Timing the Spring Run: Using Acoustic Telemetry to Characterize Spawning Movements of Rainbow Smelt (*Osmerus mordax*) in the Penobscot River, Maine

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Introduction:

- Rainbow smelt are an anadromous fish of local interest due to their **ecological role** [1] and their **cultural role** [8] supporting recreational fisheries and indigenous traditions.
- In 2004 NOAA listed Rainbow smelt as a **species of concern** in the Gulf of Maine [5].
- Most of rainbow smelt life-history understanding comes from broader Gulf of Maine studies, however, there is little information on the Penobscot River in Maine, one of the largest river systems in their range [3].

Research Objective:

Characterize rainbow smelt movements and residency times in the Penobscot River, Maine

Research Questions:

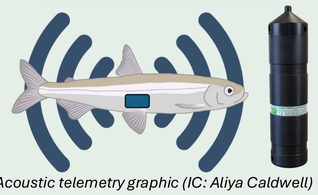
1. How long are rainbow smelt spending in each section of the river system (tributary vs. main stem vs. estuary)?
2. How many tributaries were visited and how often were they visited?
3. Do rainbow smelt movements correspond to water temperatures or tides?

Methods:

- In April and May of 2025 rainbow smelt were tagged with Innovasea V6-69kHz acoustic tags.
- Rainbow smelt (18 females and 32 males = 50 total) were tagged over the course of three different weeks:

  Early run: **April 7-11** (n= 6)
  April 29-May 3 (n= 5)
  Late run: **May 11-16** (n= 39)
- Fish were released at the site of capture and tracked through July 23rd, 2025.

Sasha Milsky tagging rainbow smelt



Acoustic telemetry graphic (IC: Aliya Caldwell)

Study Site and Residency:

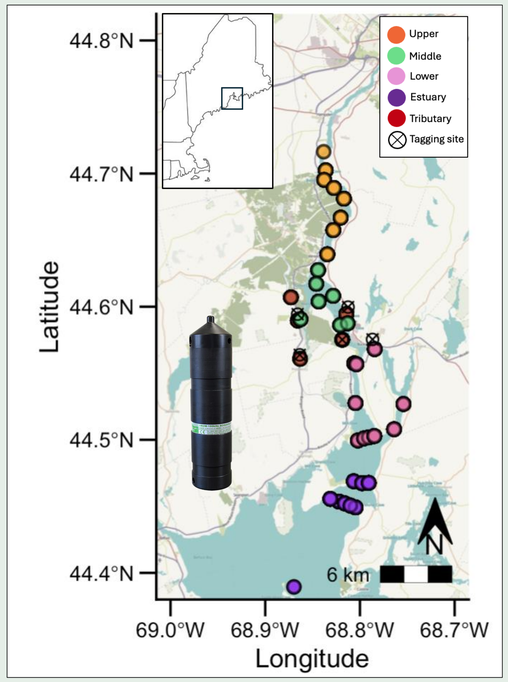


Figure 1: Zoom in on the lower Penobscot acoustic receivers (n=39) and tagging locations (n=5).

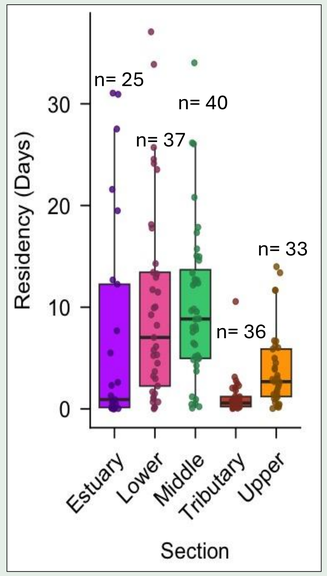


Figure 2: Boxplot with points for each individual fish depicting the amount of time in days a fish was in each section (Figure 1).

Spawning Over Multiple Nights Across Tributaries:

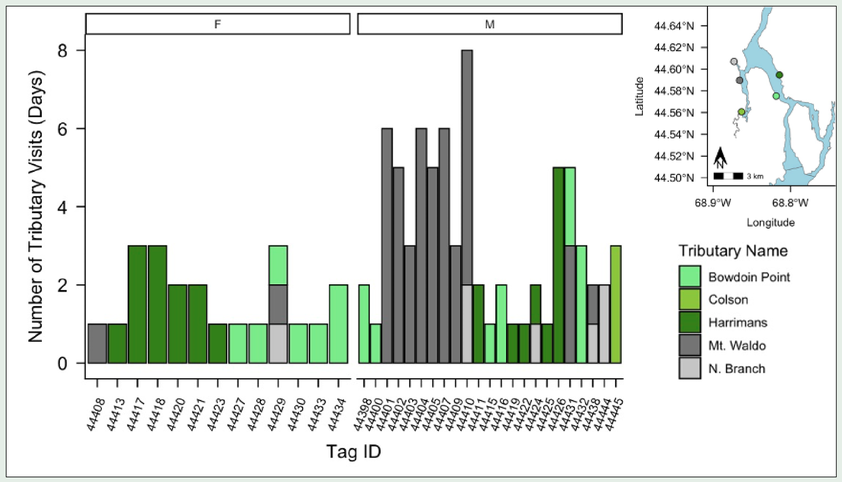


Figure 3: Bar graph representing how often individual fish visited shallow tributaries. Individual fish are separated by sex and bars are color coded by location. The height of the bar corresponds to the number of days a fish visited tributaries post-tagging.

Temperature and Tides:

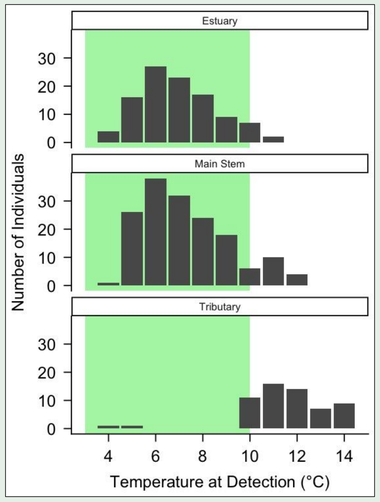


Figure 4: Number of individuals detected at each temperature (°C) for different sections of the river system. Green shading represents optimal spawning temperatures [1] (3-10°C).

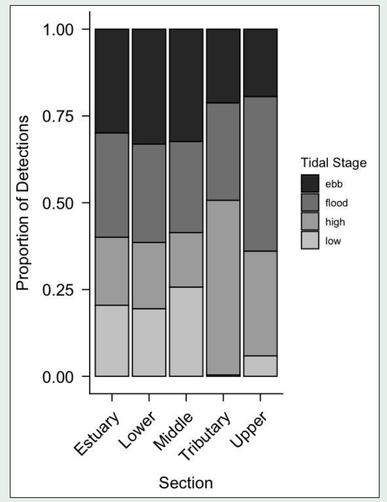


Figure 5: The proportion of total detections in each section at each tidal stage.

Conclusions:

- Rainbow smelt may be using river system for **more than spawning** (1-8 days in spawning habitat but detected 3 weeks; Fig. 2) [7].
- There is **more than one pulse** of rainbow smelt entering spawning grounds [2] and **tributary usage varied by individual and location** (Fig. 3).
- **High tides** and water **temperatures in the estuary and main stem** likely drive the timing of rainbow smelt movements into tributaries to spawn [1,3,7] (Figs. 4 and 5).

Further Research:

- Complete a second field season this spring 2026!
- Relate habitat usage in the Lower Penobscot to mercury concentration of rainbow smelt analyzed by the Penobscot Nation

Acknowledgements:

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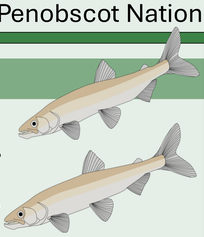

Thank You!
Questions?

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