WDFW & ODFW
EULACHON
MONITORING
AND RESEARCH

Olaf Langness, WDFW
**Background**

- Fisheries hit low numbers during mid 1990s
- July 16, 1999 former WDFW Biologist Sam Wright petitions
- 2001 Washington Oregon Eulachon Management Plan
Background

- System wide collapse of runs in 2005
- Cowlitz Tribe Petition November 8, 2007
- NMFS Proposes ESA listing March 13, 2009
- SDPS listed as threatened effective May 17, 2010
- Commercial and sport fisheries closed
Background

- July 1, 2010 Washington and Oregon receive 3 year Section 6 grant to estimate 2011-2013 spawning populations, explore critical habitat, and monitor eulachon bycatch in the coastal pink shrimp fishery.

- July 1, 2014, WDFW and ODFW received separate Section 6 grants to continue monitoring runs in the Columbia River and to develop estimates in various coastal rivers for 2015, 2016 and 2017.

- WDFW received additional NMFS regional funding to gather data on the adult returns in 2013-2016 and estimate the 2014 run (not covered by Section 6 grants).
**Spawning Stock Biomass Estimates**

- Use method developed in Canada
  - Larval Densities near mouth
  - Expand for water volume over larval outflow period
  - Calculate adult equivalent
Spawning Stock Biomass Estimates
### Spawning Stock Biomass Estimates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biological</strong></td>
<td></td>
</tr>
<tr>
<td>sex ratio</td>
<td>1:1</td>
</tr>
<tr>
<td>mean female length (mm)</td>
<td>173</td>
</tr>
<tr>
<td>mean female weight (gram)</td>
<td>40.84</td>
</tr>
<tr>
<td>eggs/gram female</td>
<td>802.255</td>
</tr>
<tr>
<td>eggs/ female</td>
<td>32,766</td>
</tr>
<tr>
<td>mean fish weight (gram)</td>
<td>40.6</td>
</tr>
<tr>
<td>fish/pound</td>
<td>11.16</td>
</tr>
<tr>
<td>eggs/gram of fish</td>
<td>403.5</td>
</tr>
<tr>
<td>eggs/fish</td>
<td>16,383</td>
</tr>
<tr>
<td>egg to larvae survival</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Bootstrap</strong></td>
<td></td>
</tr>
<tr>
<td>Iterations</td>
<td>1,000</td>
</tr>
<tr>
<td>alpha</td>
<td>0.05</td>
</tr>
<tr>
<td>Confidence Level</td>
<td>0.95</td>
</tr>
</tbody>
</table>
### Spawning Stock Biomass Estimates

<table>
<thead>
<tr>
<th>Cumulative values for:</th>
<th>Plankton outflow</th>
<th>Number of spawners</th>
<th>SSB (pounds)</th>
<th>SSB (megagram)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days Sampled</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n (per sample day)</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean egg density</td>
<td>1.48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean larvae density</td>
<td>21.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean egg &amp; larvae density</td>
<td>22.57</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point estimate</td>
<td></td>
<td>2,017,000,000,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bootstrap results</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td></td>
<td>3,382,000,000,000</td>
<td>207,570,500</td>
<td>18,593,000</td>
</tr>
<tr>
<td>Upper CI</td>
<td></td>
<td>2,814,000,000,000</td>
<td>172,700,000</td>
<td>15,470,000</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>2,014,000,000,000</td>
<td>123,582,800</td>
<td>11,070,000</td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td>1,999,000,000,000</td>
<td>122,700,000</td>
<td>10,990,000</td>
</tr>
<tr>
<td>Lower CI</td>
<td></td>
<td>1,293,000,000,000</td>
<td>79,400,000</td>
<td>7,110,000</td>
</tr>
<tr>
<td>Minimum</td>
<td></td>
<td>937,000,000,000</td>
<td>57,525,700</td>
<td>5,152,800</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Columbia River</th>
<th>Fraser River</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>70,200</td>
<td>35,270</td>
</tr>
<tr>
<td>2006</td>
<td>110,500</td>
<td>63,930</td>
</tr>
<tr>
<td>2007</td>
<td>143,900</td>
<td>90,390</td>
</tr>
<tr>
<td>2008</td>
<td>216,700</td>
<td>22,050</td>
</tr>
<tr>
<td>2009</td>
<td>436,700</td>
<td>30,860</td>
</tr>
<tr>
<td>2010</td>
<td>157,700</td>
<td>8,860</td>
</tr>
<tr>
<td>2011</td>
<td>3,296,300</td>
<td>68,340</td>
</tr>
<tr>
<td>2012</td>
<td>3,197,800</td>
<td>264,600</td>
</tr>
<tr>
<td>2013</td>
<td>9,653,200</td>
<td>220,500</td>
</tr>
<tr>
<td>2014</td>
<td>16,632,100</td>
<td>145,500</td>
</tr>
<tr>
<td>2015</td>
<td>11,403,900</td>
<td>698,900</td>
</tr>
</tbody>
</table>
Spawning Stock Biomass Estimates

• In 2015
• Within the Columbia Basin
  • WDFW resumes sampling the Grays River (below the mainstem Columbia River monitoring site)
Spawning Stock Biomass Estimates

- In 2015
- Within the Columbia Basin
  - The Grays River is the only significant spawning site that exists below the mainstem Columbia River index site.

<table>
<thead>
<tr>
<th>Run Year</th>
<th>Number of Spawners</th>
<th>As a % of Columbia R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>8,200</td>
<td>0.02 %</td>
</tr>
<tr>
<td>2012</td>
<td>9,700</td>
<td>0.03%</td>
</tr>
<tr>
<td>2013</td>
<td>25,800</td>
<td>0.02%</td>
</tr>
<tr>
<td>2014</td>
<td>No Survey</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>184,383</td>
<td>0.17%</td>
</tr>
</tbody>
</table>
Spawning Stock Biomass Estimates

- In 2015
- Within the Columbia Basin
  - The Cowlitz Tribe F&W staff estimated an SSB for the Cowlitz River
    - Will see how much of the Columbia River production is attributed spawning in the Cowlitz River
Spawning Stock Biomass Estimates

- In 2015 Outside the Basin
- WDFW did an SSB estimations for the Chehalis River
Spawning Stock Biomass Estimates

- In 2015 Outside the Basin
  - WDFW did an SSB estimation for the Naselle River
Spawning Stock Biomass Estimates

- In 2015 Outside the Basin
  - ODFW explored the possibilities of deriving SSB estimations for one or more central Oregon coastal streams (Tenmile, Cummins, and/or Big creeks)
Spawning Stock Biomass Estimates

• Why should we look outside the Columbia River?

• Can compare how runs to these rivers relate to the Columbia River run
  • Do they act as a sink for when the Columbia River conditions are not favorable?
  • Are they showing signs of recovery too?

• Opportunity to collect genetic samples (larvae from plankton tows) from spawning locations outside the Columbia Basin
Spawning Stock Biomass Estimates

![Graph showing estimated number of spawning eulachon by river and year from 2010 to 2016.](image-url)
Adult Eulachon Sampling and Monitoring

- 2013 Contracted with NMFS Point Adams Research Station to collect adult bio-data used in the development of the SSB estimates
- Additional samples were provided by the Cowlitz Tribe from the Cowlitz River
- Average weight, gender ratio, and relative fecundity determined
- Genetic material collected
2014 and 2015 we used limited commercial fisheries in the lower river to get the same data provided NMFS trawl operations in 2013.

2014 and 2015 sport fisheries in the Cowlitz River and Sandy River were allowed.

The commercial fishery provides the adult bio-data and allows us to resume long-term monitoring of CPUE.

The sport fishery stimulates interest in the species and their protection.
There is no 4(d) rule yet limiting take; however, as co-managers of a listed species WDFW and ODFW closed their fisheries during 2011-2013 and only opened them during 2014 and 2015 at levels below those prescribed in the WOEMP.

Prior to the listing, only the Yakima Tribe harvested smelt from the Cowlitz River.

Since the listing, the Cowlitz Tribe takes a portion of their research catch in the Cowlitz River for ceremonial purposes.

In the last two years, the Warm Springs, Umatilla, and Nisqually tribes have exerted their rights to also fish the Cowlitz and Sandy rivers.
Fisheries Management

**Graph 1:**
- **Y-axis:** Pounds
- **X-axis:** Years from 2000 to 2015
- **Legend:**
  - Commercial MS
  - Commercial Trib
  - Sport
  - Tribal

**Graph 2:**
- **Y-axis:** Exploitation Rate (%)
- **X-axis:** Years from 2000 to 2015
- **Legend:**
  - WOEMP
  - ESA Listing
Fisheries Management

- When predicting a run, we assess the impact that various marine and freshwater conditions over the past few years might have on the return of a brood year.
- 95% of a eulachon’s life is at sea, so marine conditions are a strong indicator of run strength.
**Adult Biological Parameters**

- **Sex Ratios**

  - In 2002 Hays et all reported 1:1 ratio for the Frazier., N=2352 total.
  - In Zamon et al. (unpublished, 2013) 914 fish were sampled and a 1.1:1 ratio reported.
  - During our Commercial Eulachon season this year, we found that in three of our four Columbia River sampling trips, the ratio was 1:1 (N=800).
  - The ratio for the Tributaries is still weighted heavily toward males
    - There may actually be more Males than Females in the tributaries
    - alternative hypothesis is that the un-equal sex distribution may be related to spatial and temporal differences that occur once the fish are in or near the tributaries.

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</tbody>
</table>

6.8:1 Royal 1932
10.5:1 Unknown 1946
3:1 Smith & Saalfeld 1955
to 12:1
Adult Biological Parameters

- **Fecundity**
  - Wide range of published values
  - No evidence of selective sampling
  - Sample sizes unknown
  - Too small of sample

![Maturation Index Chart]

<table>
<thead>
<tr>
<th>Rating</th>
<th>Maturation Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Under-developed eggs, but potentially a current year spawner.</td>
</tr>
<tr>
<td>1</td>
<td>Tight skein, connective tissue present, ovary membrane thick. Turbidity may be high.</td>
</tr>
<tr>
<td>2</td>
<td>Slight reduction in all the above.</td>
</tr>
<tr>
<td>3</td>
<td>Decreased membrane thickness, skeins less tight (i.e. eggs attaching to instruments or finger).</td>
</tr>
<tr>
<td>4</td>
<td>Continued reduction in membrane thickness; increase in loosening of skein.</td>
</tr>
<tr>
<td>5</td>
<td>Spawn-ready - eggs loose, membrane very thin, but mostly intact.</td>
</tr>
<tr>
<td>6</td>
<td>Spawning in progress, Spawn-out - ovary bloody/flaccid, but eggs (both developed and oocytes) may still remain.</td>
</tr>
</tbody>
</table>
Adult Biological Parameters

- Fecundity
  - Length dependent
    - This relationship varies between years

2015

2013
Adult Biological Parameters

- Fecundity
  - Length dependent
    - Strong overlap in lengths between age groups

2013 Age v Length Distribution

- 2yo13 (31)
- 3yo13 (26)
- 4yo13 (3)
- 5yo13 (1)
Adult Biological Parameters

- Fecundity
  - Length dependent
    - This relationship varies between years
    - Strong overlap in lengths between age groups
    - Need representative sample of the true length distribution
Adult Biological Parameters

- **Fecundity**
  - Wide range of published values
    - No evidence of selective sampling
    - Sample sizes unknown
    - Too small of sample
  - Length dependent

- **Relative Fecundity (eggs/gm BW)**
  - Varies with each run
  - Connected to condition factor
What We Learned

• Annual Sampling is a must, for use in SSB
  
  Length and weight
  
  Sample throughout the run
  
  Relative Fecundity

• Need both GSI (Gonad wt/Fish wt) and a way to analyze ovary condition

• Egg Diameter Tracking:
  
  Could be useful
  
  Not currently done
Unusual materials were routinely being noticed in the gonads during counting.

- Are these just contaminated samples?
  - Reviewed protocols
  - Changed to all glass labware
  - Contacted NMFS Ocean Debris Program for assistance

Samples being examined by Julie Masura at the University of Washington Tacoma.

- Initial impressions it is polyethylene
- Test equipment is still awaiting parts
Genetics

- 2013 provided samples to the CRITFC Hagerman Lab
  - Used to develop SNP analysis
  - Some promise but still not able to separate Fraser and Columbia stocks
- Genetic samples from eulachon caught during the Pink Shrimp Trawl observation program
  - Mixed Stock Analysis on hold
- Attempted temporal comparison between the late and early components of the Columbia River run
  - Found many non-eulachon larvae complicating the comparison
  - Attempting to process more early samples to make a comparison
  - Raises some concern over what is being counted
    - Need look into Longfin Smelt
Critical Habitat

- During 2011 and 2012
  - Confirmed mainstem spawning concentrated between Eagle Cliff and the Cowlitz River (some occurs up to Bonneville)
  - Teamed with Cowlitz Tribe to determine extend of spawning in the tributaries where States found larvae
  - Discovered spawning in Skamokawa Creek
Critical Habitat

• Explored Olympic Peninsula rivers during 2011 and 2012
• Eulachon present in the
  • Chehalis
  • Willapa
  • Naselle
  • Bear
Critical Habitat

- Will continue comparing larval densities in the various tributaries of Grays Harbor and Willapa Bay during 2016 and 2017
- Coastal Watershed Institute reports hundreds of eulachon returning to the Elwha River this year (last time detected was 2005)
Critical Habitat

- Smelt observed this year 5 miles up the South Fork Toutle River—15+ miles above the Toutle River critical habitat boundary

- Smelt carcasses observed in Vancouver Lake and on the Portland and Vancouver shorelines
Shrimp Trawl Fishery

- Limiting the bar space in the excluder devices to < 1 inch greatly reduced eulachon bycatch in 2011
- Eulachon bycatch went up in 2012 likely due to an increase in eulachon and shrimp abundance
- WDFW Marine Resource staff monitored almost a quarter of trips made by the WA fleet during 2011 and 2012
- NMFS WCGOP assumed monitoring the fleet in 2013
Shrimp Trawl Fishery

- Recent market demand in Europe has spurred an increase in pink shrimp trawl effort
- Possibly increasing the bycatch despite latest excluder device and LED improvements
Shrimp Trawl Fishery

- The fleet has moved northward
  - Will this mean more fishing in the northernmost cluster of observations?
  - Will this put the fleet into areas not normally exploited, especially if the demand for more product remains?
Title: Smelt Festival
Queens—1942
Museum # 86.15.1
Cowlitz County Historical Museum
405 Allen Street
Kelso, WA 98626

Any Questions?
Backup Slides for questions........
### Commercial Fisheries Sampling

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Periods (2 per week)</th>
<th>Deliveries</th>
<th>Pounds Harvested</th>
<th>Average Pounds per Landing</th>
<th>Samples Taken</th>
<th>Average Fish per Pound</th>
<th>Gender Distribution</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>8</td>
<td>38</td>
<td>18,323</td>
<td>482.2</td>
<td>No samples</td>
<td>11.2</td>
<td>43.8% female</td>
<td>40.5 pounds purchased for fecundity and aging estimations</td>
</tr>
<tr>
<td>2015</td>
<td>8</td>
<td>32</td>
<td>16,524</td>
<td>516.1</td>
<td>About 118</td>
<td>11.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Recreational Fisheries Sampling

2014
- Fisheries extended to 5 Saturdays
- 19,746 trips/participants
- 197,900 pounds harvested
- Trips averaged 22.1 min.
- Average 8.2 pounds/trip

2015
- Only two Saturdays in February
- 34,100 trips/participants
- 287,400 pounds harvested
- Trips averaged 54.1 min.
- Average 8.4 pounds/trip
- 17.1% female
- 81.3% females ripe
- Average size of fish similar to commercial average though noticeably small fish could be seen in samples on the 2nd Saturday