Pairing Environmental DNA with Acoustic Monitoring of River Herring and Other Anadromous Fish in the Penobscot River

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Environmental DNA

Environmental DNA: Genetic material left behind by organisms in their environment

- As a recently developed tool, questions remain about how these methods work and what they can be used for
- Existing monitoring frameworks in the Penobscot River offered an opportunity to ask questions about how eDNA tools function in a restoration context

Goals

Goal: Evaluate the role that eDNA tools can play in restoration monitoring

- Does the measured amount of river herring DNA accurately reflect migration timing?
- How many different fish species can we detect?
- Does the total amount of fish DNA in the water reflect total fish biomass or density?

Methods

- eDNA samples collected at 8 points along the lower estuary
  - Along with salinity and temperature data
- Measured the concentration of river herring DNA in each sample
- Sequenced DNA to determine breadth of fish species detected

Justin Stevens collecting an eDNA sample from the surface of the river

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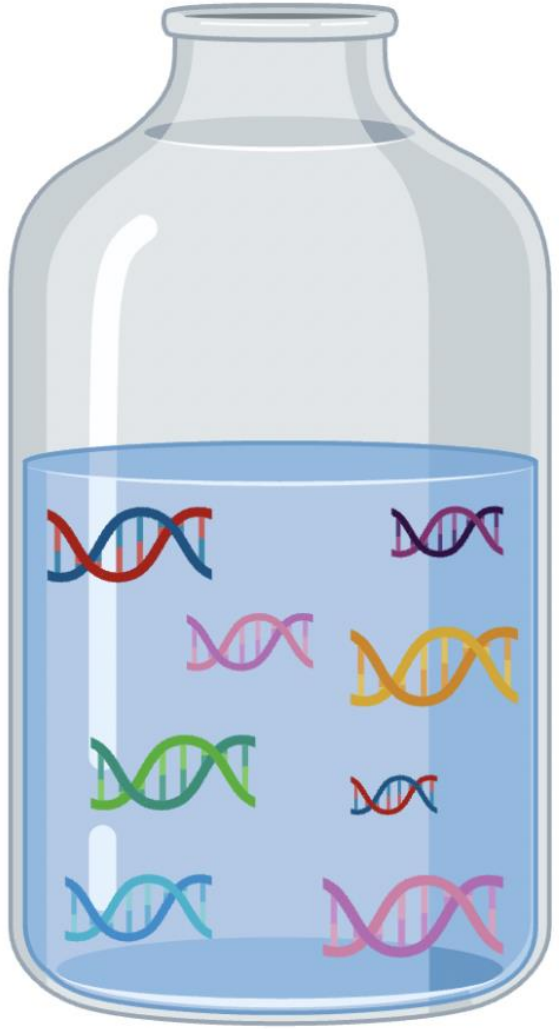
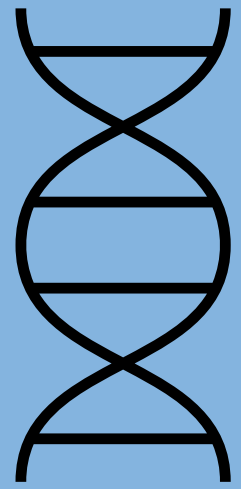
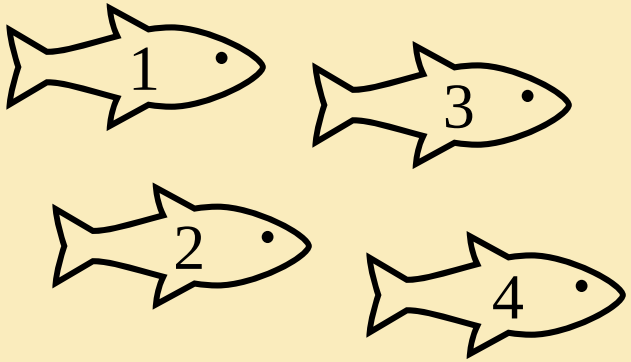


Methods



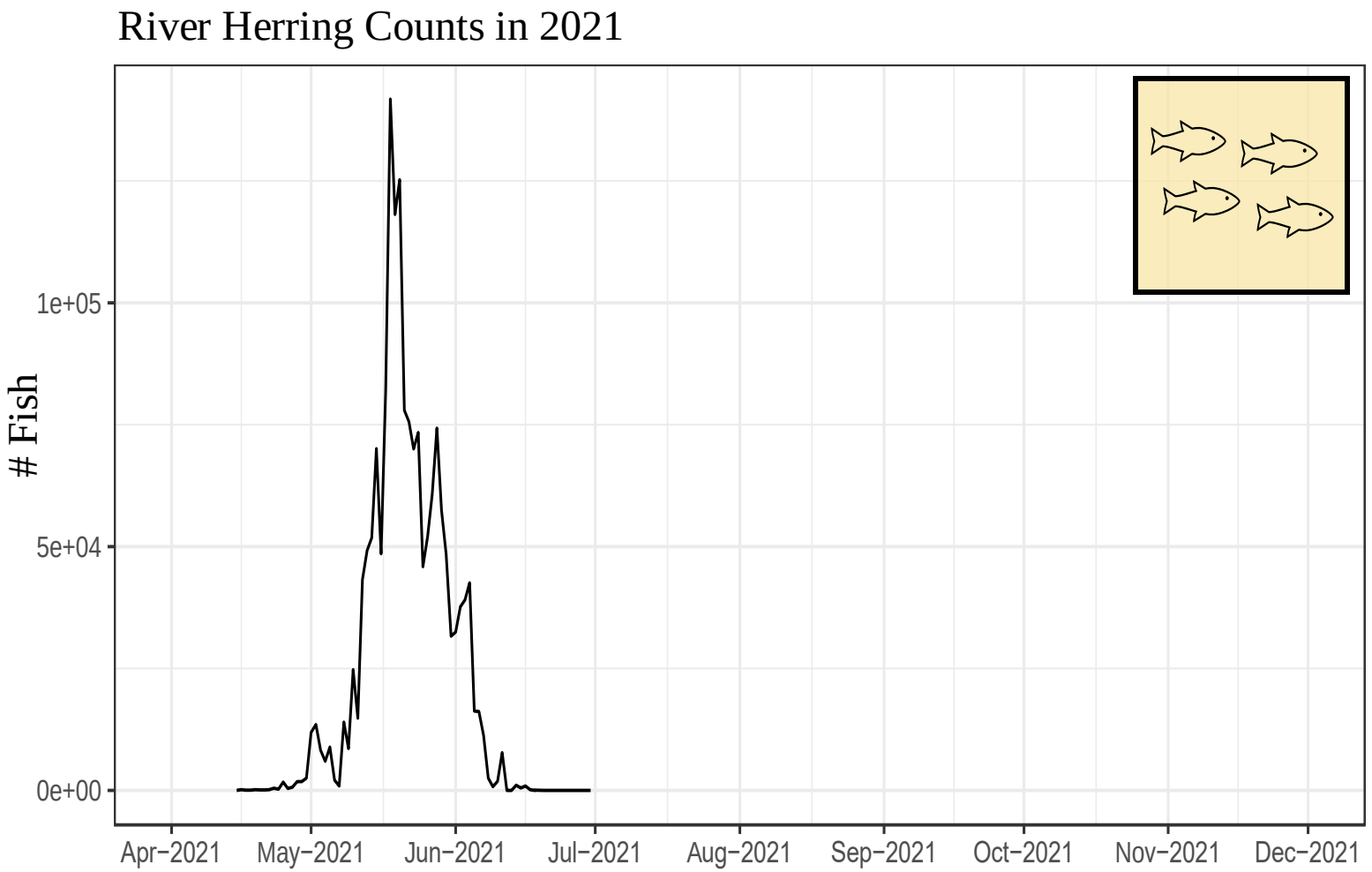
Environmental DNA



Fish Counts from Milford Dam

Hydroacoustics

River Herring Counts vs eDNA Concentration



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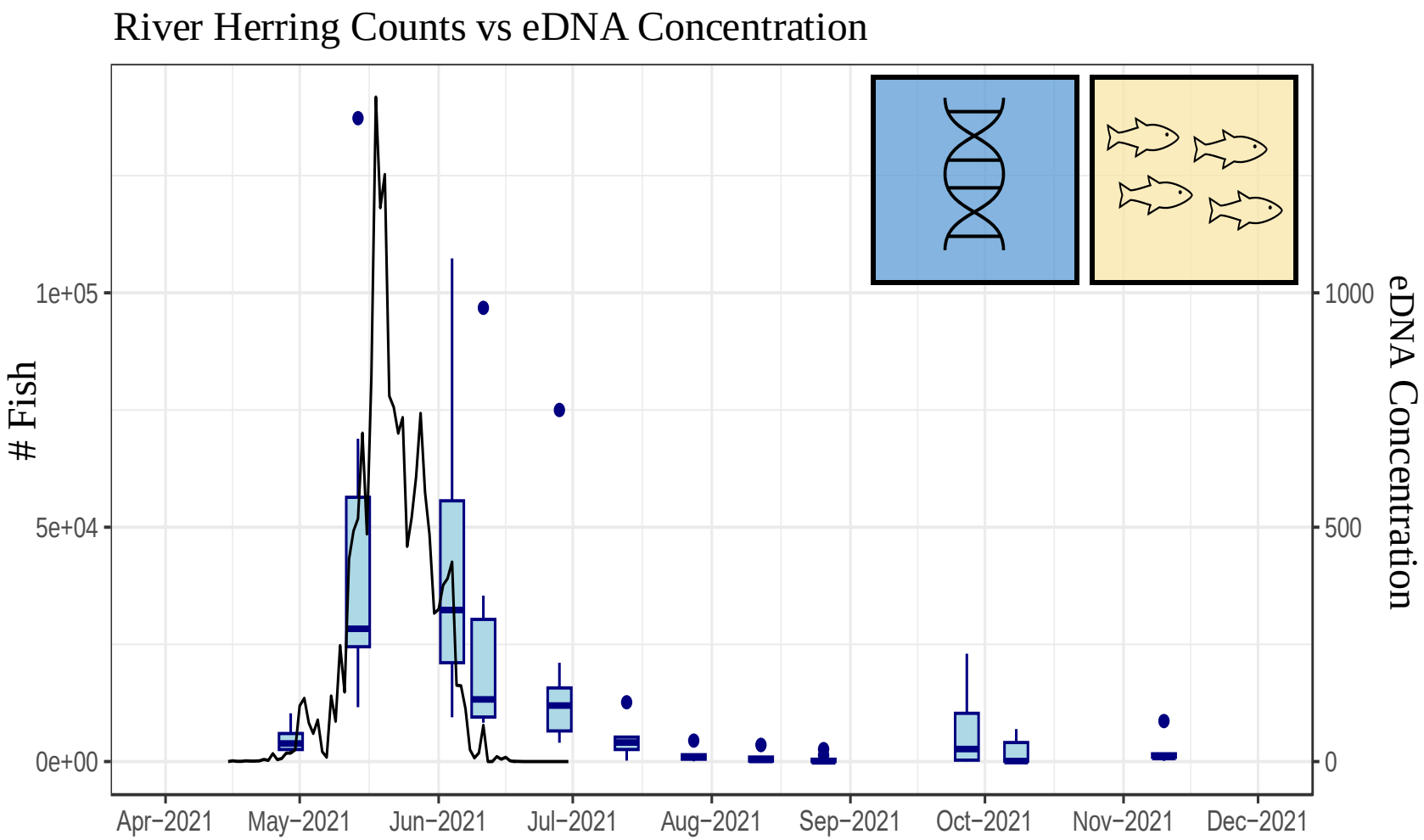
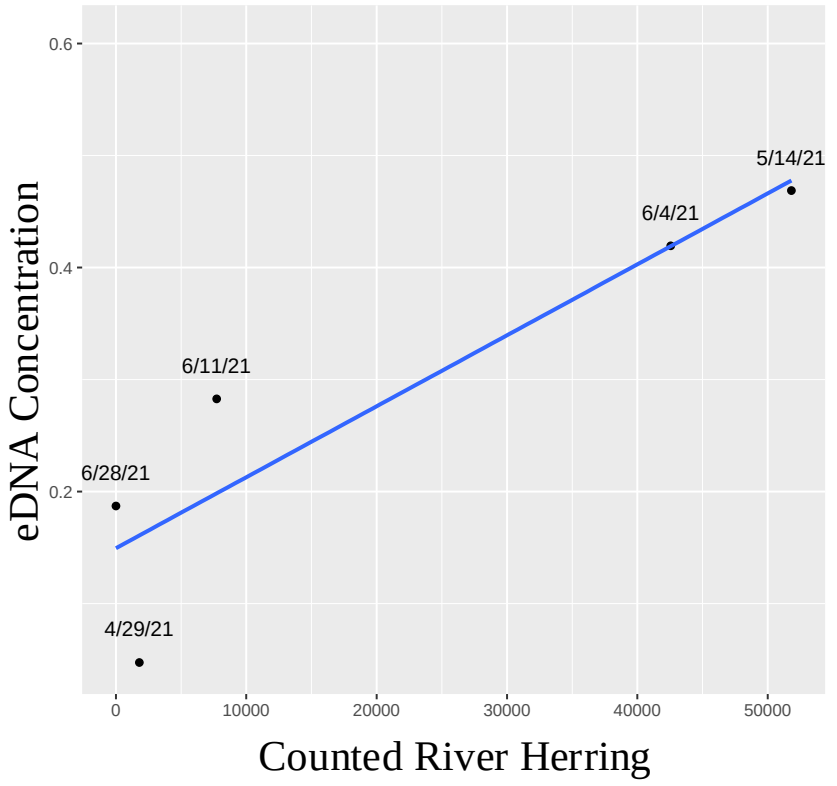




Applications for River Herring

- Enable run monitoring in systems without passage or traditional monitoring infrastructure
- Expand monitoring reach to places and times other tools may not capture
- Track recolonization of newly opened habitat

Community-Wide Assessment

- eDNA sampling detected ~40 different fish species in one year
  - Including all diadromous species known to inhabit the Penobscot

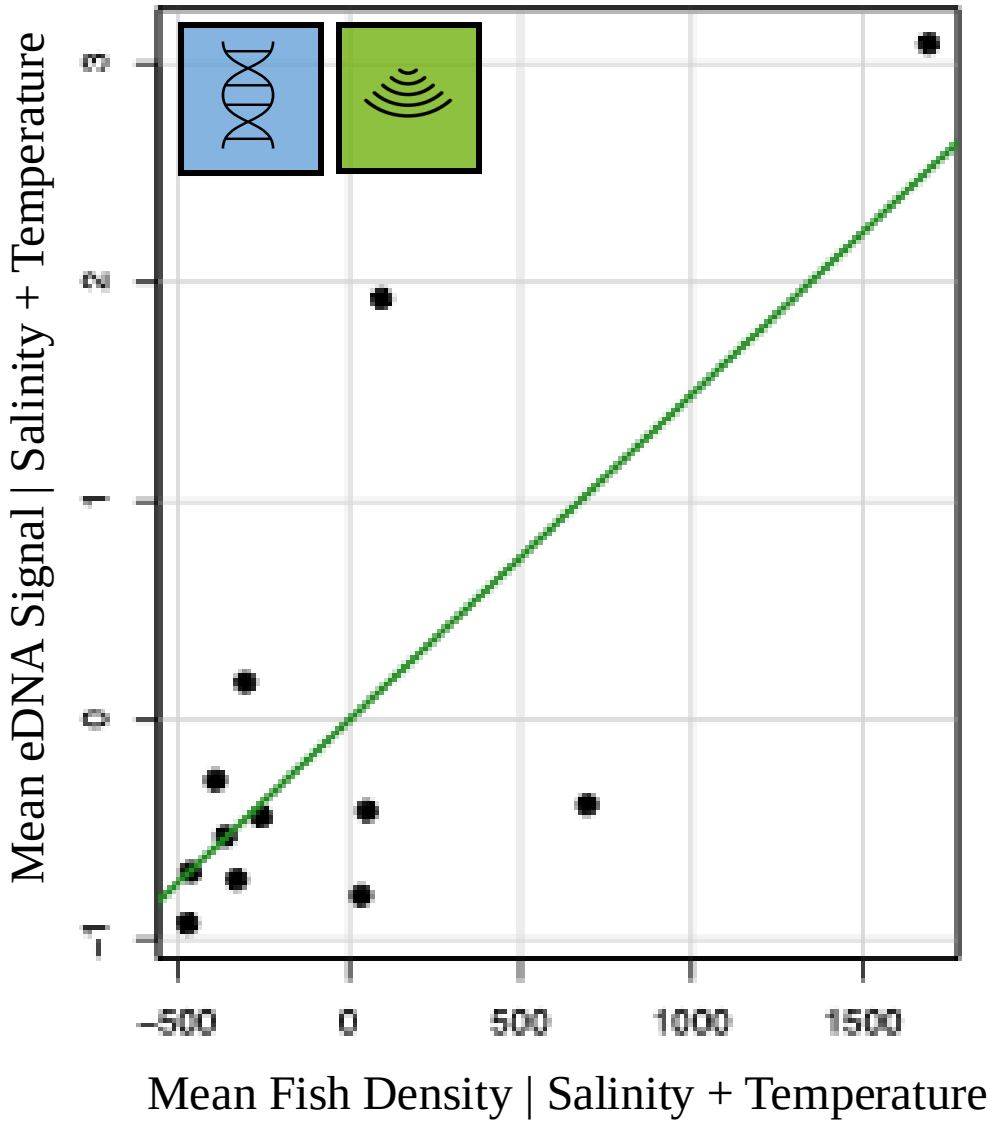
Top 5 Species Detected

Rank	Common Name	Percent of Total Reads
1	Atlantic Tomcod	23.99%
2	Atlantic Menhaden	16.36%
3	Blueback Herring	9.97%
4	Alewife	8.69%
5	American Shad	7.05%

Community-Wide Assessment

Does eDNA signal reflect fish density in the estuary?

- Positive relationship between acoustic fish density and eDNA proxy for fish signal
  - Averaged across each survey
  - Accounting for salinity and temperature



Applications for Fish Communities

- The ability to detect a wide range of fish species may be useful for pre-restoration assessment and long-term monitoring
- eDNA data can provide a useful perspective on the taxonomic composition of the fish community that compliments insights from other methods (e.g., total biomass)
- Can help understand changes in biomass if other methods are unavailable

Challenges and Remaining Questions

- eDNA data does not provide information on fish size, age, health, etc.
  - Cannot distinguish between juvenile and adult migrations if they overlap
- eDNA tools may be biased for or against certain species
- System-specific characteristics (e.g., flow dynamics) can impact how these tools function
- Our sampling was likely insufficient for determining fine scale fish movements
  - May need a high number of samples and replication

Acknowledgements

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Data Support

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Thank you!

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