Jun 21st, 4:45 PM - 5:00 PM

Eels I: Monitoring Juvenile American Eel Movements to Inform the Design of Eel Fishways: Location, Location, Location!

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Monitoring Juvenile American Eel Movements to Inform the Design of Eel Fishways - Location, Location, Location!

Fish Passage 2016
University of Massachusetts

June 21, 2016

Jesse Wechsler
Fisheries Scientist
• Refresher - Eel Migration
• Refresher - American Eel Status
• Typical Monitoring Methods at Hydropower Stations
• Typical Upstream Eelway Designs
• Straightforward Post-Installation Monitoring
Migration

American Eel Life Cycle

- Sargasso Sea
- Stages spent in freshwater
- Elver
- Yellow Eel
- Silver Eel
- Glass Eel
- Larva, or "leptocephalus"
- Eggs
Management and Status

- Cultural significance (e.g., Maori longfin - *Nga taonga tuku iho – te tuna*; The eel – *An ancient gift from the gods*).
- Important fishery - sustenance/commercial.
- Depleted stock (ASMFC).
- Protected (endangered) in Ontario.
- Species of concern in the U.S.
  - 2 listing petitions under ESA.
- Downright cute and cuddly.
Management and Status

American Eel Total Commercial Landings and Value

[Graph showing American Eel total commercial landings and value from 1950 to 2013. The graph displays data on landings (in millions of pounds) and ex-vessel value (in millions of dollars).]
Management and Status

- Gold in them eels!
- Steep increase in demand (Asian aquaculture)
- Value $<200\text{ a pound (2010)}$ to $2,600\text{ (2012)}$ back down to $1,450\text{ (2016)}$
- 9,700 pound quota in Maine (2016)
- Also harvested in SC (limited)
Glass Eel Gold

*Animal Planet – Cold River Cash

“Back when it was $30 a pound, nobody was fighting.”
Federal Energy Regulatory Commission may require a dam/hydro owner to:

- perform an American eel passage location study to determine need for eel ways;
- identify the location and design specifications;
- outline a schedule for installing the facility;
- develop an operational and maintenance plan;
- develop a monitoring plan to evaluate effectiveness; and
- work with state, federal, and tribal organizations.
Monitoring at Dams

Visual, nighttime surveys

- Below spillways
- Face of dam
- Bedrock outcrops
- Project structures (gates, rough concrete walls)
- Tailrace areas
- Every nook
- Every cranny

• Gear:
  - Hip boots ($40)
  - Spotlight ($50)
  - Binocs ($75)
  = $165!
Monitoring at Dams

• June-Aug (Maine)
• Typically distinct patterns through migration
• Start with 2x/week
• Often drop to 1x/week or every other week
• Varying operational or river flow conditions; non-spill is very good
• Survey length: 1 to 2 hours
• Approximate counts
• ID primary locations
• Temporary traps to get better sense of numbers
  • Hit or miss
Monitoring at Dams
Monitoring at Dams
### Nighttime Survey Monitoring Results
#### 2015

<table>
<thead>
<tr>
<th>Date</th>
<th>Small water leak near powerhouse</th>
<th>On or near dam between eelway and powerhouse</th>
<th>Near eelway and bedrock island</th>
<th>On or near dam between eelway and river right shore</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 18</td>
<td>100</td>
<td>40</td>
<td>125</td>
<td>195</td>
<td>5</td>
<td>465</td>
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<tr>
<td>July 7</td>
<td>35</td>
<td>15</td>
<td>150</td>
<td>250</td>
<td>0</td>
<td>450</td>
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<tr>
<td>July 13</td>
<td>550</td>
<td>1,750</td>
<td>920</td>
<td>400</td>
<td>0</td>
<td>3,620</td>
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<tr>
<td>July 20</td>
<td>200</td>
<td>200</td>
<td>1,050</td>
<td>350</td>
<td>0</td>
<td>1,800</td>
</tr>
<tr>
<td>July 27</td>
<td>260</td>
<td>80</td>
<td>300</td>
<td>25</td>
<td>150</td>
<td>815</td>
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<tr>
<td>August 5</td>
<td>100</td>
<td>45</td>
<td>115</td>
<td>0</td>
<td>0</td>
<td>260</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,245</strong></td>
<td><strong>2,130</strong></td>
<td><strong>2,660</strong></td>
<td><strong>1,120</strong></td>
<td><strong>155</strong></td>
<td><strong>7,410</strong></td>
</tr>
</tbody>
</table>

- **Small Water Leak**
  - less than 150 mm (6 inches): 4500
  - 150-300 mm (6 to 12 inches): 70

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**Eelway and Bedrock**

- Dam between Eelway and River Right
- Dam between Eelway and Powerhouse
- Small Water Leak
- High Concentration of Eels during July 13 survey
Designing Eelways at Dams

• Facilitate passage up and over
• Location, location, location
• Design, design, design
  – Slope and orientation
  – Substrate
  – Cover
  – Attraction flow
  – Conveyance flow
  – Predators
  – Spill and high flows
  – Access
  – Debris and Maintenance
  – Monitoring
Designing Eelways at Dams

• Primary Options:
  – Ramps: seasonal installation of wooden or aluminum cable tray
  – Permanent concrete flow-through designs
  – Screw-Auger
  – Lifts
INITIAL DESIGN CONSIDERATIONS

• Anecdotal Information About Eel Behavior at the Site
  • Where have eels been seen?
  • Have eels been noted to gather at certain times or under certain flow conditions?
**Design Criteria**

- Location of Entrance - Critical to Success of Passage
  - Near Point of Known Eel Congregation
  - Near Existing Attraction Flow
  - Avoid Areas of High Turbulence

- Location of Exit
  Avoid discharge of eels near hydro intakes
Design Criteria

- Ramp Design
  - Material - Aluminum, Wood, Concrete
  - Custom vs. Off-The-Shelf
  - 2’-0” Width
  - Angle of Incline 45° or Less
  - Cover
SUBSTRATE OPTIONS
**Design Criteria**

- Conveyance Flow
  - Dependant on Substrate Style and Ramp Width (2-10 gallon a minute)
  - Spray Bars and Nozzles
Design Criteria

- Attraction Flow
  - Depends on Hydraulic Conditions at Entrance (up to 250 gpm)
  - Considerations For Sites With Large Fluctuations in Water Level
**DESIGN CRITERIA**

- High Flows and Debris
  - Robust Design of Ramps and Supports
  - Removable
  - Hinged
  - Sacrificial
- Red Lighting for Night Time Observation
- Predation
MONITORING AND TESTING

- Raw counts over time
- Biological information (length and weight data)
- Video monitoring
- Simple ladder efficiency tests – compare what goes in to what comes out
- Time to successful passage
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