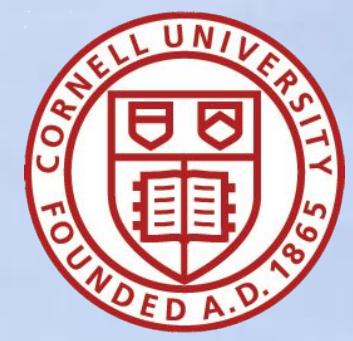


Soundscapes of the Hudson River Estuary: NERRS Science Collaboration for Bioacoustics Research, Management, and Education

Aaron N. Rice¹, Chris H. Bowser⁵, Maija L Niemistö⁵, Rebecca Cohen², Alexander S. Flecker², Patrick J. Baker³, Suresh A. Sethi⁴



The Cornell Lab
of Ornithology

¹K. Lisa Yang Center for Conservation Bioacoustics, Cornell Lab of Ornithology, Cornell University, Ithaca, NY, ²Department of Ecology and Evolutionary Biology, Cornell University, Ithaca, NY, ³Department of Geography & Environmental Engineering, U.S. Military Academy, West Point, NY, ⁴Department of Natural Resources and the Environment, Cornell University, Ithaca, NY, ⁵New York State Department of Environmental Conservation, Norrie Point Environmental Center, Staatsburg, NY



Collaborative Research

The Hudson River National Estuarine Research Reserve (HRNERR) has diverse stakeholders and critical fisheries management goals. Passive acoustic monitoring in aquatic habitats engage key and inform fisheries management. Our ecological acoustic surveys cover key habitats in all four HRNERR component sites to understand the seasonal and spatial use patterns by important fish species. This technology offers unique sensory engagement using underwater sounds with students and the public. This project helps establish acoustic technology as a strategic tool for estuarine habitat monitoring, outreach, and engagement in the Hudson River.



Project Objectives

- Record and characterize soundscapes using passive acoustic monitoring in the Hudson River Estuary.
- Develop a reference library of underwater sounds with field and captive recordings of fish.
- Increase temporal and spatial understanding of important managed species in Hudson River Estuary, including Atlantic Sturgeon, Shortnose Sturgeon, River Herring, Freshwater Drum, Striped Bass.



Education and Outreach

- Education and community engagement opportunities with student researchers collecting and analyzing their own biological acoustic data.
- Education modules and experiences for local high school and college students.
- Soundscape exhibit for members of the public and school groups visiting the Norrie Point Environmental Center.
- New audiences reached through increased online accessibility of acoustic library and river soundscape experiences.
- Connection to other National Estuarine Research Reserves interested in biological acoustic monitoring.



Hudson River and Ecological Acoustics

- Hudson River Estuary is a diverse continuum of habitats in New York State extending from the Atlantic Ocean to the Federal Dam in Troy.
- HRNERR consists of four discrete component sites ranging from brackish to freshwater tidal habitats.
- There is a wide diversity of fishes in HRNERR sites, including marine, brackish, and freshwater species.
- There are many anthropogenic sounds, including vessels, cars, and trains near the river that may impact fish habitats.
- Passive acoustic research helps to establish this technology as a central strategic approach for aquatic habitat management and public engagement in the Hudson River Estuary.

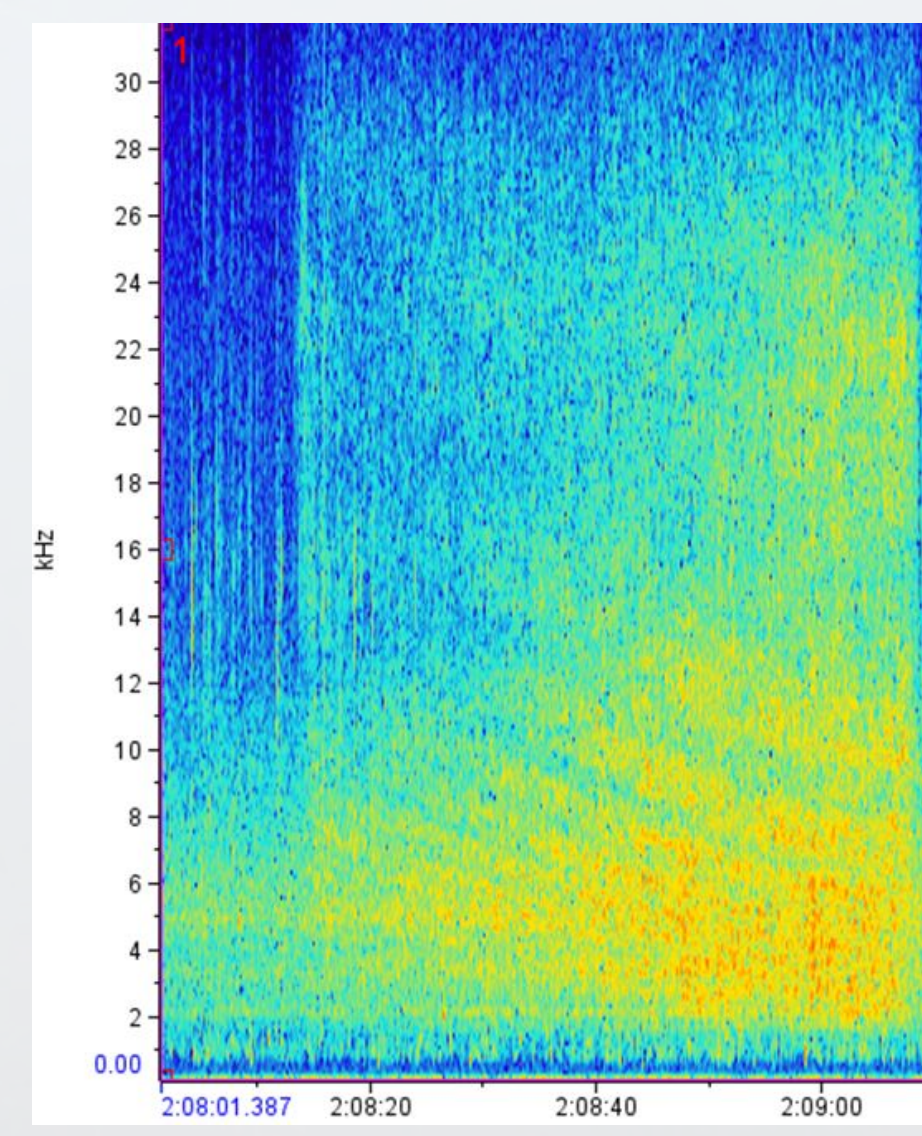


Figure 1 (above): Spectrogram of anthropogenic noise (powerboat) recorded on the Hudson River Estuary.

Figure 2 (below): Scan QR the code to hear a recording of researcher Maija Niemistö describing the array of acoustic recorders deployed in the Hudson River Estuary.



Listen and Look

Passive aquatic biological acoustic recordings can be visualized by looking at spectrograms (below) or by listening to selected sound clips from field recordings.

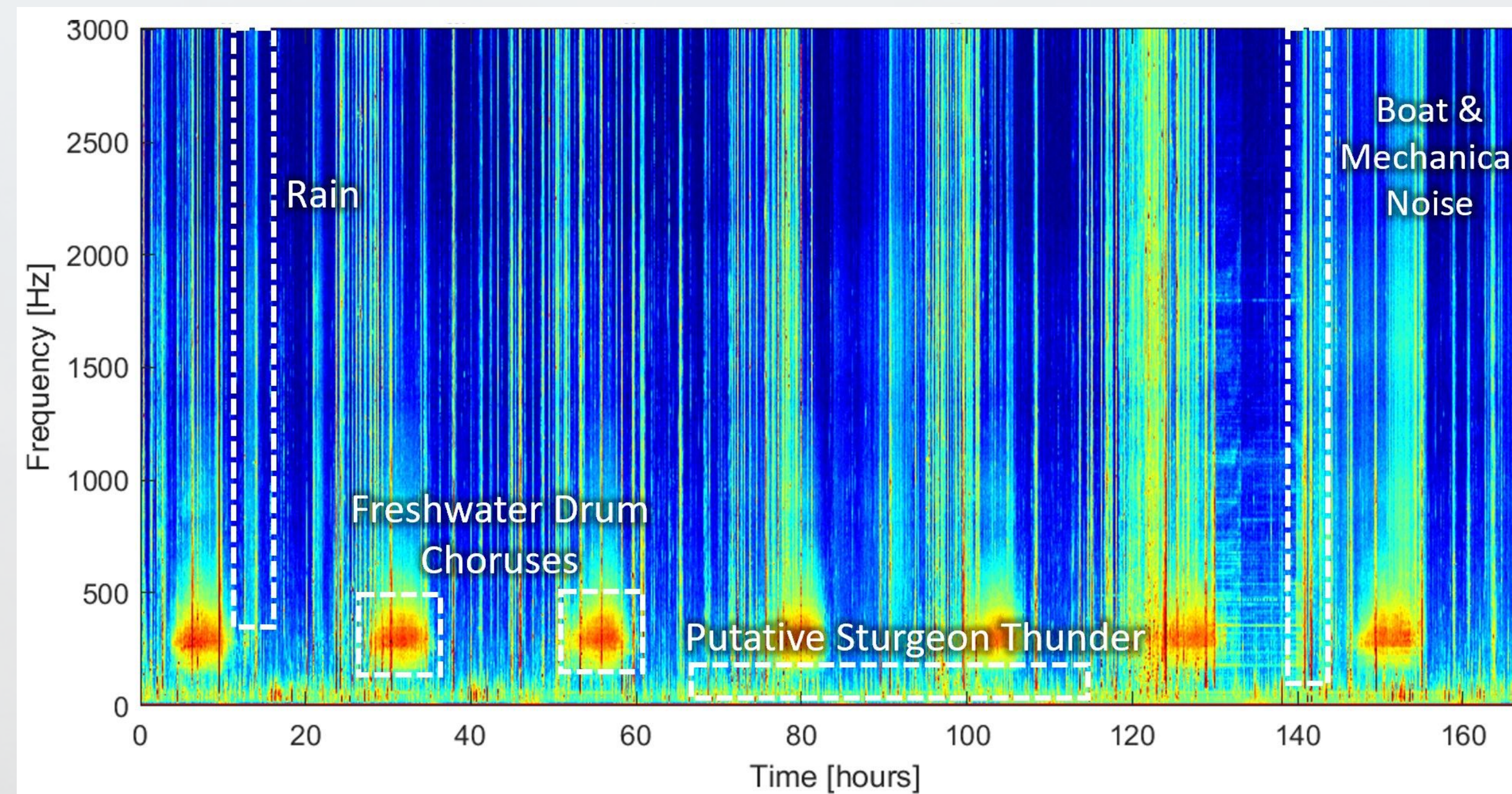
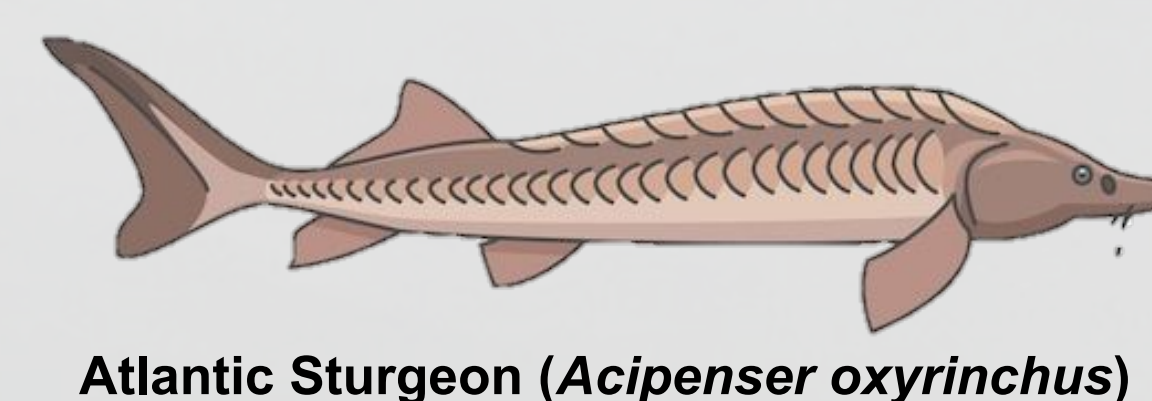


Figure 3 (above): Spectrogram of rain falling, chorusing Freshwater Drum, Atlantic Sturgeon thunder, and mechanical boat noises in Hudson River Estuary.

Figure 4 (right): Scan the QR code to hear a recording from the Hudson River Estuary featuring researcher Rebecca Cohen, who describes the sound of sturgeon thunder.



Atlantic Sturgeon (*Acipenser oxyrinchus*)



Field Recordings

Recorders are deployed at HRNERR Component sites and other locations.

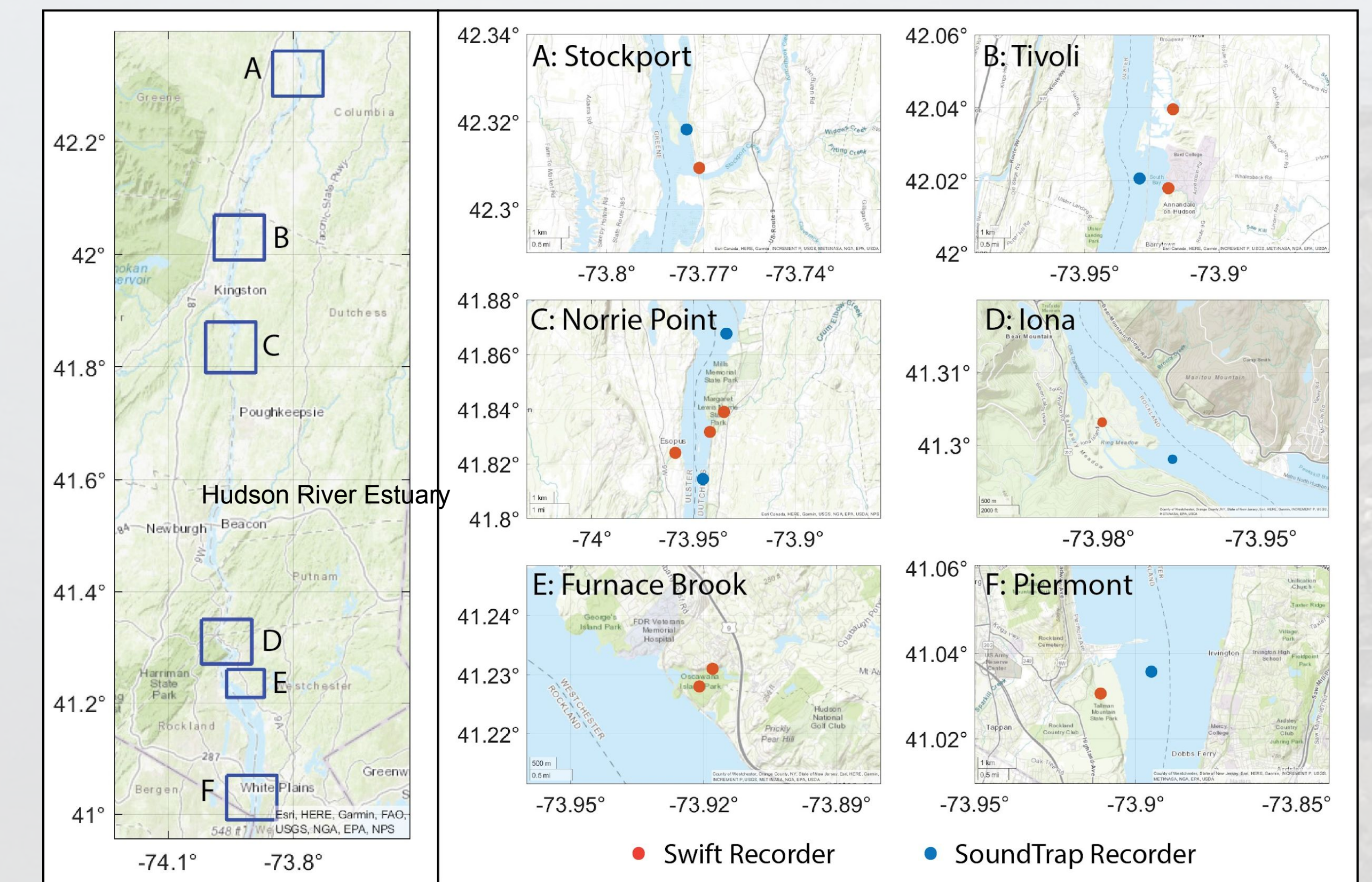
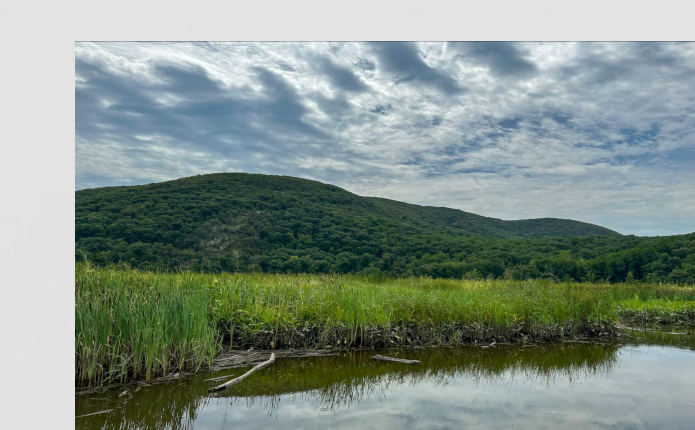


Figure 5 (above): Map of hydrophone recording locations for NERRS Collaborative Grant funded 2022-2024 project.

Figure 6 (right): Scan the QR code to hear a sound collage of recordings from above and below the waters of the Hudson River Estuary.



Funding

Support provided by the NERRS Science Collaborative (Award NA19NOS4190058) and the New York State Water Resources Institute at Cornell University.

References

Bain, M. B. 1997. Atlantic and shortnose sturgeons of the Hudson River: common and divergent life history attributes. *Environmental Biology of Fishes* 48:347-358.
 Carlsson, D. M., R. A. Daniels, J. J. Wright. 2016. *Atlas of Inland Fishes of New York*. The New York State Education Department, Albany, NY.
 Flecker, A. S., P. B. McIntyre, J. W. Moore, J. T. Anderson, B. W. Taylor, R. O. Hall. 2010. Migratory fishes as material and process subsidies in riverine ecosystems. *American Fisheries Society Symposium* 73:559-592.
 Higgs, D. M., R. K. Beach. 2021. Ecosoacoustic monitoring of lake sturgeon (*Acipenser fulvescens*) spawning and its relation to anthropogenic noise. *Journal of Applied Ichthyology* 37:816-825.
 New York State Department of Environmental Conservation (NYSDEC). 2019. Hudson River National Estuarine Research Reserve Management Plan. Albany, NY.
 Rountree, R. A., F. Juanes. 2017. Potential of passive acoustic recording for monitoring invasive species: freshwater drum invasion of the Hudson River via the New York canal system. *Biological Invasions* 19:2075-2088.
 Waldman, J. R. 2006. The diadromous fish fauna of the Hudson River: Life histories, conservation concerns, and research avenues. Pages 171-188 in *The Hudson River Estuary* (J. Levinton, and J. R. Waldman, eds.). Cambridge University Press, Cambridge, U.K.

Contact Info

bioacoustics.cornell.edu

arice@cornell.edu, aflecker@cornell.edu, patrick.baker@westpoint.edu, suresh.sethi@cornell.edu,
majia.niemisto@dec.ny.gov, chris.bowser@dec.ny.gov, oka22@cornell.edu