montgomery
School of Marine and Environmental Affairs, University of Washington

Summary: Eulachon abundance fluctuates from year to year and over long time periods, but there were no reliable historical fishery-independent estimates of eulachon abundance in the Columbia River until 2000 to present. This time series presents an opportunity for understanding what environmental and biological factors drive fluctuations in abundance in a major spawning basin. Eulachon spend most of their life in the ocean before returning to streams to spawn. NOAA has identified ocean ecology as a key knowledge gap and research priority in developing a recovery strategy for eulachon.

NOAA has developed ocean ecosystem indicators for salmon that are used to predict abundance (a.k.a., stop-light charts). The sixteen indicators represent physical, chemical, and biological processes that affect salmon in the ocean. Because these existing data are already collected and modeled for salmon, they were combined with the eulachon abundance time series in the Columbia River into a multivariate analysis to quantify the relationship between ocean conditions and eulachon. This is a "proof of concept" analysis to determine next steps for modeling the relationship between eulachon and ocean conditions.

Results of the multivariate analysis suggest that ocean ecosystem indicators in the years prior to their return to freshwater are correlated with eulachon abundance in the Columbia River. Eulachon abundance was better described by large-scale indicators, directly influenced by upwelling (i.e. bottom-up processes) than indicators measured at a local scale or specific to salmonids. Results also suggest that the ocean ecosystem indicators developed for salmon are a reasonable starting point for a more fine-tuned model for predicting eulachon abundance in the Columbia River or for the DPS.

2014 Supplemental FCRPS and 2019 CSR Biological Opinions

ESA Section 7(a)(1) Conservation Recommendations for Southern DPS Eulachon

The following Conservation Recommendations are consistent with section 7(a)(1), and are consistent with the existing RME Strategies identified in the FCRPS Action Agencies' 2007 BA and NOAA Fisheries' 2008 BiOp. To address critical uncertainties on the effects of the FCRPS on eulachon, the FCRPS Action Agencies should fund selected research directed at resolving these uncertainties that are fundamental in understanding estuary, plume, and ocean effects. Therefore, where the Action Agencies are conducting RME for salmon and steelhead in the action area, the FCRPS Action Agencies should carry out the following RME for eulachon.

1. To promote eulachon conservation and address uncertainties regarding changes in the hydrograph of the Columbia River and adverse effects on eulachon productivity and abundance, the FCRPS Action Agencies should:
    - Monitor eulachon abundance in the Columbia River via annual spawning stock biomass surveys.

2. To promote eulachon conservation and address uncertainties regarding changes in the hydrograph of the Columbia River and adverse effects to eulachon larval and juvenile survival in the estuary, plume, and ocean, the FCRPS Action Agencies should:
    - Monitor and evaluate temporal and spatial species composition, abundance, and foraging rates of juvenile eulachon predators at representative locations in the estuary and plume.
    - Monitor, and evaluate the causal mechanisms, e.g., shifts in the timing, magnitude, and duration of the hydrograph of the Columbia River, and migration/behavior characteristics affecting survival of larval eulachon during their first weeks in the plume-ocean environment.
    - Monitor and evaluate the ecological importance of the tidal freshwater, estuary, plume, and nearshore ocean environments to the viability and recovery of the Columbia River sub-population of eulachon.

2014 Columbia River Basin Fish and Wildlife Program (abbreviated) - Eulachon

Strategy

Increase understanding, protection, and required restoration of eulachon for the Columbia Basin, estuary, and ocean ecosystems. Better understand how the development and operation of the Federal Columbia River Power System (FCRPS) affects eulachon spawning, survival of eggs and larvae, and migration patterns.

- Eulachon have been impacted by changes to the lower mainstem and estuary caused by construction and operation of the hydropower system.
- There is a need to understand the importance of eulachon within the ecosystem and to initiate appropriate mitigation efforts.

General Measures

- The Council supports measures to implement the two eulachon conservation recommendations found in the 2014 Supplemental FCRPS Biological Opinion.
- Upon completion of a recovery plan for eulachon, the Council will incorporate appropriate information regarding eulachon into the program and reflect the importance of this species and the need for protection and mitigation to the extent affected by the hydrosystem.

The Council will consider developing the following:

- Biological objectives for eulachon population characteristics and habitat needs
- A high-level indicator for eulachon abundance
- Monitoring and evaluation of the status of eulachon and evaluation of the characteristics affecting their survival

Mainstem and hydrograph:

- The Council, in collaboration with Bonneville, the Corps, NOAA Fisheries, and agencies and tribes, will help organize and facilitate a science/policy forum in 2015 to address the biological requirements of eulachon, combined with related inquiries into the relationship between flow, current hydropower dam operations, and the biological requirements of lamprey and sturgeon. The goal would be to report to the Council, NOAA Fisheries, and interested others on the state of the science, the reasonable next steps in the assessment process, and a recommendation for how to incorporate those steps into the recovery plan. **Completed in 2015.**

- Monitor and report eulachon abundance at Bonneville Dam. **On-going, last reports of eulachon at the smolt monitoring facilities was in 2014.**
- Study the role of eulachon as an alternative prey for sea lions.

• Ocean and Estuary:

Monitor and evaluate the importance of the tidal freshwater, estuary, plume and nearshore ocean environment to the recovery of eulachon in the Columbia River Basin.

Questions


of small fish which now begin to run and are
taken in great quantities in the Columbia R.
about 40 miles above us by means of skiming
or scooping nets. on this page I have drawn
the likeness of them as large as life; it
as perfect as I can make it with my
pen and will serve to give a
general idea of the fish. the
rays of the fins are boney but
not sharp tho' somewhat pointed.
the small fin on the back
next to the tail has no
rays of bone being a
membranous pellicle.
to the gills have
each. those of the
eight each, those
are 20 and a
that of the back
the fins are of
is of a bluish
the the lower
is of a silver
part. the
behind the
second of
the purple
a silver
and
the
thin mem
the fins next
eleven rays
abdomen have
of the pinnavani
haff formed in front
has eleven rays. all
a white colour. the back
dusky colour and that of
part of the sides and belly
of white. no spots on any
first bone of the gills next
eye is of a bluis cast, and the
a light goald colour nearly white
of the eye is black and the iris of
white. the under jaw exceeds the upper
the mouth opens to great extent, folding
that of the herring. it has no teeth.
the abdomen is obtuse and smooth; in this
differing from the herring, shad, anchovey
&c of the Malacaptergian Order & Class
Clupea