



**NOAA
FISHERIES**

**Northwest Fisheries
Science Center**

11.1 West Coast Protected Fish Species Science Program Review

Eulachon Overview

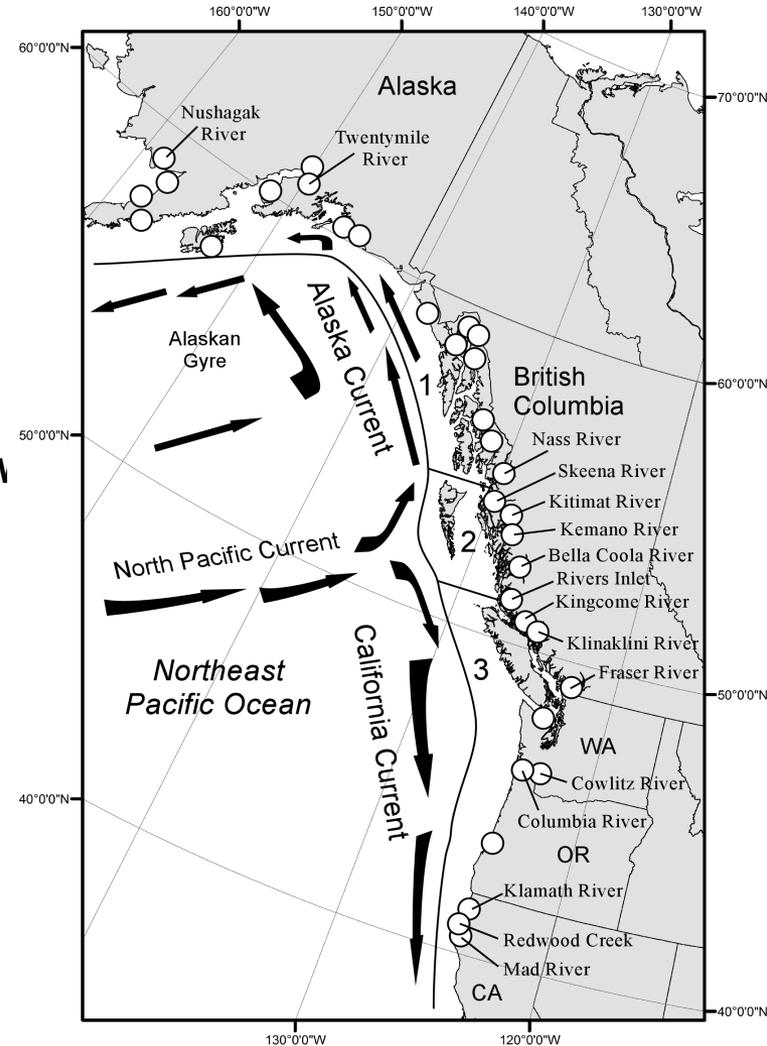
Rick Gustafson

6 May 2015



Eulachon *Thaleichthys pacificus*

- Columbia River smelt, candlefish, oolichan, hooligan
- Small (150 – 250 mm) anadromous osmerid smelt; 95% of life spent at sea
- Spawn in lower portions of snow or glacial fed rivers from December to June at age 2 to 4; semelparous
- Eggs and larvae (4 – 6 mm) are carried rapidly down river into estuaries
- Found offshore over the continental shelf at 80 – 200 m depth when age 1+ and age 2+



Cultural and Nutritional Importance

15% - 20% fat

Grease Trails – trade routes



Fishery Bay – Nass River



Savior or Salvation Fish

Eulachon oil or “grease”

- Oil signified wealth
- Gift at feasts and potlatches
- Widely traded



“The grease trade from the coast to the interior was so important that the trails connecting the communities were known as “grease trails.”

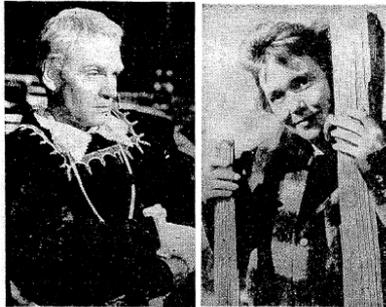
Columbia River Smelt – Economic and Cultural Importance

The Oregonian

Weather
Thursday temp
36 degrees
Friday forecast
etc. Complete

Portland, Oregon, Friday, March 25, 1949 CITY EDITION 40

Film Academy Awards Acting Honors



LAURENCE OLIVIER
For his "Hamlet"

JANE WYMAN
For her "Johnny Belinda"

Oscar Goes To 'Hamlet' For Picture

Laurence Olivier, Jane Wyman Win For Best Acting

See Wirephoto Page. Also HOLLYWOOD, March 25 (AP)—"Hamlet," which William Shakespeare wrote and Laurence Olivier brought to life, almost swept the board Thursday night for 1949 Academy awards.

It took the coveted Oscar as the best picture, for Olivier as the best actor, for art direction and decoration and costume design.

Lovely Jane Wyman won the feminine award for her plain but appealing part made in "Johnny Belinda," for Warner Bros.

"Hamlet" is the first British picture to win this country's top award. It was made for J. Arthur Rank, the British film mogul and released in this country by Universal-International.

Youngster Receives Award Douglas Fairbanks Jr. accepted the Oscar for "Hamlet" and said: "I am sure that Larry Olivier who lived and worked among us so long, must feel that of all the awards he has received, this can be more gratifying than this one by his choice of production."

A miniature statuette, a special award, went to Jess Lane, for the best juvenile performance of this year. The 12-year-old was the sensation of the ceremony—the "Search" tie is the son of Mr. and Mrs. Clement Hanft of Pasco.

John Huston was named the best director for "The Treasure of the Sierra Madre."

Vets' Per Killed In By Singl

WASHINGTON, March 25 (AP)—The house T. veterans' pension bill—by a President Truman told his was exceedingly happy over a forward-looking action.

Smelt Hordes Reach Sandy

Picture on Wirephoto Page. It's finally happened. After the usual seasonal false alarms the smelt have actually begun to run in the Sandy, Hays Quade, unofficial oracle of the Smelt, announced at 7:22 a.m. Thursday.

The first which he dipped the net full set of smelt from the mouth of the river, he said. Later he dipped more of the eager eulachon from the float at San Don beach, which he operates, Quade said.

The specific date, official keepers of the smelt were notified and confirmed the run, which was just getting under way Thursday night. The run started March 24 last year and March 23 in 1948, Quade said.

Last year 23,100 permit licenses were sold for 50 cents each, a new record.

State law prohibits starting the smelt shacks from midnight of any Sunday to midnight of the following Monday and limits the catch to 25 pounds per day per person. Otherwise no holds are barred.

Vanporters Make Claims

Properly damage claims against the Portland housing authority may run as high as \$5,500,000 for losses incurred in the disaster of last Memorial day, it was revealed Thursday as attorneys prepared suits for filing in federal district court.

Soft Answer Kills Wrath

PHOENIX, Ariz., March 25 (AP)—A Phoenix apartment paid the 50-cent overtime parking ticket at police headquarters with protest. Minutes later he was back to a trunk.

Tigner Twins Add to Quads

Picture on Page 10 Mrs. Laura Tigner, who gave birth in Portland's only quadruplet 2 1/2 years ago at St. Joseph's county hospital, Thursday gave birth in Iowa boys at the same hospital.



Smelt Hordes Reach Sandy

Lifesaver



Smelt Run Ends; New Record Set

The smelt vanished from the Sandy river Sunday, after one of the longest and heaviest spawning migrations on record. More than 17,400 persons bought special licenses to fish for the eulachon. This was almost three times as many as had ever taken such licenses before. Game commission employees and state police estimate that during the two weeks of the run 200,000 men, women and children visited the Sandy merely to watch others net the fish.

Columbia River Commercial Landings

Columbia River commercial

1914

**RUN OF SMELT LARGEST
EVER IN THE COLUMBIA**

PORTLAND, Ore., Jan. 14.—The greatest run of smelt ever in the Columbia river is now being harvested. Fresh offerings of Columbia river smelt were quoted at 5 cents a pound today by the wholesale fish trade and there were indications that even this low price would be cut. The market is glutted.



Eulachon Status Review

- In 1999, NMFS determined that a petition filed by Sam Wright to list eulachon in the Columbia River as a threatened or endangered species under the ESA did not present substantial scientific or commercial information indicating that the petitioned action may be warranted.
- The Cowlitz Indian Tribe petitioned NMFS in 2007 to list eulachon in Washington, Oregon, and California under the ESA as a threatened or endangered species. The petition was accepted and a Biological Review Team (BRT) was formed with members from NWFSC, SWFSC, AFSC, USFWS, and USDA – Forest Service

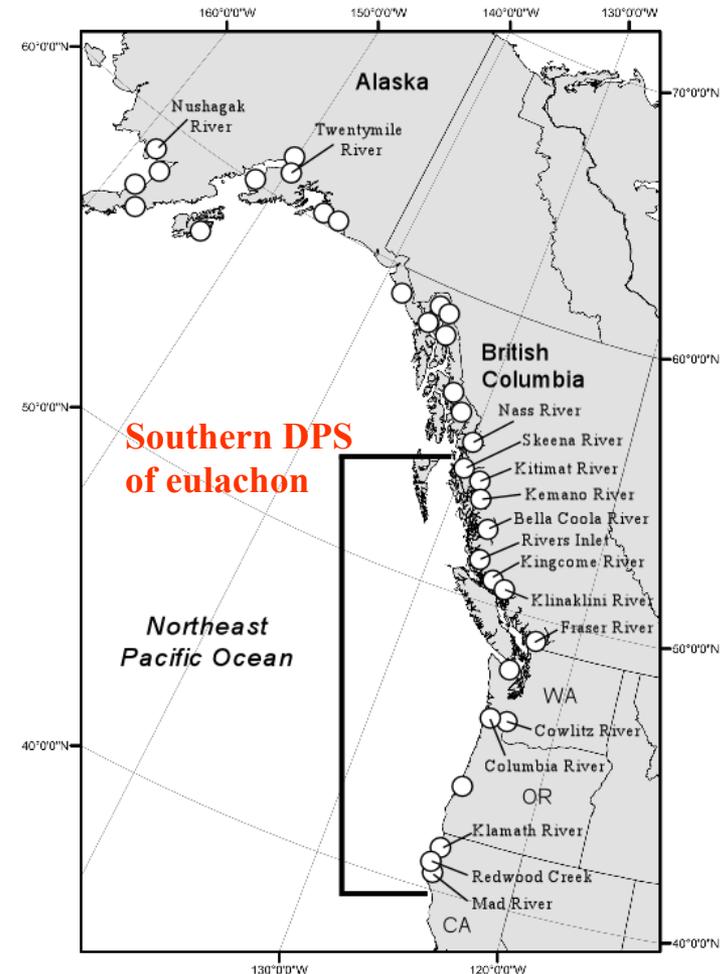
Delineation of a Southern Distinct Population Segment (DPS) of Eulachon in the California Current

Discrete

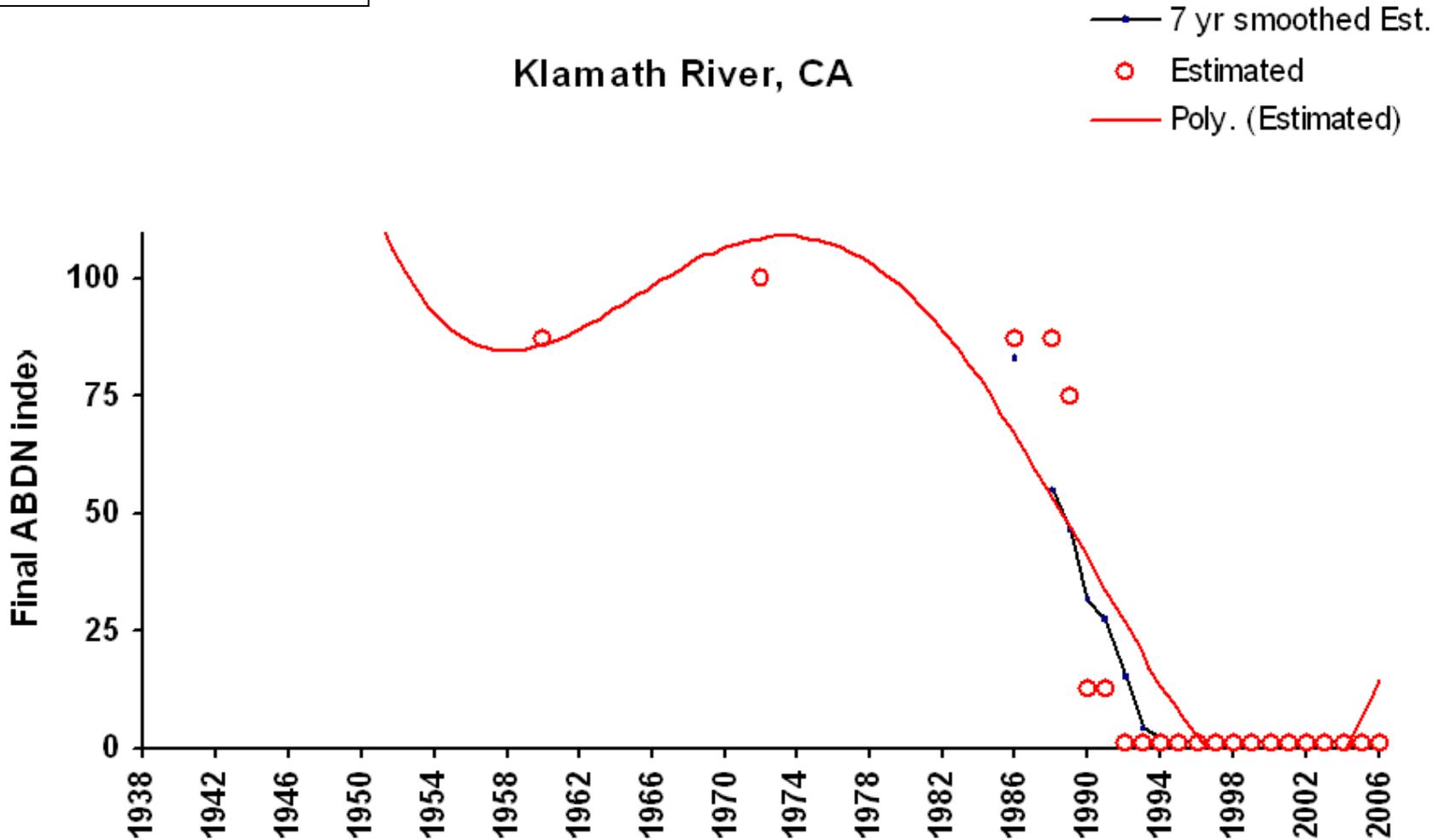
- Major ecological break in coastal ocean biomes
- Eulachon in the north often spawn under ice at 0 – 2°C versus 4 – 10°C in the south

Significant

- Significant break in ecological setting
- Loss of a California Current population would result in a significant gap in the species' range



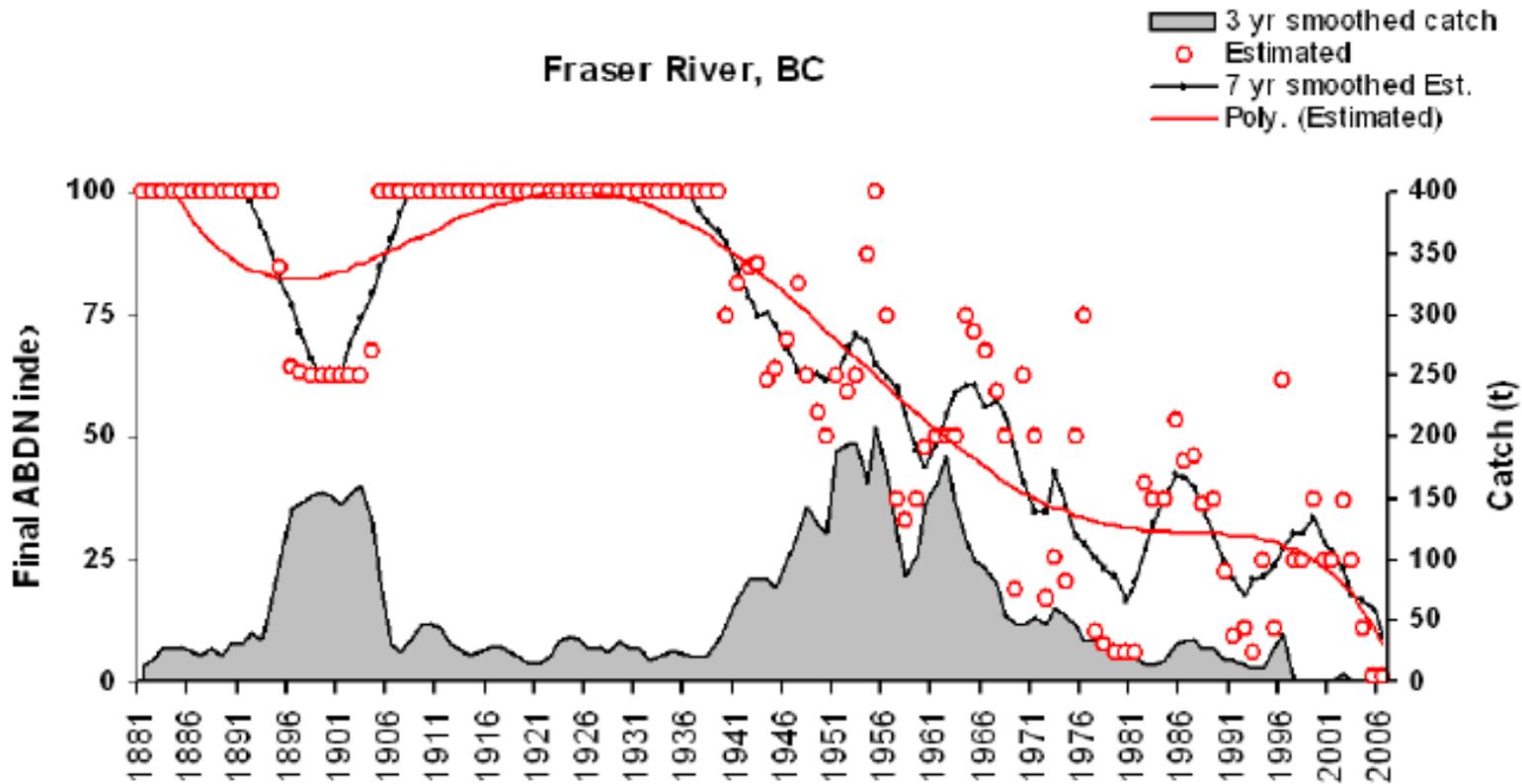
Klamath River, CA



Estimated eulachon abundance status (circles), 7 year smoothed abundance status estimations (black line), and a polynomial fitted trend line (red line).

Megan Moody (2008)

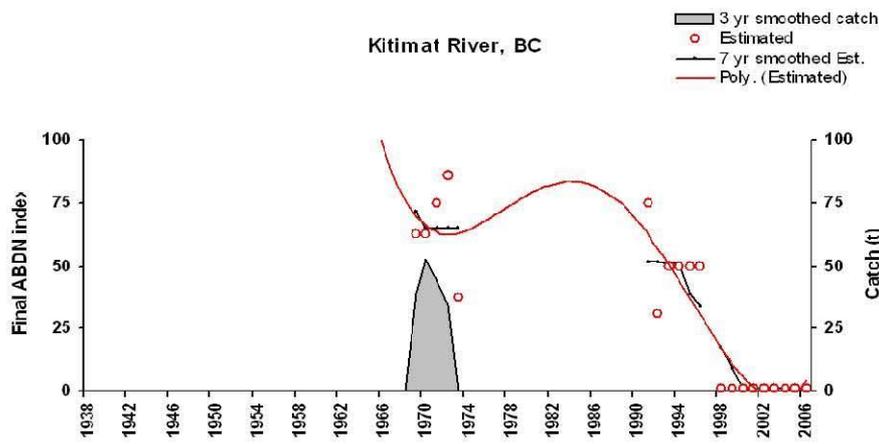
(CA) - First Nation/recreational/commercial catches;
 (LE) - Fishing effort comments;
 (CPUE) - Catch-per-unit-effort data;
 (SSB) - Spawning stock biomass estimates;
 (TF) - Test fishery catches;
 (RC) - Annual run size report comments;



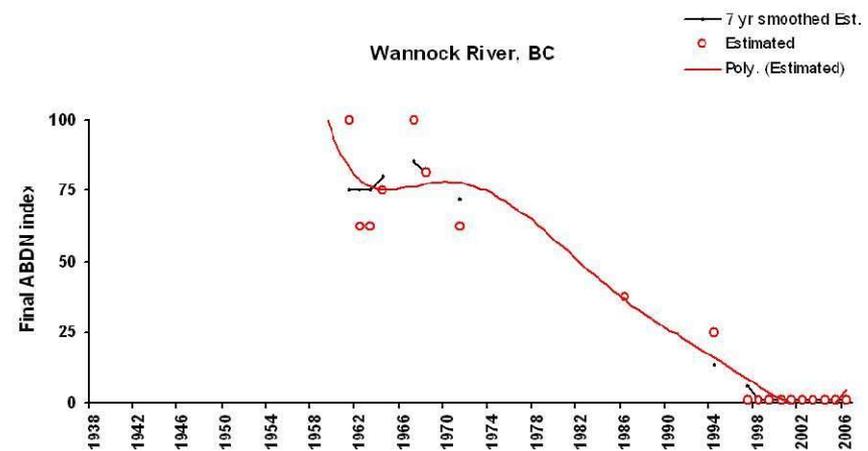
Estimated eulachon abundance status (circles), 7 year smoothed abundance status estimations (black line), 3 yr. smoothed catch (grey fill) and a polynomial fitted trend line (red line).

Megan Moody (2008)

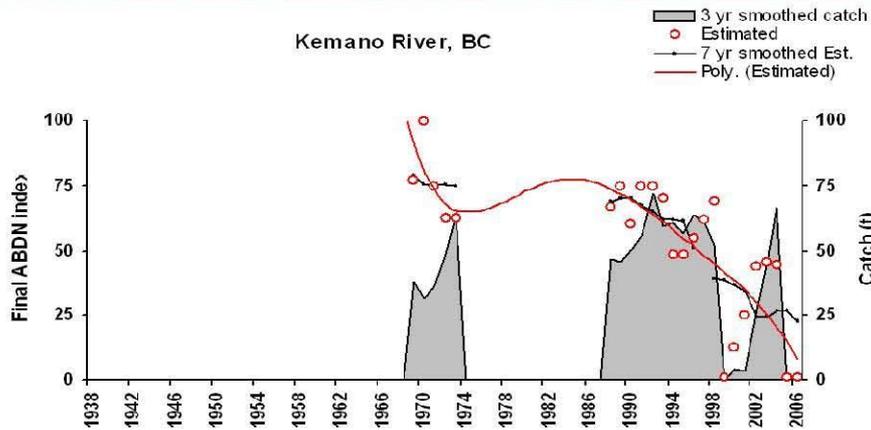
Kitimat River, BC



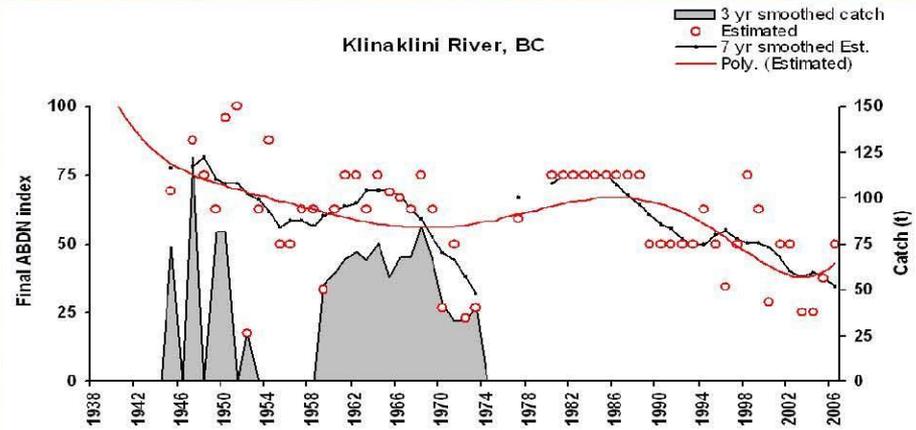
Wannock River, BC



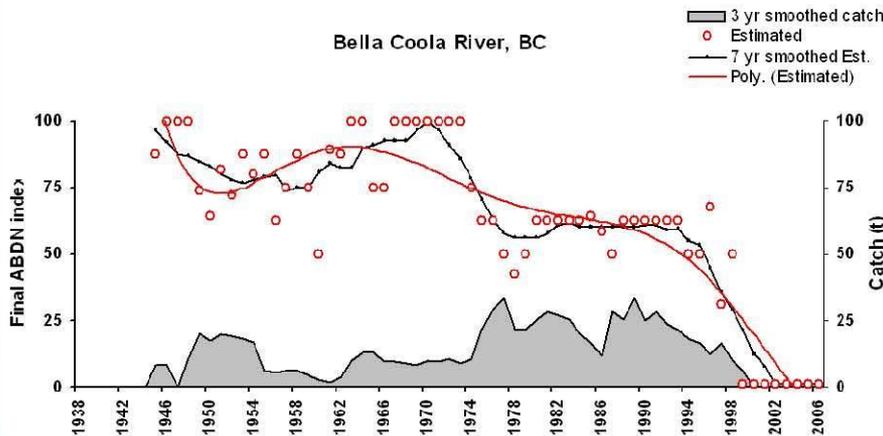
Kemano River, BC



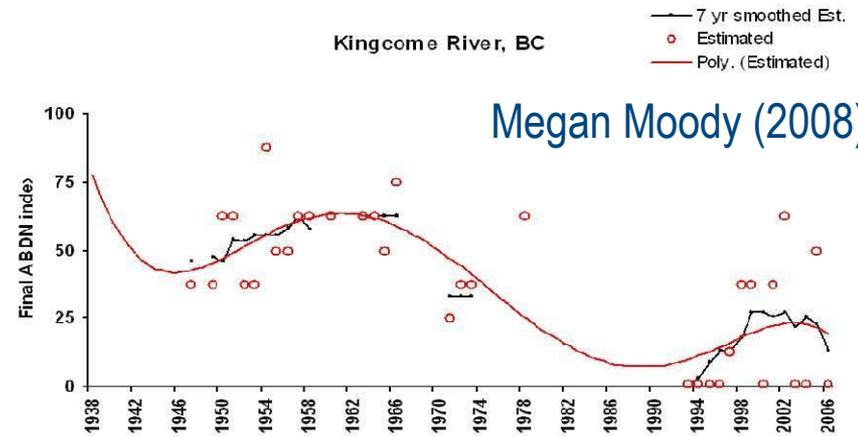
Klinaklini River, BC



Bella Coola River, BC



Kingcome River, BC



Megan Moody (2008)

Qualitative Threats Assessment for the Southern DPS of Eulachon

Threat	Klamath	Columbia	Fraser	Mainland BC
Climate change impacts on ocean conditions	high	high	high	high
Dams /water diversions	moderate	moderate	very low	very low
Eulachon by-catch	moderate	high	moderate	high
Climate change impacts on freshwater habitat	moderate	moderate	moderate	moderate
Predation	moderate	moderate	moderate	moderate
Water quality	moderate	moderate	moderate	low
Catastrophic events	very low	low	very low	low
Disease	very low	very low	very low	very low
Competition	low	low	low	low
Shoreline construction	very low	moderate	moderate	low
Tribal/First Nations fisheries	very low	very low	very low	low
Non-indigenous species	very low	very low	very low	very low
Recreational harvest	very low	low	very low	very low
Dredging	very low	moderate	low	very low
Commercial harvest	very low	low	low	very low
Scientific monitoring	very low	very low	very low	very low

BRT Risk Conclusions

- Not at risk of extinction (8% support)
- At “moderate risk” of extinction (60% support)
- At “high risk” of extinction (32% support)
- NMFS listed the Southern DPS of Eulachon as a threatened species under the ESA in March 2010

Committee on the Status of Endangered Wildlife in Canada (COSEWIC)

Canadian Species at Risk Act (SARA)



Eulachon DUs

Nass / Skeena – special concern

Central Pacific Coast - threatened

Fraser River - endangered



NOAA Fisheries Eulachon Research

Protected Species Recovery Grants to States and Tribes Programs

- **Expand fisheries observation to Washington's ocean shrimp trawl fishery to provide further bycatch information (WA, WCGOP)**
- **Develop a eulachon SSB estimate for Columbia River (WA, OR)**
- Identify environmental factors and habitat quality factors influencing spawning run-timing and tributary selection (CIT)
- Conduct egg and larval surveys to identify spawning eulachon distribution (WA, OR, CIT, YT)
- Investigate egg mortality potentially caused by sedimentation (CIT)
- Assess spatial and temporal genetic differences of spawning eulachon (WA, OR, CIT)

Bycatch Reduction Engineering Program (BREP)

- **Develop and test modifications to ocean shrimp trawl gear to reduce eulachon bycatch (OR)**

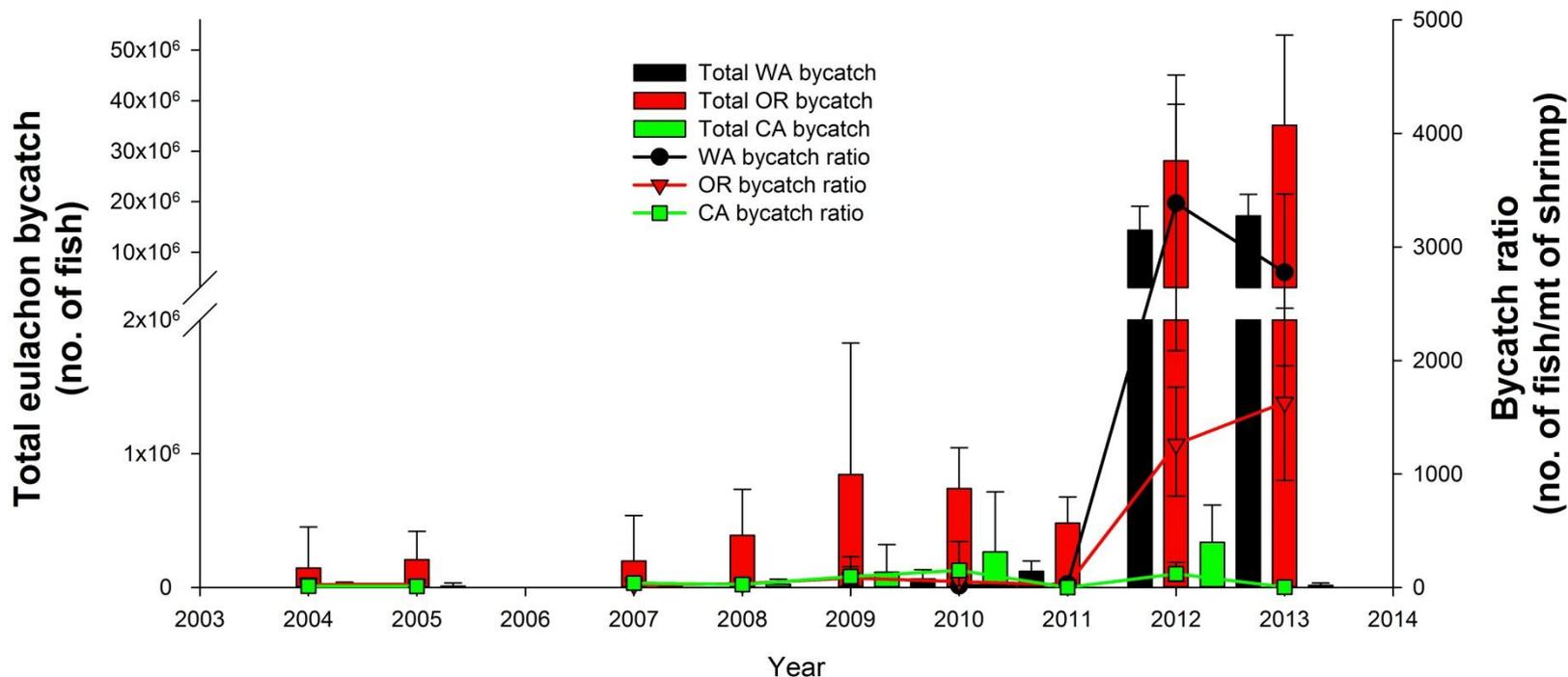
WA – WDFW; OR – ODFW; CIT – Cowlitz Indian Tribe; YT – Yurok Tribe

Estimated Bycatch of Eulachon in US West Coast Groundfish Fisheries 2002–2013

(Fisheries Observation Science Program)

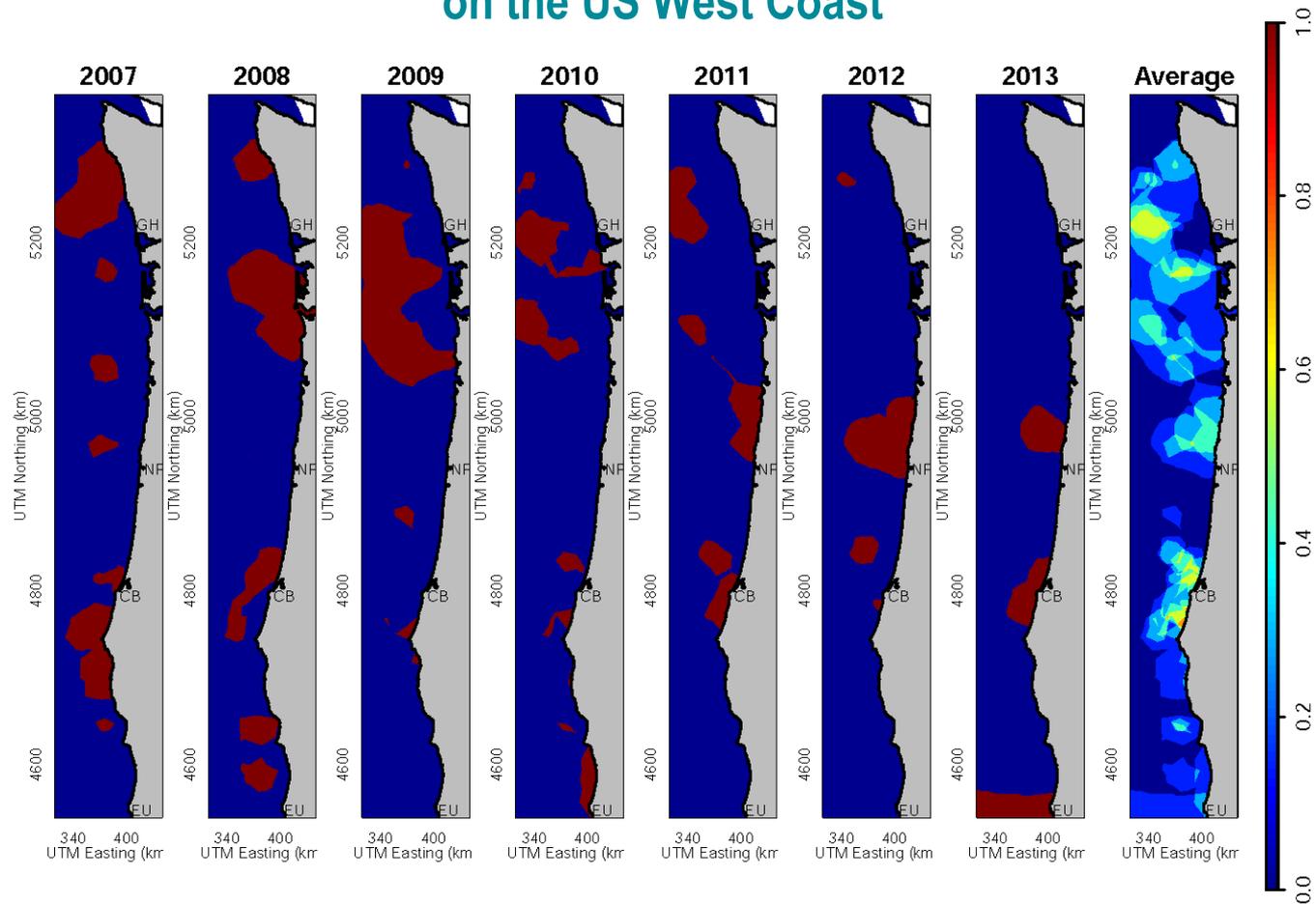
Total eulachon bycatch

Estimated Bycatch of Eulachon in Ocean Shrimp Fisheries (Fisheries Observation Science Program)



Estimated total bycatch and bycatch ratios of eulachon in the California, Oregon (2004–2013), and Washington (2010–2013) ocean shrimp trawl fisheries. Ocean shrimp fisheries were not observed in 2006.

Estimated Areas of Highest Eulachon Bycatch Risk in Ocean Shrimp Fisheries on the US West Coast



Estimated areas of highest bycatch risk, projected from the posterior predictive distribution on a 1 km grid. For any year, bycatch risk is defined as the top 10% of values (shown in red); to show consistent areas across time, averages are calculated over all years, 2007–2013. (Ward et al. in press, *Ecological Applications*)

LED Lights Dramatically Reduce Shrimp Fishery Bycatch of Eulachon

Bob Hannah and Steve Jones (ODFW)

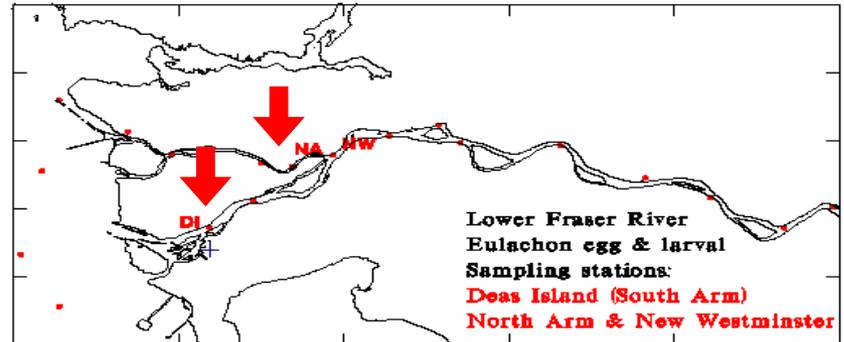
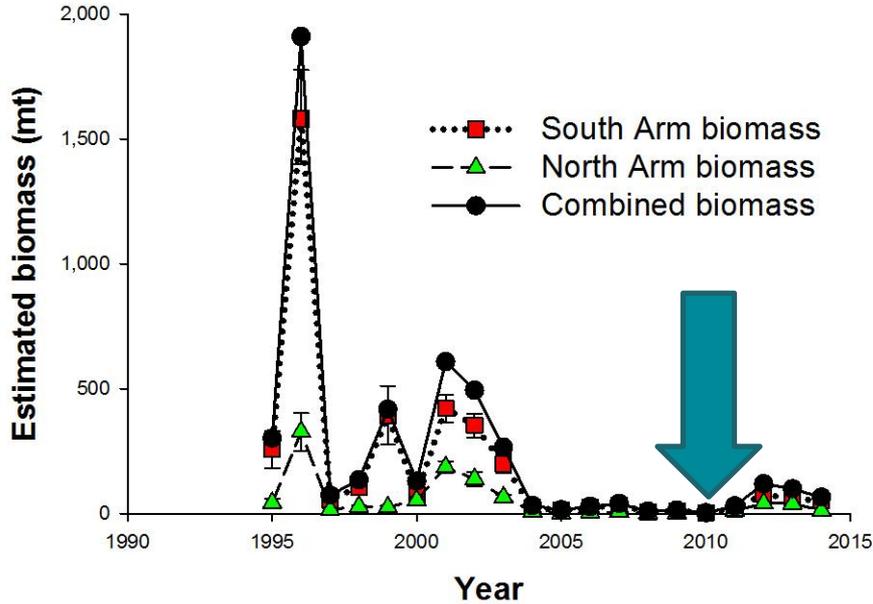
- Eulachon bycatch was reduced by 90.4% (by weight)
- Shrimp loss was 0.7% and was statistically non-significant



Research funded through NOAA Fisheries' Bycatch Reduction Engineering Program (BREP) and administered by the Pacific States Marine Fisheries Commission

Fisheries and Oceans Canada (DFO)

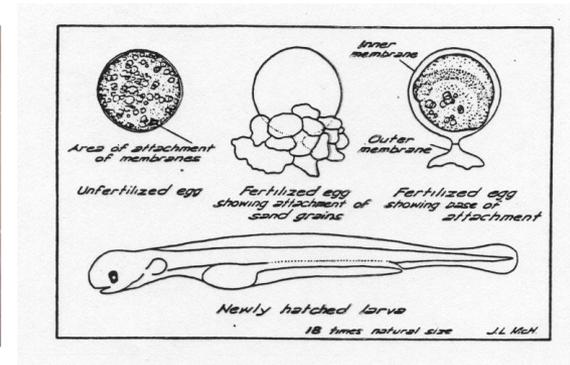
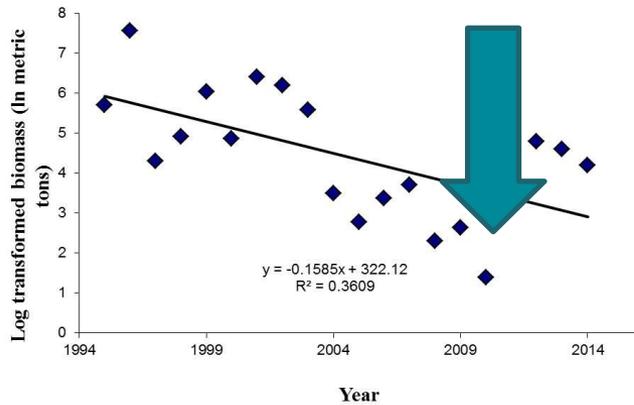
Fraser River Eulachon Spawning Stock Biomass (SSB) Trend



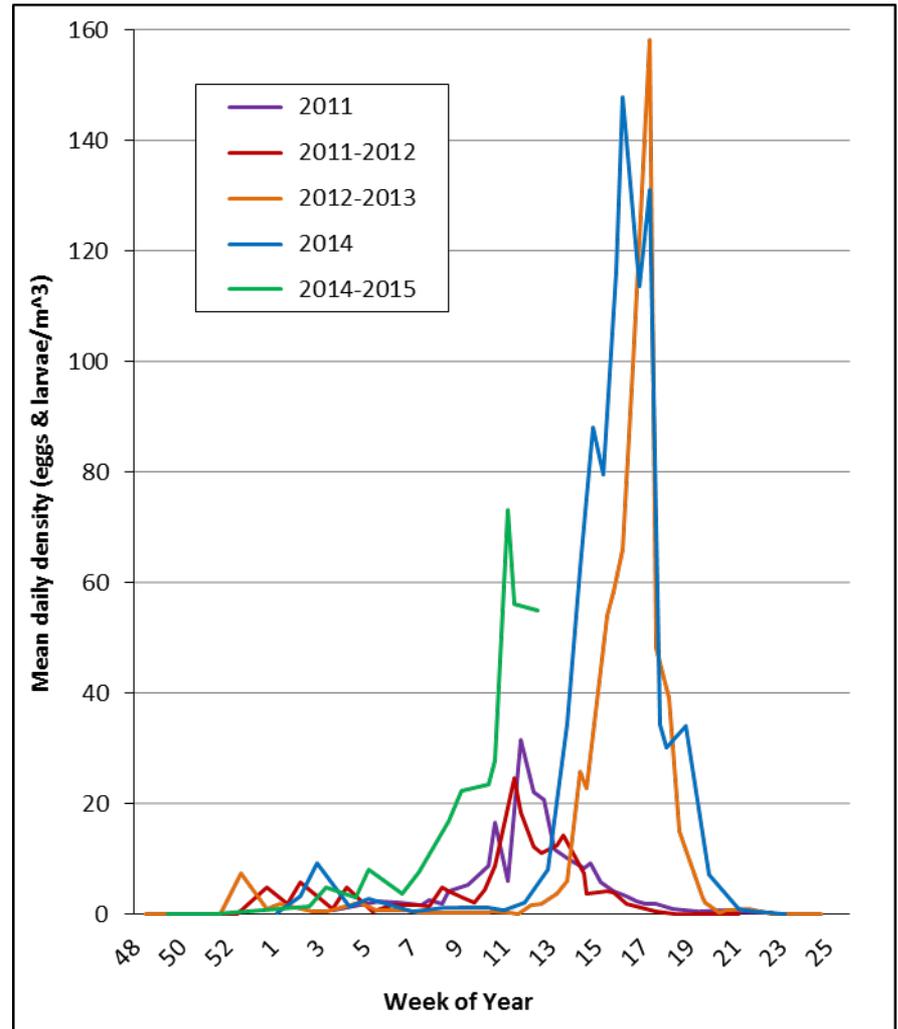
$$\text{Egg \#} = \text{River discharge (m}^3\text{)} \times (\text{eggs+larvae/m}^3\text{)}$$

Relative fecundity is ~ 700 eggs per gram of female body weight, assuming a 1:1 sex ratio

$$\text{Spawning Biomass} = (\text{Egg \#}) \times 2 / \text{Relative fecundity}$$



Estimating Eulachon Spawning Stock Biomass (SSB) in the Columbia River (WDFW / ODFW)

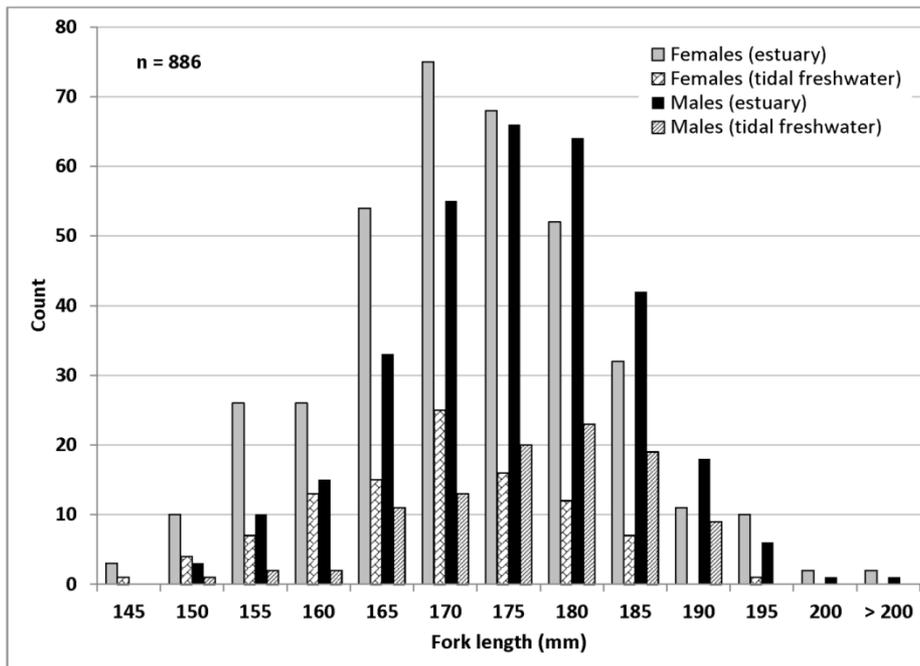


Sampling of adult eulachon in the Columbia River for sex ratio, body size (W and L), and fecundity to refine SSB estimates

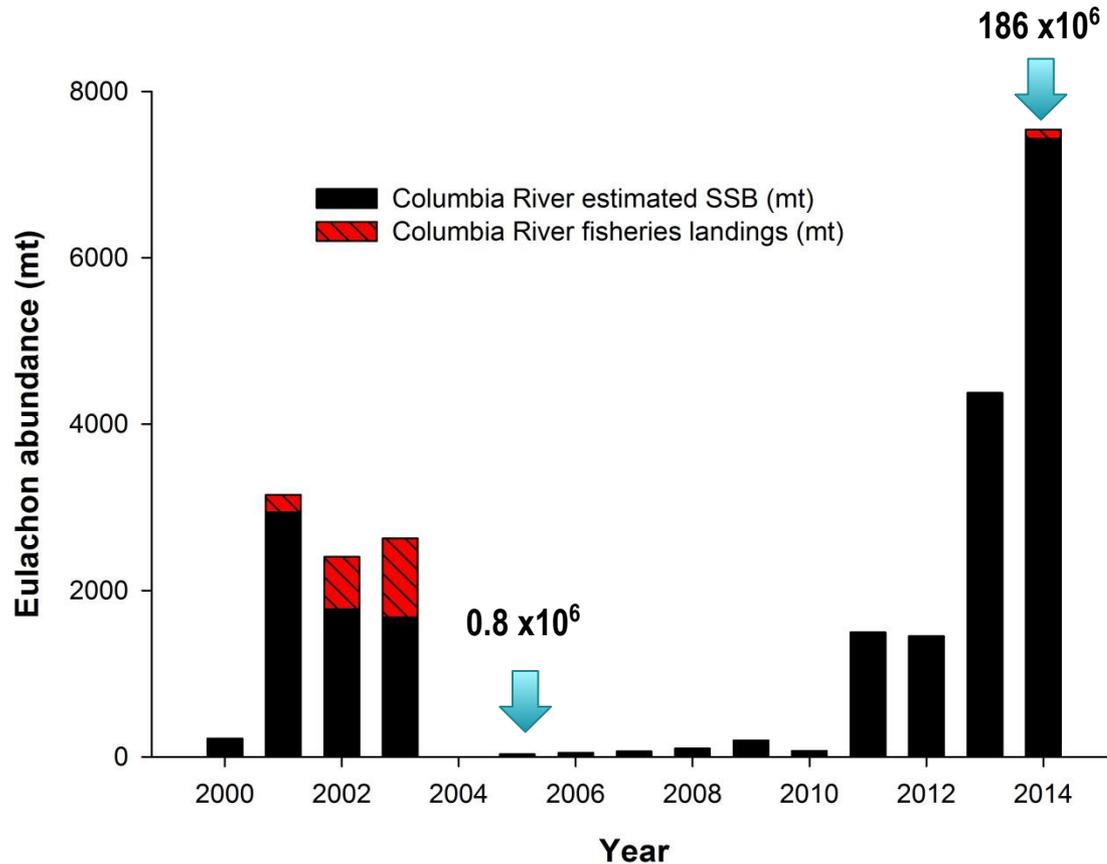
– Jen Zamon, et al. (NWFSC), Cowlitz Indian Tribe, and WDFW



- Sex ratio (M:F) = 1: 0.93
- Mean female length = 173 mm
- Mean female weight = 40.8 g
- Relative fecundity = 802.3 eggs per gram female (n = 59)

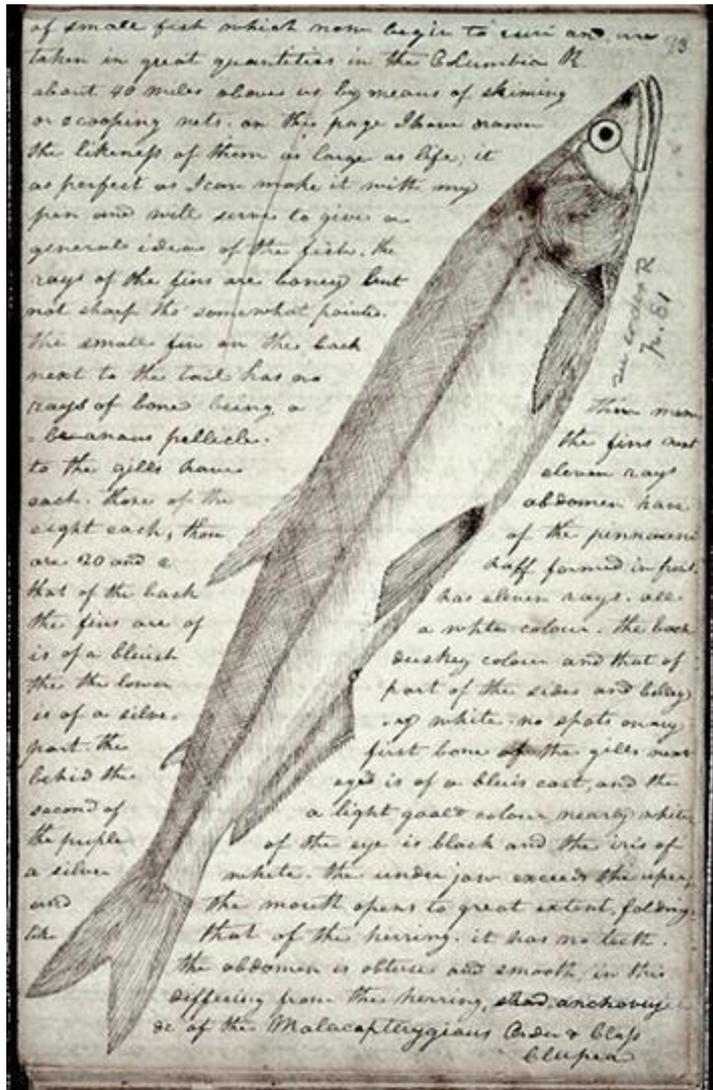


Estimate of Run Size Biomass of Columbia River Eulachon (WDFW / ODFW)



2000 – 2010 estimated from historical larval density measurements in mainstem Columbia River

Historical Ecology of Eulachon



Data sources

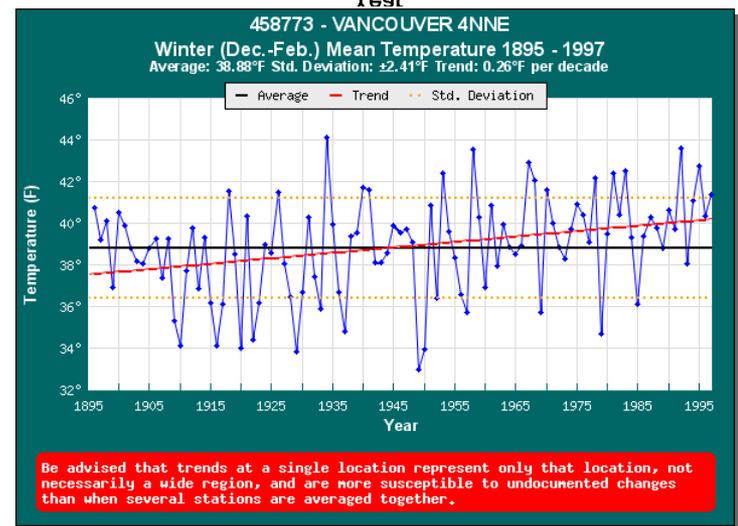
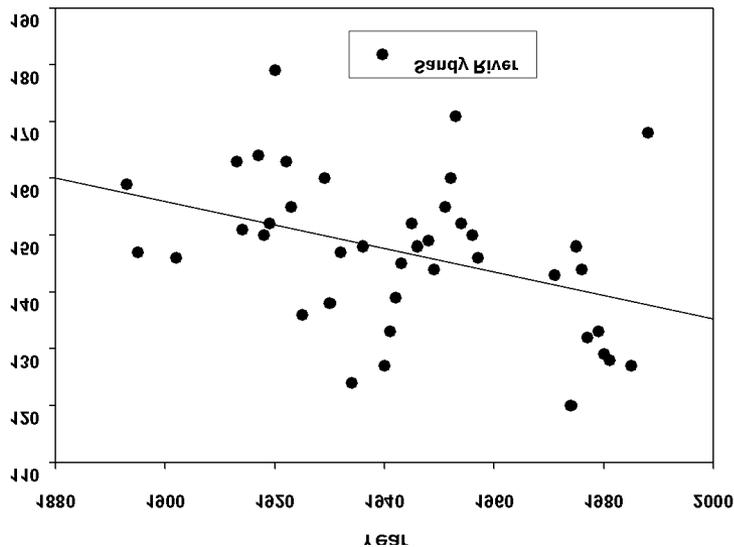
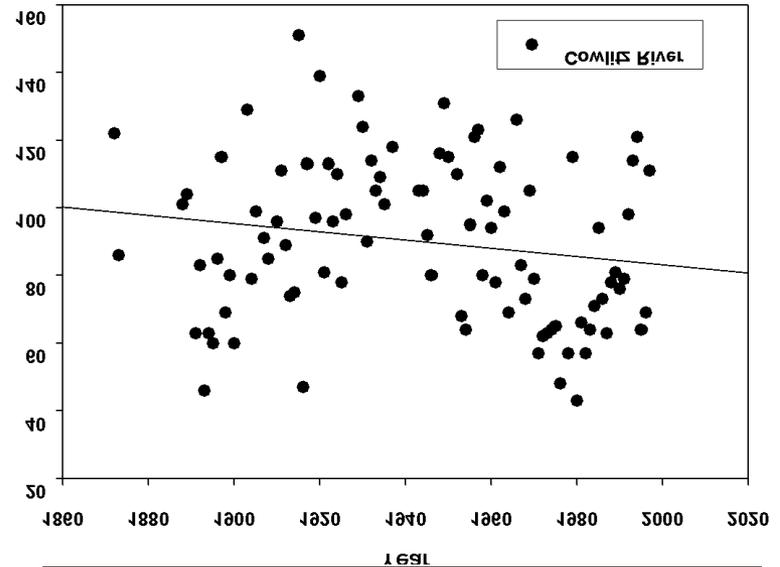
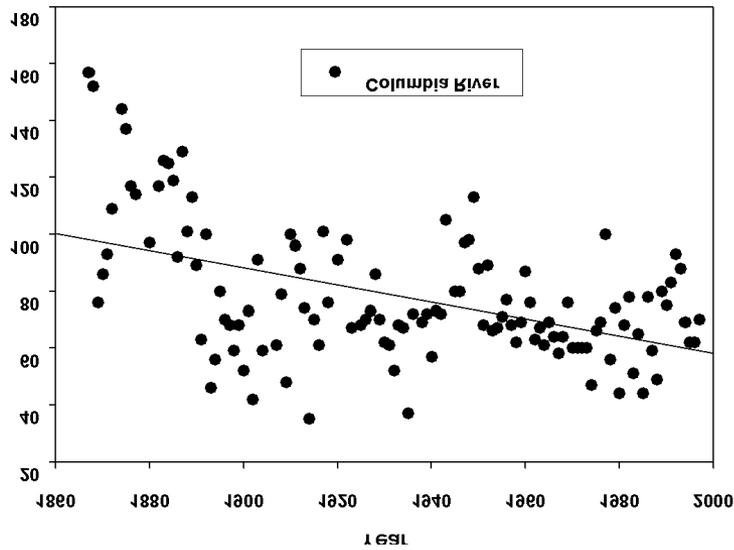
- Journals of early explorers, fur trappers, etc.
- Archived fishery agency annual reports
- Online digitized historical newspapers

Lewis and Clark Expedition 1803 – 1806

24 February 1806

The [Clatsop Indian] chief and his party had brought ... a species 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 skimming or scooping nets. On this page I have drawn the likeness of them as large as life ... I think them superior to any fish I ever tasted_ - Merriweather Lewis

Day of Initial Arrival as a Proxy for Historical Eulachon Run Timing (pre-1949 data from newspaper records)



Eulachon Data Gaps and Challenges

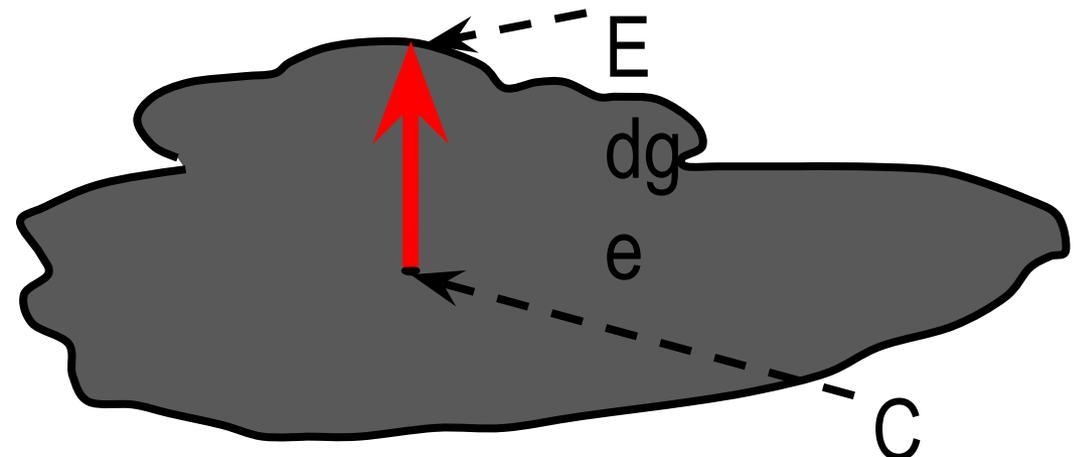
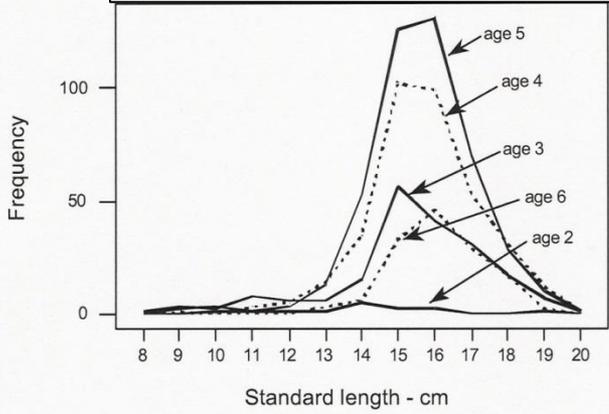
- No validated ageing method
- Lack estimates of growth rates, natural mortality (M) and total mortality (Z) between life history stages (i.e., from eggs to larvae, larvae to juveniles, juveniles to adults)
- Lack of long-term fishery-independent abundance trends for all but Fraser River (1995-2014)
- Insufficient knowledge of genetic population structure (need more geographic and temporal sampling)
- Lack of knowledge of marine habitats, distribution, abundance, and genetic stock of origin of bycaught eulachon
- Past recreational catch largely unrecorded

Eulachon Research Recommendations

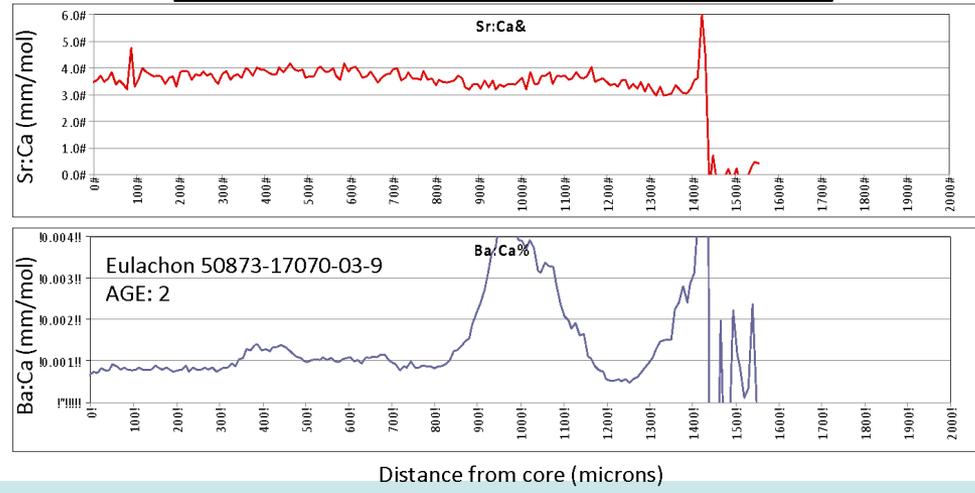
- Produce a validated ageing technique
- Expand temporal and geographic sampling for genetic population structure studies of eulachon spawning populations
- Develop protocol to genetically assign marine eulachon bycatch to natal rivers using a genetic baseline of river populations
- Monitor marine fish, seabird, and marine mammal predator diets to assess impact of predation on eulachon survival and mortality
- Develop an index of eulachon abundance in the marine environment that is proportional to the total abundance
- Evaluate eulachon distribution and habitat requirements in the marine environment to provide strategies to minimize fishery impacts and evaluate oceanographic factors on survival and mortality
- Explore acoustic/trawl methodology to determine in-season eulachon abundance in the Columbia River

Proposal: Evaluation of age composition and somatic growth in eulachon using otolith chemistry and microstructure (Rich Zabel and Paul Chittaro - NWFSC)

Age based on otolith increments – evidence of false annuli



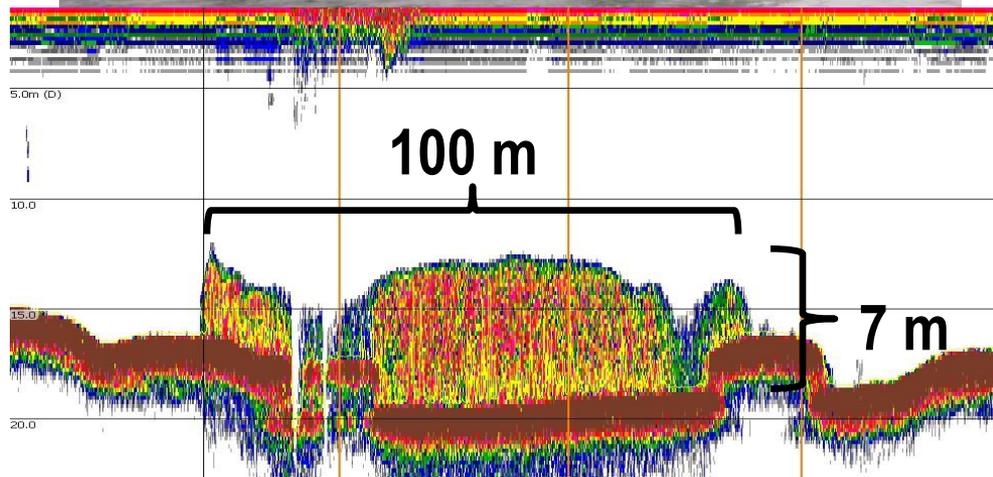
Age based on otolith microchemistry (Ba/Ca)



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Proposal: Acoustic-trawl surveys of eulachon abundance in the Columbia River (Jen Zamon – NWFSC)

- Five-year pilot study
- Federal/state partnership
- November - April
- Provide specimens for egg-larval SSB estimates and migration timing
- Develop direct index of in-season adult abundance



Acknowledgments

**Brad James & Greg Bargmann --- Washington
Department of Fish and Wildlife**

**Tom Rien --- Oregon Department of Fish and
Wildlife**

**Doug Hay & Jake Schweigert --- Department of
Fisheries and Oceans Canada**

