

Pairing environmental DNA with acoustic monitoring of anadromous fish in the Penobscot River, Maine



Julia Clem¹, Justin Stevens², Kristina Cammen^{1,4}, Michael Kinnison^{3,4}

¹School of Marine Sciences, University of Maine, Orono, ME

²Maine Sea Grant, Orono, ME

³School of Biology and Ecology, University of Maine, Orono, ME

⁴Maine Center for Genetics in the Environment, University of Maine, Orono, ME



Introduction

Environmental DNA

Environmental DNA (eDNA) is genetic material that is left behind by organisms in their environment

- eDNA sampling can potentially reduce the impact of research on organisms and increase sampling capacity
- Validating eDNA tools against other methods can be done to evaluate the strengths and limitations of eDNA sampling for a particular research aim

Anadromous Fish Monitoring

- For anadromous fish in the Penobscot River, hydroacoustics and trap counts have been used to understand changes in the fish community and to monitor annual migrations in the aftermath of recent restoration efforts
- eDNA tools have the potential to expand these efforts and mediate their biases and limitations

The objectives of this study are to

Evaluate the ability of eDNA tools to capture:

- Spatiotemporal variation in community composition
- Spatiotemporal variation in river herring abundance and distribution

Methods

- eDNA water sampling was integrated into a long-term hydroacoustic survey of the Penobscot River estuary
 - Vertebrate community composition was characterized using 12S rRNA metabarcoding
 - The concentration of river herring eDNA in each sample was measured using quantitative PCR

eDNA data were compared to acoustic data and trap counts to evaluate the utility of eDNA for characterizing fish assemblages and assessing the ecological impacts of restoration efforts

Results

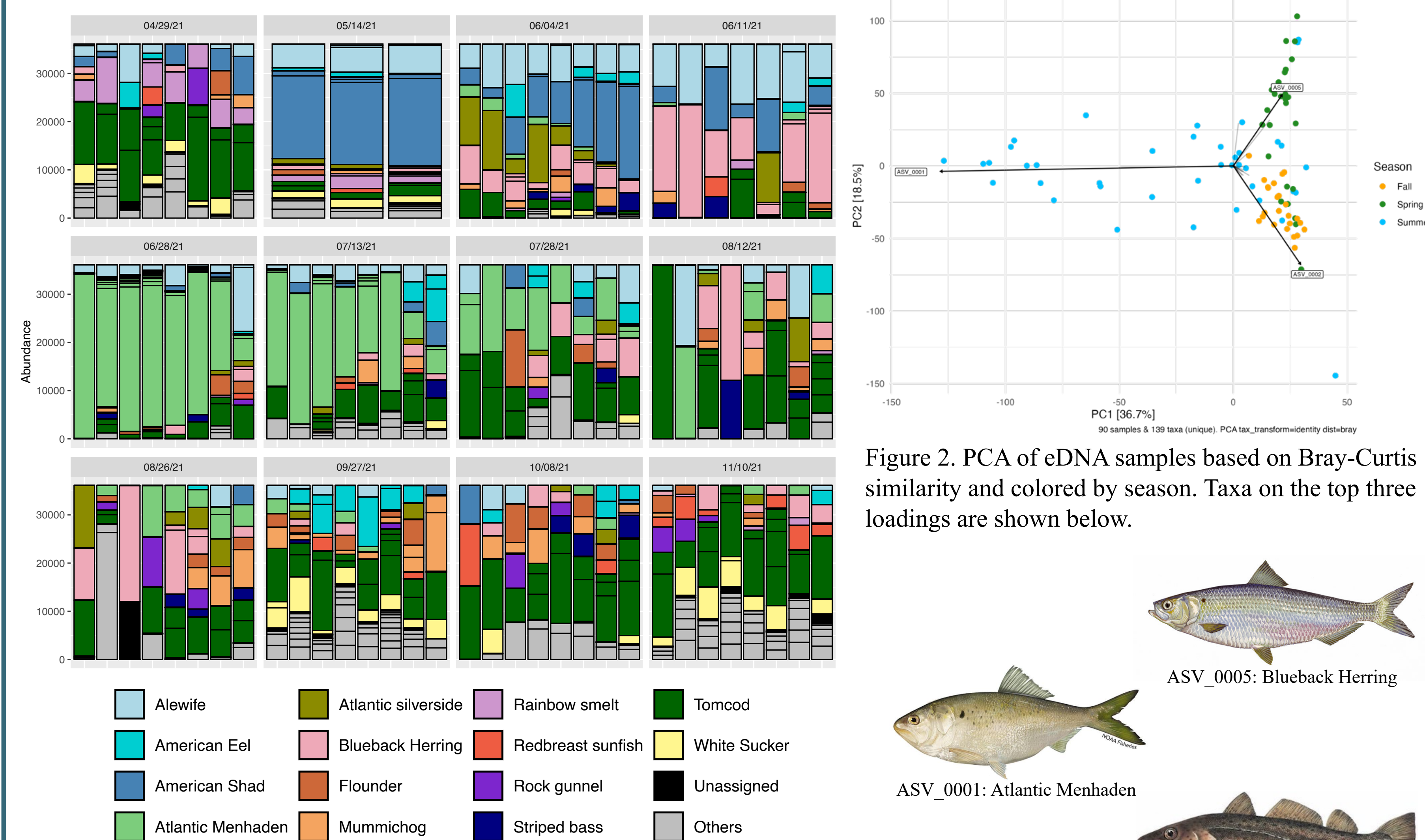


Figure 1. Taxonomic composition of eDNA water samples, organized by survey. Within a survey, bars are arranged downstream to upstream when moving from left to right.

Results Cont.

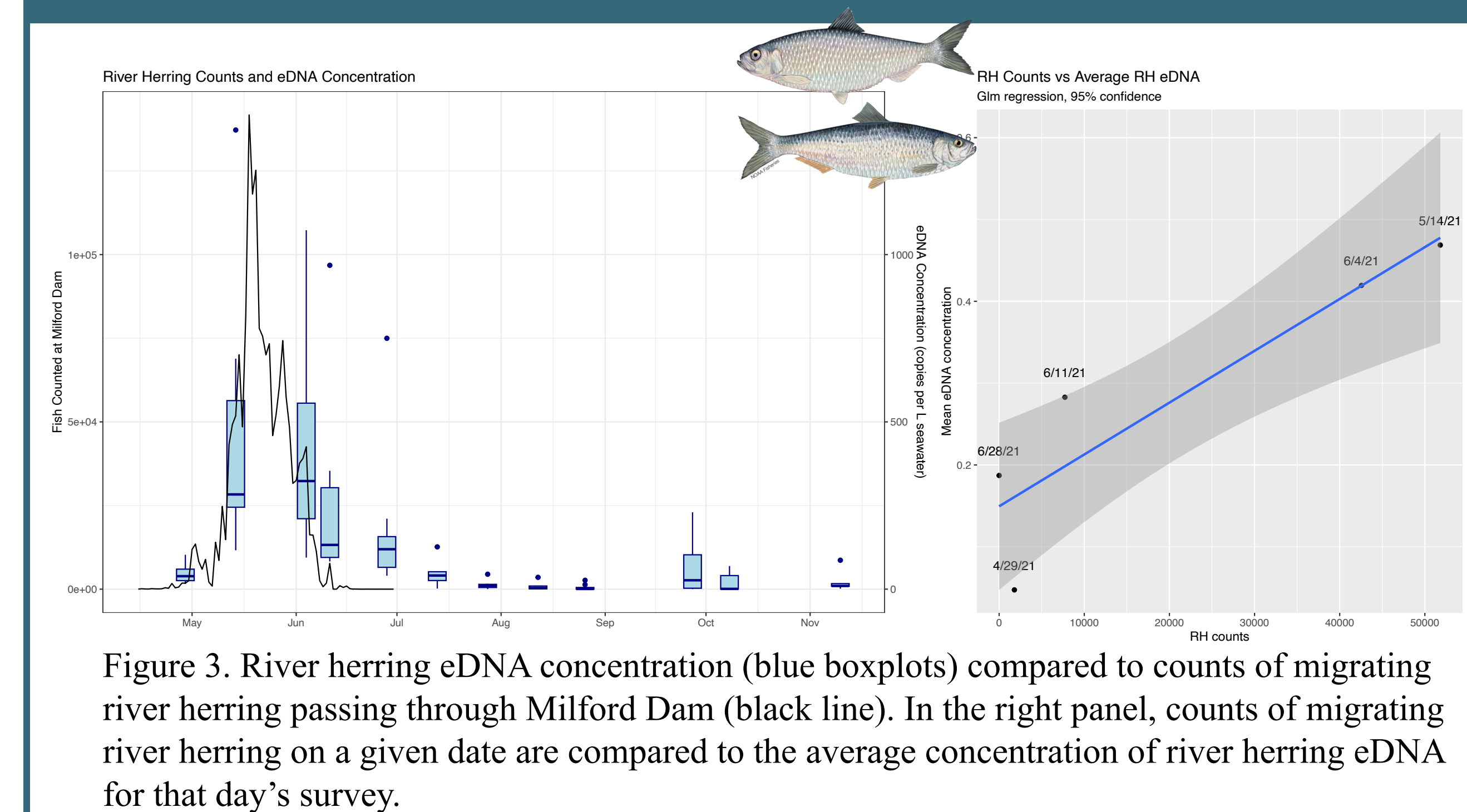


Figure 3. River herring eDNA concentration (blue boxplots) compared to counts of migrating river herring passing through Milford Dam (black line). In the right panel, counts of migrating river herring on a given date are compared to the average concentration of river herring eDNA for that day's survey.

Conclusions

- eDNA sampling detected a wide range of fish, including each of the anadromous species known to inhabit the estuary
- Fish community composition varied seasonally, with anadromous species driving differentiation in the spring and fall
- eDNA concentration for river herring spiked in alignment with the timing of the spring spawning migration
- eDNA metabarcoding provided insights into the taxonomic composition of the total fish biomass measured by hydroacoustics
- Using all three methods together provides a more holistic view of the estuary and insights into the strengths and limitations of each tool

Acknowledgements

Funding was provided by the Maine Outdoor Heritage Fund. Fish counts were provided by Maine DMR. Continued support for the acoustic survey was provided by NOAA and Maine Sea Grant. Graduate stipend was provided by Maine-eDNA (NSF #1849227) and Maine Sea Grant.

