Eulachon in the Columbia River Estuary & Plume

Highlights of what is known, what is unknown, what is needed for recovery planning

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Olaf Langness (WDFW)
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Jen’s quick & dirty habitat definitions

Tidal freshwater - rkm 235-rkm 29
Estuary – rkm 29- rkm 0
• larvae, spawning adults

Plume – marine area directly influenced by river discharge
• larvae, juveniles, adults

Climatology & plume model courtesy www.stccmop.org
Columbia River Estuary & Tidal Freshwater

- Joint work NWFSC, WDFW; Jan-Mar 2013
- Proof of concept – research trawl + hydroacoustics
- Cost-effective, direct, fishery-independent sampling of spawning run: distribution, sex ratio, size, fecundity
- Potential work on run timing, age structure, acoustic biomass estimates, live specimens
- Compare w/historical estuary data from CREDDP 1980-81
# Numerical species composition of trawls

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>CATCH (n)</th>
<th>CATCH (%)</th>
<th>FO (%)</th>
<th>CATCH (n)</th>
<th>CATCH (%)</th>
<th>FO (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ESTUARY (n = 38)</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>TIDAL FRESHWATER (n = 9)</strong></td>
<td></td>
<td></td>
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<tr>
<td>American shad</td>
<td>12,152</td>
<td>50.20</td>
<td>84.2</td>
<td>385</td>
<td>0.2</td>
<td>1.1</td>
</tr>
<tr>
<td>Longfin smelt</td>
<td>5,827</td>
<td>24.1</td>
<td>73.7</td>
<td>34</td>
<td>&lt;0.1</td>
<td>22.2</td>
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<tr>
<td>Threespine stickleback</td>
<td>4,204</td>
<td>17.4</td>
<td>85.9</td>
<td>204,506</td>
<td>96.4</td>
<td>88.9</td>
</tr>
<tr>
<td><strong>Eulachon</strong></td>
<td>715</td>
<td>3.0</td>
<td>60.5</td>
<td>7,061</td>
<td>3.3</td>
<td>22.2</td>
</tr>
<tr>
<td>Dungeness crab</td>
<td>304</td>
<td>1.3</td>
<td>31.6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Starry flounder</td>
<td>256</td>
<td>1.1</td>
<td>65.8</td>
<td>72</td>
<td>&lt;0.1</td>
<td>55.6</td>
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<tr>
<td>English sole</td>
<td>242</td>
<td>1.0</td>
<td>31.6</td>
<td>1</td>
<td>&lt;0.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Pacific staghorn sculpin</td>
<td>240</td>
<td>1.0</td>
<td>55.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Snake prickleback</td>
<td>64</td>
<td>0.3</td>
<td>26.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sand sole</td>
<td>61</td>
<td>0.3</td>
<td>15.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pacific tom cod</td>
<td>59</td>
<td>0.2</td>
<td>15.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Chinook salmon (juvenile)</td>
<td>36</td>
<td>0.1</td>
<td>26.3</td>
<td>12</td>
<td>0.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Other, excluding bay shrimp</td>
<td>53</td>
<td>&lt;0.1</td>
<td></td>
<td>1</td>
<td>&lt;0.01</td>
<td>-</td>
</tr>
</tbody>
</table>
Size distribution, Columbia estuary

- 1:1 sex ratio
- Mean fork length, 2013 spawners:
  - males: 173.9 mm
  - females: 169.9 mm
- Size distribution changed, 1980-81 vs. 2013
- Is this a change in age distribution?
Length-weight distribution, Columbia estuary

- Apparent change in length-weight distribution, 1980-81 vs. 2013
- Less precise weights in 1980s: ±1.0g vs. ±0.1g
- Inclusion of spawned out fish? Recent poor survival of smaller fish?
1st acoustic images of Columbia River eulachon shoals

- 5-7 Mar 2013
- Tidal freshwater
- Blanketed ~2 km section of river
- Single species, bottom-oriented, well-defined edges, densely packed
- Unique echo signatures

Hull-mounted 38 kHz Simrad split-beam system, 12° beam-width
Run timing & Columbia estuary conditions

- 5-7 Mar: eulachon shoal 1st seen in tidal freshwater near Wauna, OR (rmk 64-66)
- 15 Mar: eulachon enter Cowlitz River (rmk 109)
- Is 6°C a critical estuary minimum temperature trigger for upstream migration? Is it the transition from tide-dominated to flow-dominated temperature?

Temperature data courtesy www.stccmop.org
Columbia River Plume

- NOAA-led work
- Emmett et al. legacy
- At-sea surveys to understand mechanisms governing early marine distribution, growth, & survival of juvenile salmon
Size distribution, Columbia plume

- Emmett et al. 2004, occur w/herring, whitebait smelt, juvenile salmon
- Two size classes = two age classes? two spawning events? two growth conditions?

- 21-22 Jun 2000
- 28 x 12 rope trawl
- 8 mm mesh liner
- 12-24 m depth
- 13 km offshore
- 8-10°C
- > 31 salinity
Seasonal size distribution, Columbia plume

- Emmett et al., unpublished data
- 85% captured in < 100 m, overlap with juvenile salmon & nearshore predators
- Growth into spawner size classes between Apr-Jun? Multiple age classes?

2013 estuary spawners
mean FL = 171.6 mm

- 2003-2011
- Night only
- 28 x 12 rope trawl
- 8 mm mesh liner
- 0-12 m depth
- 7.4-55.6 km offshore
- 12 stations
Filling data gaps for recovery planning

- Bringing existing NWFSC resources into play
- Coordinating work with state, tribal, academic resources

Adult spawner, estuary 2013

Acoustics vessel R/V Magister
Eulachon in Columbia estuary/tidal freshwater

**KNOWN**
- Spawners occupy estuary habitat weeks before peak spawning
- Size distribution of spawners has changed
- Daytime eulachon are bottom-oriented
- Research trawl captures fish w/greater size range, lower mortality (<0.1%), better condition than commercial gear
- Acoustics can map, target, & enumerate spawners
- Spawning run attracts large numbers of predators (e.g. seabirds, pinnipeds, sturgeon)

**UNKNOWN and NEEDED**
- Size-at-age structure of spawners
- Sex ratio of spawners
- Variation in run magnitude, timing
- Direct estimate of spawner biomass
- Mechanisms triggering upriver movement of spawners: temperature, flow, etc.
- Larval density/size/condition/timing at ocean entry w/r/t flow, tides, other estuary conditions (present larval sampling in tidal freshwater, rkm 55-65)
Eulachon in the Columbia plume

KNOWN

- Juveniles, sub-adults, adults definitely present Apr-Jul
- Length-frequencies suggest
  - Critical marine growth Apr-Jun
  - Recruitment to spawner size classes
- Not caught in daytime surface trawls or estuary seines

UNKNOWN and NEEDED

- Variation in size-at-age composition
- Larval, juvenile marine distribution - hydrography
- Marine growth/survival – hydrography, food, predators
- Eulachon function as alternative prey for salmon predators
“Low-hanging fruit” - critical uncertainties we could resolve with high probability of success

• Tidal freshwater & estuary
  • Adult spawning stock biomass, run timing (direct, indirect)
  • Age, size, genetic structure of estuary spawners & larvae
  • Spawning migration timing vs. flow, temperature, other estuary/ocean conditions
  • Ocean entry timing, size, condition for larvae w/r/t temp, flow

• Plume
  • Synthesize/analyze existing ocean eulachon data w/physical & biological ocean ecology data
  • Marine distribution, age, size structure of larvae
  • Juvenile/adult age, size structure
Acoustic spawning stock biomass estimate: a sound investment in recovery planning

- Direct estimate of run timing, biomass in estuary, tidal freshwater
- Ground-truth size, age distribution w/ net sampling
- Proven technique in fisheries management, used in Alaska, Canada***
- Strong conceptual framework from which to launch other studies

***Stables et al. 2005, Sigler et al. 2004
Acknowledgements, questions

NOAA

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WDFW

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Dedicated to the memory of Dr. Robert Emmett

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