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2024 RIOS Projects

Shellfish Ecology and Pathology

Understanding dynamic seascape ecology through the movements of whales

Atlantic Surfclam dynamics in southern end of their range

Optimizing ribbed mussel aquaculture techniques

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Shellfish Ecology and Pathology

David Bushek, Haskin Shellfish Research Laboratory

Shellfish are important components of coastal ecosystems and economies. They create habitat, protect shorelines, filter water and support fisheries and aquaculture. Major challenges to their persistence include climate change, sea level rise, habitat loss, overfishing and disease. My lab investigates how shellfish respond to these challenges and what can be done to enhance their populations for their ecological value while developing sustainable fisheries and aquaculture.

Multiple opportunities are available for RIOS students to participate in ongoing projects investigating shellfisheries, shellfish aquaculture, living shorelines and the ecology of selected shellfish diseases. Interns would experience daily life at a research station as they gain experience in both field and laboratory investigations. A 2024 RIOS intern would likely focus on climate change impacts with respect to shellfish population dynamics, temporal and spatial patterns of shellfish pathogens, or assist with developing and evaluating living shoreline strategies that incorporate shellfish such as oysters or mussels. Increasing temperatures and sea level rise are changing host-parasite interactions and the latitudinal ranges in which they interact. Understanding how these interactions are changing and will continue to change is important to both our fundamental understanding of shellfish ecology and how to manage and protect shellfish resources into the future.

Understanding dynamic seascape ecology through the movements of whales

Josh Kohut
Rutgers Center for Ocean Observing Leadership

On the continental shelf off New Jersey the ocean is characterized by remarkable variability across time scales from days to seasons to decades. This drives an equally variable ecosystem from primary producers to highly migratory marine mammals. With offshore wind construction scheduled to begin within the next couple years, it is critical that decision making consider the coupled oceanographic and ecological dynamics. Our team has collected decades of data from satellites (e.g. surface temperature, surface chlorophyll), high-frequency radar (surface currents), and gliders (e.g. sub-surface temperature). More recent eco-glider deployments have been equipped with passive acoustic whale monitoring systems, providing whale detections that can be associated with concurrent measurements of surrounding environmental features. These data, with additional concurrent marine mammal and ocean observatory data, offer an unprecedented opportunity to explore the overlap between oceanographic features and the distribution of these animals.

A RIOS student working on this project will explore these data to better understand the dynamic habitat of marine mammals in the coastal waters of the Mid-Atlantic Bight. This region has a range of water masses that interact and evolve throughout each season. Focusing on the available data gathered through our ocean observatory, a student working on this project will associate ocean features to overlapping marine mammal detection data from visual surveys and our fleet of eco-gliders. To do this, they will learn about the local oceanography and ecology and apply data tools to analyze and visualize their results.

Atlantic Surfclam dynamics in southern end of their range

Sarah Borsetti
Haskin Shellfish Research Laboratory

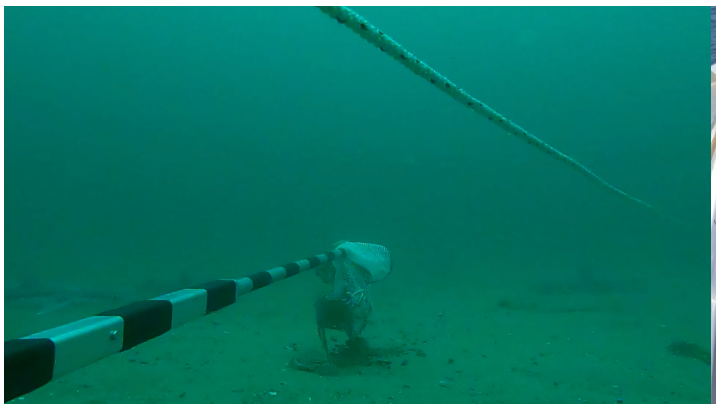
The Atlantic surfclam is a widely distributed clam species from the Gulf of St. Lawrence, Canada, to North Carolina, USA. Despite this wide range, the surfclam distribution's center has been shifting northward and into deeper, cooler waters. Until recently, the surfclam fishery had not fished for surfclams on the southern edge of the range due to low population numbers resulting from mortalities in the 1990s. Catches of surfclams off Virginia in the past few years have raised the question of whether the surfclam population has recovered in the region or if a single large cohort survived to support those catches. Surfclams in the southern region are at relatively high densities and show reduced size compared to those in the northern areas. It remains to be seen why the size distribution and densities of surfclams in the regions differ. These differences could be attributed to warmer bottom water temperatures, genetics, intraspecific competition (density dependence), or some combination of these factors. This project aims to better understand the population dynamics of surfclams, which have re-emerged in the southern range of the stock. Environmental data and biological data describing the genetic structure, size and age demographics, and density impacts on surfclam growth in the southern region will be analyzed to evaluate if these factors impact the surfclam population's structure in the southern end of its range.

For more information on on-going research:
https://rowlrs.marine.rutgers.edu/research/orsted/ocean-wind-1-fisheries-monitoring-plan/surfclam-survey/

Optimizing ribbed mussel aquaculture techniques

Michael Acquafredda & Sean Towers
Haskin Shellfish Research Laboratory and the Aquaculture Innovation Center

Ribbed mussels (*Geukensia demissa*) are ecologically important bivalve molluscs, which are crucial for the healthy functioning of the salt marsh ecosystems that fringe the US East Coast. Ribbed mussels are gregarious, generally inhabit intertidal zones, and form strong associations with marsh cordgrass (Spartina sp). Together with cordgrass, ribbed mussels stabilize shorelines and protect coastal areas from erosion. Ribbed mussels are also highly effective filter feeders, capable of clearing water of fine particles and bacteria, which improves water quality in estuarine ecosystems. For these reasons, ribbed mussels are in high demand for a breadth of ecological engineering projects, including bacterial remediation, ecosystem stabilization, and coastal resiliency. Ribbed mussels can be incorporated into living shoreline installations, which can protect coastal communities from sea level rise, erosion, and storm surge. Ribbed mussels can also be deployed near wastewater treatment plants and contaminated sites to improve water quality, especially in urban areas. However, ribbed mussel aquaculture techniques are challenging and unreliable. Many key aspects of ribbed mussel husbandry, including broodstock conditioning and larviculture, remain poorly understood. The aim of this project is to improve hatchery-based ribbed mussel husbandry techniques and develop methodologies that could be scaled for commercial mussel production. The student intern will learn bivalve husbandry techniques and conduct their research at the Aquaculture Innovation Center, one of the largest public aquaculture facilities in the Northeast. This project will occur within the framework of an ongoing multi-institution effort known as the Ribbed Mussel Aquaculture Collaborative (RMAC). This project will primarily consist of wet lab work, with some field work also occurring.




Advancing survey methodology for evaluating the impacts of windfarm construction on fisheries resources

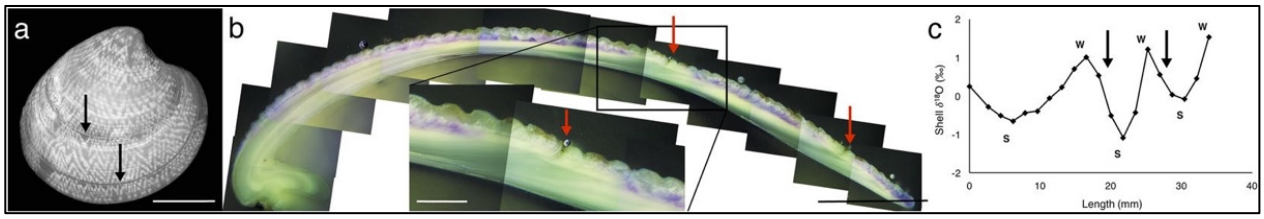
Douglas Zemeckis & Jason Morson
Haskin Shellfish Research Laboratory

Rapid development of offshore wind is occurring off the northeast U.S. in response to demands for renewable energy. It is critical that we evaluate the impacts of this development on marine resources and ecosystems. We are currently pilot testing methods for evaluating how windfarm construction will impact fisheries resources that associate with different forms of structured habitats (e.g., shipwrecks, reefs, and wind turbines). Baited Remoted Underwater Video (BRUVs) is a non-extractive approach to sampling aquatic organisms that is gaining popularity because it is minimally invasive and can be inexpensive relative to more traditional survey gear. Ideally, when video samples are clear and of high enough quality, fish and shellfish can be identified and counted using machine learning. However, since this sampling gear has not been used in this region previously, there are no annotation libraries with which to build automated detection algorithms. Using video collected over the last two years, this project will assist with building automated detection software suited to the species assemblage off the coast of the northeast US. Results from this project will aid in our understanding of this surveying method and the utility for evaluating the impacts of windfarm development on fisheries resources.

The physics of Estuaries and salt water intrusion

Bob Chant
Department of Marine and Coastal Sciences

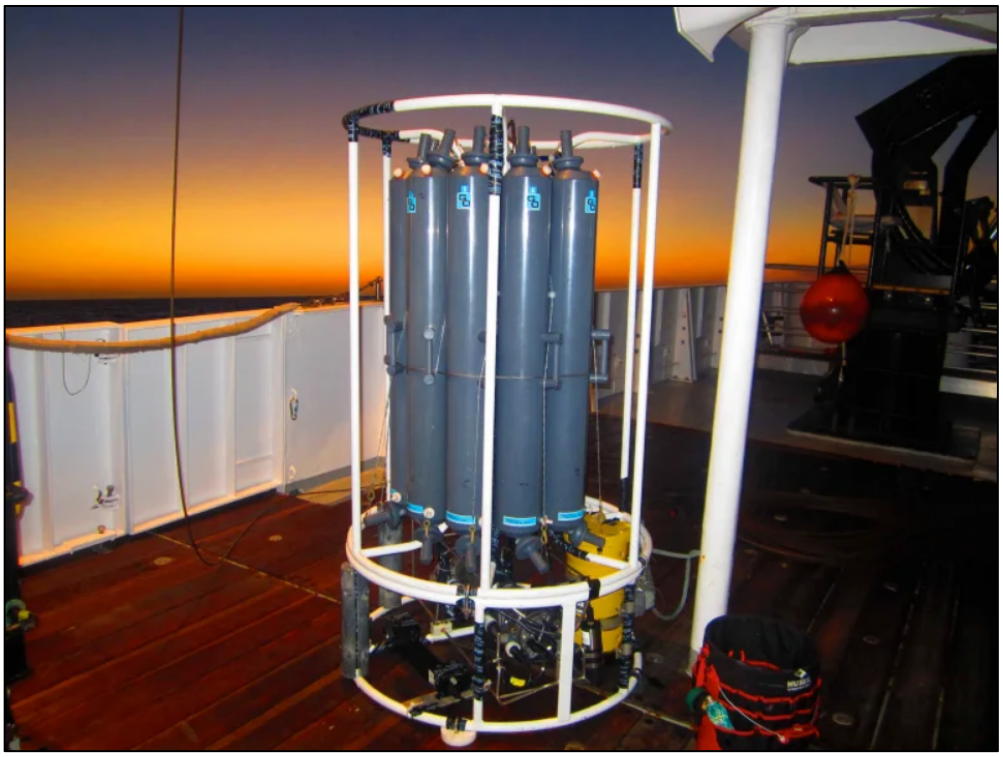
Processes that control salt intrusion in estuaries is both a fundamental problem in fluid mechanics and an important socioeconomic issue. Fluid dynamical processes that drive salt flux in estuary can be traced back to classical problems in shear dispersion first studied by Sir G I Taylor and the pioneering observational work by Donald Pritchard both done in the 1950's. Among the important society implication of the limit of salt intrusion are the availability of fresh water for drinking as well as agricultural and industrial needs. Models of estuarine circulation can be used to predict how salt water intrusion will be influenced by climate change due to changes in River discharge associated with changing precipitation patterns and increased water depth due to sea-level rise. In a number of recently funded projects my group is using theory, models and observations to better understand the processes that drive the estuarine circulation that ultimately controls the salinity intrusion in estuarine systems. Working with my group in the summer of 2024 you will have the opportunity to analyze moored and shipboard current meter and salinity/temperature data and numerical model output from several local estuaries to quantify processes that drive circulation and salt flux. You will also relate these results to estuarine circulation theory that will form the basis of discussions throughout the summer. You will also have the opportunity to participate in field programs and operate our underway rapid CTD profiling system shown in use by graduate student Cody Benton above.



Atlantic Surfclams as recorders of extreme thermal events

Travis Miles & Fiorella Prada
Department of Marine and Coastal Sciences

The Mid Atlantic Bight is experiencing rapid climate change with warming surface and bottom temperatures. This heavily urbanized coastline is also experiencing significant anthropogenic development as a leading region to meet the national goals of over 30 GW of offshore wind by 2030. Sclerochronology (the study of accretionary hard parts for e.g., in corals and bivalves) has emerged as a useful tool for developing paleoclimate reconstructions, similar to dendrochronology (the study of tree-rings), to establish a biological chronology for that organism. The physical and chemical variations along that biological chronology may record the environmental conditions, such as temperature, when that layer was formed and thus has come to be known as sclerochemistry. Bivalve shells typically form layers as they grow and thus contain a record of the environment. Long-lived bivalves have been used to build reconstructions of temperature, pollution, climate patterns, upwelling and other parameters on interannual to centennial time scales, but also on seasonal cycles and intra-annual climate variability. In this project, the intern will combine data from a networked ocean observing system with in situ surf lam shell samples to evaluate long term trends and extreme events in ocean temperatures in the Mid Atlantic Bight. Surfclams are highly sensitive to environmental changes and maintain a record of stressor events through their growth rings: often a semi-completed ring may appear in the growth record as an indicator of a particularly stressful event such as abnormally warm bottom temperatures. By identifying historical events that may not have been identified based on available data, paired model simulations may be able to aid in recognition of early Cold Pool breakdown years, or analogously warm events such as marine heat waves. Based on interests, this project could include work with autonomous underwater vehicles, remote sensing, laboratory analysis of surf clams, numerical models, and artificial intelligence techniques.



Seawater Hydrogen and Oxygen isotope measurements

Kat Dawson
Department of Environmental Sciences

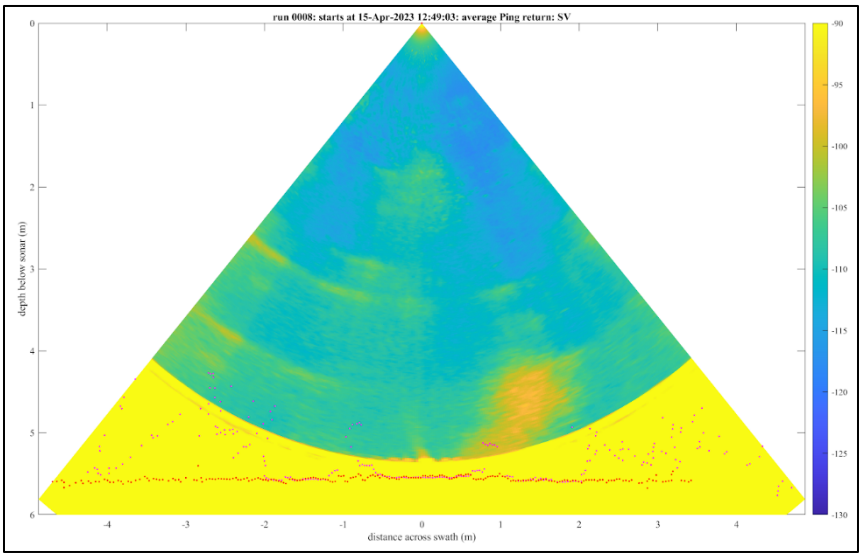
The oxygen and hydrogen atoms that make up the water molecule can reveal information about the sources and physical environmental parameters that have affected a pool of water. This can allow us to differentiate between cold polar and warm equatorial water currents, as well as to observe the mixing of the two. In this project, we will examine and compares water samples collected in New England and Maritime Canada with samples collected in the Gulf of Mexico near Louisiana. We will construct profiles of the variation in oxygen and hydrogen isotopes with depth and along transects from these two cruises. The student will learn how to use a water isotope analyzer, process data, and build profiles with the Ocean Data View software.

Summer Stress and the Atlantic Surfclam: Effects of Low Oxygen and High Temperature

Laura Steeves & Daphne Munroe
Haskin Shellfish Research Lab

The Atlantic surfclam (*Spisula solidissima*) is a widely distributed clam species, found from the Gulf of St. Lawrence, Canada to North Carolina, USA. In 2021 the surfclam was the largest commercial clam fishery in the USA by weight; however, the habitat of this economically important species is being impacted by changing marine conditions. Marine shellfish are susceptible to environmental stressors, including warming ocean temperatures and low dissolved oxygen concentrations (hypoxia). Often, during warm summer months, these two stressors may occur concurrently. Ocean temperatures are rising along the Atlantic coast of North America at a rate higher than that of the global average, and these warming temperatures are a likely cause of shifting surfclam distribution both northward and into deeper, cooler waters. Additionally, prolonged hypoxic events have been linked to historic mass mortality events, or in shorter duration may reduce growth rates. Although the effects of temperature and oxygen stress have been studied in the surfclam, it is important to consider the combined effects of these stressors as they occur simultaneously in natural habitats.

The goal of this project is to use laboratory experiments with surfclams to better understand the impacts of combined low oxygen concentrations and high summer temperatures on surfclam physiology, growth, and survival. From the results of this project, we hope to contribute to our understanding of how environmental stress may impact the growth, survival, and distribution of this species.



Detecting and visualizing hydrothermal plumes using water-column acoustic backscatter data

Karen Bemis
Department of Marine and Coastal Science

Detecting and visualizing hydrothermal plumes using water-column acoustic backscatter data is the subject of ongoing research of a team of scientists from the University of Washington's Applied Physics Lab, the University of New Hampshire, and Rutgers. Spring 2023 we conducted a tank test of how sonar signals correlate with water temperature at a discharge point for both stationary and moving sonars. Previous work centered on a stationary sonar deployed at Axial Seamount off the coast of Oregon. Current work focuses on processing sonar data using Matlab or Python and collating the tank experiment results.

A RIOS student could work on projects that continue work on processing tank experiment sonar data, apply various visualization and image analysis techniques, or analyze related thermistor data. The project connects with investigations of many aspects of seafloor hydrothermal discharge.