Unique characteristics of riverine spawning pygmy whitefish (Prosopium coulterii)

Cedar River Municipal Watershed, Washington, USA

Heidy Barnett and Dwayne Paige
Seattle Public Utilities

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PYGMY WHITEFISH (Prosopium coulterii)

- Occur in deep lakes across North America – remnants of the last Ice Age
- Most often in oligotrophic lakes with temperatures <10°C.
- Max age = 9 yrs (typically less than 5 yrs)
- Mature 2-3 yrs of age
- Lake spawning and riverine spawning known
Eliminated from a minimum of 40% of range in Washington

(From WA State Status Report for the Pygmy Whitefish Hallock and Mongillo, 1998)
Cedar River Municipal Watershed

- Managed to provide drinking water to Seattle and has a 50-year HCP (signed 2000)
  - No commercial harvest, active restoration (forest, aquatic, road decommissioning)
- Natural falls barrier downstream of Chester Morse Lake blocks anadromous/migratory species
Chester Morse Lake Fish Community

- Bull trout
- Rainbow trout
- Pygmy whitefish – food source for adfluvial bull trout
- Shorthead sculpin – food source for bull trout, distributed around shoreline
Project Objectives

• Develop survey for approximating the number of spawners each year
  – Determine location of riverine spawning
  – Determine timing of the spawning run

• PIT tag individual fish to investigate individual characteristics
  – Residence time (♂ vs. ♀)
  – % return after one year
  – Number of yrs individual returns
Pygmy Whitefish Spawning School
Spawning Index Surveys

• Survey river at least twice weekly during spawning season

• Collect data
  – Location of school
  – Estimate of number of fish in each school

• Calculate area-under-curve index for annual spawning estimate (needed residence time)
Between 12,000 to 25,000 spawners

Figure 7.—Area-under-curve calculation using index count surveys of pygmy whitefish present in the Cedar River at the peak of the spawning run, 2001 - 2010. Access to the field site was blocked for much of the pygmy whitefish spawning run during 2003 and 2005.
# Spawning – General Characteristics

<table>
<thead>
<tr>
<th>Year</th>
<th>Date start</th>
<th>Days in run</th>
<th>Temp at initiation (°C)</th>
<th>Avg. Temp during run (°C)</th>
<th>Range of Temp (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>12/8</td>
<td>12</td>
<td>4</td>
<td>3.7</td>
<td>2.9 to 4.2</td>
</tr>
<tr>
<td>2008</td>
<td>12/1</td>
<td>15</td>
<td>2.7</td>
<td>3.0</td>
<td>1.5 to 4.0</td>
</tr>
<tr>
<td>2009</td>
<td>11/30</td>
<td>15</td>
<td>5.7</td>
<td>4.5</td>
<td>2.0 to 5.7</td>
</tr>
<tr>
<td>2010</td>
<td>11/29</td>
<td>10</td>
<td>4.9</td>
<td>3.3</td>
<td>1.6 to 4.9</td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td></td>
<td><strong>13</strong></td>
<td></td>
<td><strong>3.7</strong></td>
<td></td>
</tr>
</tbody>
</table>
Individual Spawning Behavior

• Timing of run – how long does an individual remain in the river (needed for AUC)

• What are sex ratios in schools?

• How many seasons do individuals return to spawn?

.....use PIT tag technology to address these questions.
Capture – Seine schools
Pygmy Whitefish PIT tagging

2006 = 424
2007 = 486
2008 = 580
2009 = 499
2010 = 523

TOTAL
PIT tagged = 2,512
Sex ratios of pygmy whitefish collected from spawning schools in the Cedar and Rex rivers by year, 2007 - 2010.

<table>
<thead>
<tr>
<th>Year</th>
<th>Fish Handled</th>
<th>Percent Female</th>
<th>Percent Male</th>
<th>Number of schools collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>1,803</td>
<td>9.6</td>
<td>90.4</td>
<td>9</td>
</tr>
<tr>
<td>2008</td>
<td>1,595</td>
<td>3.2</td>
<td>96.8</td>
<td>12</td>
</tr>
<tr>
<td>2009</td>
<td>966</td>
<td>3.1</td>
<td>96.9</td>
<td>5</td>
</tr>
<tr>
<td>2010</td>
<td>678</td>
<td>5.8</td>
<td>94.2</td>
<td>5</td>
</tr>
</tbody>
</table>
PIT Tag Antenna array

~1km to Chester Morse Lake
- Allowed us to look at RESIDENCE TIME for an individual

- upstream movement
- downstream movement
- Tagging days
Females vs. Male?

Figure 5.—Mean number of days (+SE) spent in Cedar River by PIT tagged female and male pygmy whitefish, 2007 – 2010 (data from all years combined).
Returning Individuals – 1 year post tagging

Study Average = 30%
Number of Years – Individual Return

Percent of Tagged Returning

Scale analysis = 3 to 4 most common age
Summary

• Developed index to assess spawning population

• Spawning Surveys
  – Within 3 km of lake system
  – Duration = ~2 weeks

• Individual
  – Residence time = 4.5 days
  – Sex ratio heavily skewed toward males
  – Individuals can spawn in at least 5 years
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- Jim Erckmann, (SPU retired)
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