Soundscapes and Seascapes

New research examines the use of passive acoustic monitoring and genetic testing to determine the connectivity of Gulf of Maine marine habitats

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Meet Marine Biologist Grant Milne

Crustacean Consternation
UNH researchers have documented the first-ever pair of mated blue crabs in Great Bay Estuary, with potentially serious impacts on the ecosystem.

Pearl of Hope
UNH researchers have collected new data that will aid oyster restoration in New Hampshire's Great Bay Estuary and support ongoing efforts to understand the
For the past two summers, marine biology doctoral student Grant Milne spent several days a week off the coasts of New Castle, N.H., and Fort Foster, Maine collecting sound and water samples. Donning scuba gear, deploying hydrophones (underwater microphones) and carrying water sampling containers, Milne recorded the soundscapes via a methodology.
called *Passive Acoustic Monitoring*, or PAM, in three habitat types to better understand the connectivity of these potentially at-risk Gulf of Maine areas—as well as investigate how natural or human change would impact their soundscapes. Milne’s research and research like it occurring at the **UNH College of Life Sciences and Agriculture** (COLSA) represent an emerging, non-destructive approach to studying natural environments and conservation ecology—by comparing soundscapes and genetic makeup, and tracking them over time, to assess anthropogenic impacts and other causes of environmental change.

“The ability to assess the acoustic environment through minimally invasive monitoring techniques is valuable for managing marine ecosystems, particularly in terms of the impacts of human-caused noise,” described Milne. “Additionally, observation of biological and acoustic connectivity between habitats is valuable for assessing indirect impacts to surrounding habitats’ soundscapes, especially when the soundscape of one habitat experiences natural or human caused change.”

Recently, Milne published findings of his research in an issue of *Oceanography*. Milne, who served as the lead author on the paper, is a student in the lab of **Bonnie Brown**, professor and chair of the department of biological sciences, and **Jennifer Miksis-Olds**, director of the **UNH Center for Acoustics Research and Education**. Milne has pursued his interest in **metagenomics**—the study of genetic materials found within a sample taken from the environment—in **Brown’s Ecological Genetics Lab**.

“My study looked at three particular coastal marine habitats: common eelgrass (*Zostera marina*) in soft seabeds made up of sand and mud, macroalgae colonies located on hard seabeds made up of gravel beds and boulders, and soft seabeds without eelgrass,” said Milne. “My colleagues and I would visit our
sampling sites a few times per week, then take our samples back to the lab to categorize and sequence them.”

In the acoustics research lab of Miksis-Olds, Milne analyzed the sounds using a “Soundscape Code” developed by co-author Dylan Wilford ’21G. The code helped compare the soundscapes of different habitats and geographic regions and allowed the scientists to determine whether there are significant relationships or differences among the soundscapes of the three habitats.

“Grant's work is progressive in that the combination of acoustics and genomics provides more information about the environment together than either sensing method does alone,” explained Miksis-Olds. “PAM only provides information on animals or sources generating sound (silent animals or sources go undetected). With genomic information, it is possible to learn
about what animals are present in an ecosystem but silent.”

In Brown’s ecological genetics lab, Milne isolated organic matter found in the water samples and sequenced the DNA to determine which plants and animals were present. To do this, he used a method called *metabarcoding seawater samples* (MSS), which amplifies and then sequences the genetic material from various organisms found in a single sample of seawater and compares the DNA to a database to determine from which organisms the DNA was derived.

“Metagenomics allows us to detect living members of communities without actually capturing the species—instead
using microbes, poo or sloughed cells left behind by transient species, or whole or parts of organisms that washed into the water from the land, for example,” said Brown. “Grant’s work to combine MSS with PAM is pushing the envelope of non-destructive environmental sampling.”

“This project initially interested me for the work involving ecological genetics, which I studied as an undergraduate,” added Milne. “However, during this research, I also grew to appreciate the power of acoustics as a tool for monitoring and managing ecosystems and continue to realize the research opportunities in this field.”

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You can read the published article, Evaluating Connectivity of Coastal Marine Habitats in the Gulf of Maine by Integrating Passive Acoustics and Metabarcoding, in Oceanography.

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