

RUTGERS

2021 RIOS REU Projects



Project Titles:

1. Caribbean Sea Ocean Processes During Hurricanes from Autonomous Underwater Robots
2. Shellfish Ecology and Pathology
3. Characterization of Hydrothermal Discharge Regimes
4. Investigation of Small Volcanic Eruption Mechanisms
5. Plumes at the Ocean-glacier Interface
6. How the Ocean Exhales: Examining Climate Change Controls from the Southern Ocean
7. Genetics of Bivalve Molluscs
8. The Impact of Ocean Acidification on Phytoplankton Host-virus Interactions
9. Impacts of Scallop Fishing Gear on Bycatch
10. Ecosystem Services Provided by Shellfish Farms
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1. Caribbean Sea Ocean Processes During Hurricanes from Autonomous Underwater Robots

[Travis Miles](#)

Landfalling hurricanes result in the greatest amount of deaths and economic losses of all US national disasters ([read more](#)). Communities in the Caribbean Sea are particularly vulnerable to rapidly intensifying and powerful storms supported by warm ocean temperatures. While significant improvements in forecasting storm track have been made over the past few decades, hurricane intensity forecast errors remain large. The ocean represents the heat engine that provides energy to these storms and in coastal regions can lead to significant uncertainty in storm intensity.



In this project we will use data from underwater robots to investigate processes in the ocean ahead of and during hurricanes to better understand the ocean's impact on storm intensity. For the intern this will include data investigation of previous and newly deployed ocean robot data, comparisons of these data with ocean models, and preparation, deployment, and recovery of ocean glider systems alongside personnel of the Center for Ocean Observing Leadership (COOL).

2. Shellfish Ecology and Pathology

[Dr. David Bushek](#)

[Haskin Shellfish Research Laboratory](#)

Shellfish are important components of coastal ecosystems and coastal economies. They create habitat, protect shorelines, filter water, and support fisheries and aquaculture. They are challenged by climate change, sea level rise, habitat loss, disease, and overfishing. My lab investigates how shellfish respond to these challenges and what can be done to enhance shellfish populations for their ecological value while developing sustainable fisheries and aquaculture. Multiple opportunities are available for RIOS interns to participate in ongoing projects investigating shellfisheries, shellfish propagation and 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.



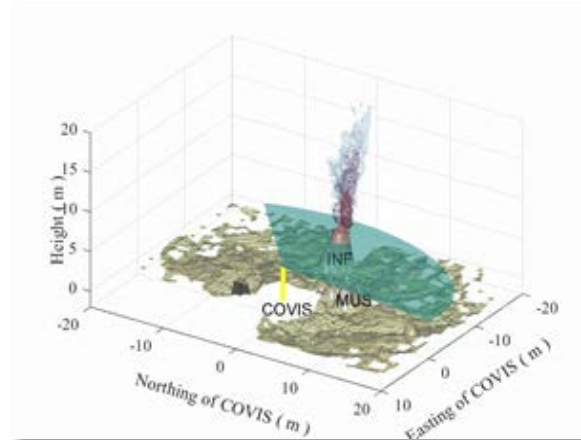
For 2021, two projects that may involve a RIOS intern are (1) the seasonality of dermo disease in Delaware Bay oysters in response to freshwater discharge management from reservoirs, and (2) evaluating the performance of different living shoreline structures designed to recruit shellfish while protecting the marshes behind them.

3. Characterization of Hydrothermal Discharge Regimes

[Karen Bemis](#)

[Rutgers Vizlab](#)

A team of scientists from Rutgers and UW have developed an acoustic imaging method (using the sonar system COVIS) to detect hydrothermal discharge, quantify volume or areal fluxes, and estimate heat contents. COVIS is currently deployed in the [caldera of Axial Volcano off the west coast of North America](#). Related work uses in situ measurements (video, temperature, flow) to establish baseline and ground truth estimates of discharge area and heat transfer by hydrothermal fluids for selected regions.

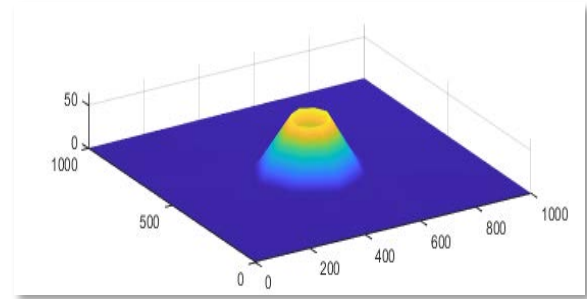


Intern projects could focus on several areas: a) **Collation and analysis of in situ temperature data.** This project would involve collecting all the temperature measurement data, merging it with navigation data, and analyzing it for spatial and temporal gradients and fluxes. Data sets include ROV Jason temperature probe data from two field seasons and autonomous 1D vertical array data from several short and long term deployments. b) **Production of photo-maps.** This would include compilation and selection of relevant video data from two field seasons, merging ROV navigation with the video, and production of photo-maps. Several smaller sites are of critical interest. Projects could include image analysis for areal extent of diffuse discharge. Building the photo maps could focus on geologic mapping, use traditional photogrammetry approaches, or use machine learning techniques depending on an intern's interests and skills. c) **COVIS bathymetric processing.** This project would apply computer vision techniques to our acoustic imaging data to extract the seafloor location relative to COVIS. The starting point is either raw or gridded acoustic imaging data optimized for imaging hydrothermal plumes. The challenge is the low grazing angle with the seafloor spreads and complicates the seafloor signal.

4. Investigation of Small Volcanic Eruption Mechanisms

[Karen Bemis](#)

A series of projects have investigated the mechanisms of small volcanic eruptions and how such studies can improve our understanding of eruption initiation. This series of projects seeks to understand how the morphology of volcanic edifices reflects syn- and post-eruptive processes. An ultimate goal is to infer typical eruptive conditions or processes from volcanic edifice populations in a localized region. Immediate projects could include:

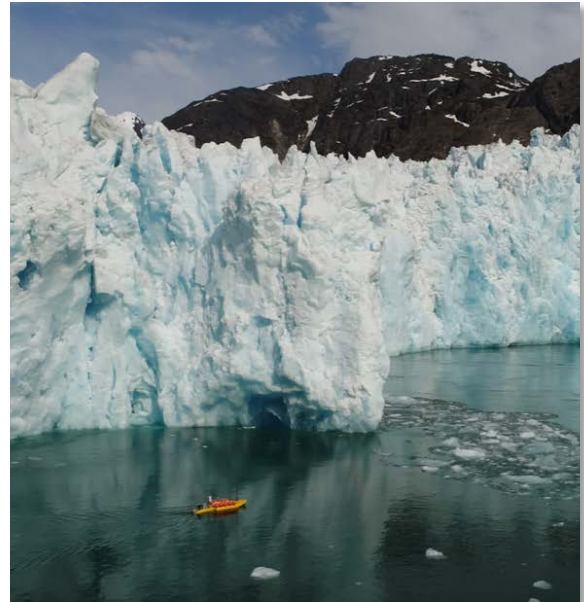


- **Eruptive process model.** An existing 3D model uses ballistic, grainflow, and lava flow processes to model the growth of scoria cones (small explosive volcanoes). This project would likely involve running the existing model on Rutgers high performance computers. Extensions of the code to include additional processes or refine the existing processes could be pursued. Alternatively, the project could focus on exploring the parameter space and running longer eruption durations.
- **Automated morphologic analysis.** For both the synthetic volcanic edifices and actual volcanic fields, the basic data is elevation fields (aka DEMs). Analysis of growth processes requires the extraction of morphologic data. Recent and earlier publications have developed methods of automating the extraction of quantitative measurement of morphology such as volcano steepness and base contour concavity. This project would implement and apply such methods to either the synthetic volcano dataset or actual volcanos on DEM data.
- **Tectonic context and connections.** This project would investigate tectonic and geochemical data available for volcanic populations for which morphologic data already exists. Main activities would be literature searches for existing data and building a database to match morphologic, tectonic and geochemical data. Analysis would focus on inferences of magma source depth, magma reservoir size, and magma supply rates for both historical and ancient eruptions.

5. Plumes at the Ocean-glacier Interface

[Rebecca Jackson](#)

Glaciers around the globe are shrinking and contributing to rising sea levels. Growing evidence suggests that ocean warming has enhanced underwater melting and triggered the retreat of many glaciers. However, we have few observations of melt or ocean dynamics near glaciers due to the remote and icy conditions. This project will focus on the plumes of meltwater that rise along the underwater face of glaciers. These plumes drive vigorous mixing between glacial freshwater and ocean waters, controlling how fast ocean heat can reach the ice to drive melting. These plumes also modulate the impact of shrinking glaciers on the ocean, since mixing in plumes affects the fate of glacial meltwater as it spreads into the ocean.



For this project, a RIOS intern would analyze ocean data collected near two glaciers, one in Greenland and one in Alaska. The intern would analyze profiles of ocean velocity, salinity and temperature that have been collected by ships, helicopters, and autonomous vessels. This data analysis would be ideally suited to an intern with quantitative interests and would allow the intern to build their programming skills while exploring ocean-glacier interactions.

6. How the Ocean Exhales: Examining Climate Change Controls from the Southern Ocean

[Liz Sikes](#)

My research is in the field of paleoceanography—paleoclimatology. An important aspect of our research concentrates on the exchange of carbon between different reservoirs on the earth and how that affects climate. Photosynthesis fixes the greenhouse gas carbon dioxide removing that carbon from the atmosphere as organic carbon that sinks into the deep ocean where it is sequestered away from the atmosphere. Deep ocean circulation brings this carbon back to the surface and one of the main places the ocean releases this carbon back to the atmosphere (“exhales”) is the Southern Ocean. This is why my lab studies the past levels of carbon dioxide in the Southern Ocean using stable isotopes in foraminifera fossils in sediment cores. Variations in circulation changes the ocean-atmosphere balance of carbon dioxide. We know these circulation fluctuations lowered the atmospheric carbon dioxide in the last ice age – contributing to ice age cooling.



A RIOS intern working with our group would speciate microfossils (foraminifera) and prepare them for isotope ($\delta^{18}\text{O}$ and $\delta^{13}\text{C}$) analyses to determine past temperatures and CO_2 levels in our new cores from the Southern Ocean.

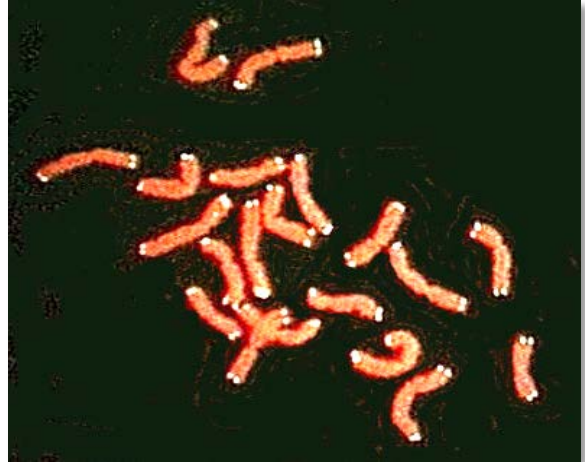
Photo Caption: Sediment coring gear on the R/V *Thomas Thompson* during our coring voyage to the Southern Ocean in November – December 2019.

7. Genetics of Bivalve Molluscs

[Ximing Guo](#)

Bivalve molluscs are descendants of a Cambrian lineage that have become well adapted to marine benthic life. They are widely distributed in the world's oceans and play important roles in estuary and coastal ecology. Many bivalves are also economically important species and support major aquaculture industries worldwide. Some bivalve species such as oysters are remarkably tolerant to environmental stresses including prolonged air-exposure and extreme salinities and temperatures. They lack adaptive immunity but thrive in microbe-rich environments as filter-feeders. Understanding the genetic bases of these adaptations has been a major area of my research. We conduct genetic studies to identify genes and genetic variations that affect the fitness and economically important traits such as disease resistance. The applied goal is to improve cultured stocks through selective breeding as well as advanced genetic manipulations. One genetic manipulation that has proven to be useful is the production of triploid (with 3 sets of chromosomes) oysters using tetraploids (with 4 sets of chromosomes). We breed and supply tetraploid oysters to the oyster industry for the production of triploids that are desired by farmers due to their fast growth and improved quality.

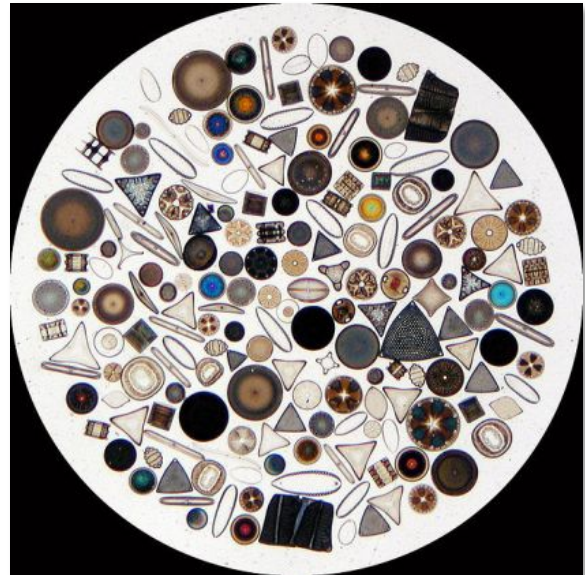
A RIOS intern in my lab could conduct focused studies related to the genetics of diploid and polyploid oysters. Studies may include assessing the effects of various genetic changes such as polyploidy and inbreeding on the fitness of oysters. Interns could learn how to spawn, culture, sample and evaluate experimental oysters, extract DNA, and conduct genotyping and other genetic analyses.



8. The Impact of Ocean Acidification on Phytoplankton Host-virus Interactions

[Kim Thamtrakoln](#) & [Grace Saba](#)

Ocean acidification refers to a reduction in the pH of the ocean that is primarily caused by an increase in the uptake of carbon dioxide from the atmosphere. Phytoplankton are the dominant organisms responsible for that uptake and the impact of ocean acidification on phytoplankton physiology is a hot topic of study. Diatoms are one of the most dominant groups of phytoplankton, responsible for almost 20% of global primary productivity and thus understanding the factors that mediate growth and mortality in these organisms has global implications for the carbon cycle. Viral infection is one mechanism of mortality in these organisms and we are interested in understanding how environmental conditions impact host-virus dynamics.



A RIOS intern associated with this project would explore the impact that ocean acidification will have on diatom host-virus interactions. Viral infection experiments on model laboratory host-virus strains will be done under a range of ocean acidification scenarios. Interns will learn phytoplankton culturing techniques and gain experience counting hosts and viruses using various techniques, as well as the application of diagnostic fluorescent staining to assess host physiology.

Figure Caption: Light microscopy of different diatom species. Source: unknown.

9. Impacts of Scallop Fishing Gear on Bycatch

[Daphne Munroe](#)

Co-Advisor: [Jason Morson](#)

[Haskin Shellfish Research Laboratory](#)

Atlantic sea scallops, *Placopecten magellanicus*, occur on the continental shelf from Newfoundland to Cape Hatteras where they support an extremely valuable commercial fishery that utilizes paired and single dredges, and to a lesser extent trawl gear, to capture scallops from the sea floor. While the sea scallop fishery is data-rich and well-managed, there are still some gaps in our understanding of sea scallop ecology and opportunities for improvements to fishery management.



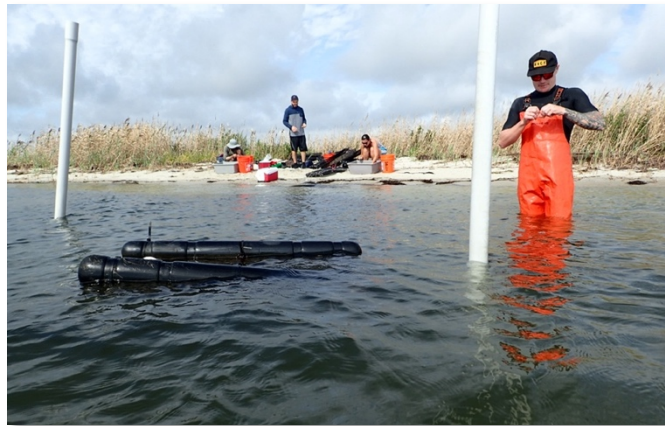
At the Haskin Shellfish Research Laboratory there are currently several ongoing research projects related to sea scallop ecology and fishery management. A RIOS intern working in our group could conduct lab experiments to evaluate how temperature and/or density influence predation rates or analyze video transects to help determine the influence of fishing gear modifications on bycatch.

10. Ecosystem Services Provided by Shellfish Farms

[Daphne Munroe](#)

[Haskin Shellfish Research Laboratory](#)

Shellfish farms are an ideal model system for studying the interaction of human and coastal systems. Farms provide jobs to coastal communities, depend on healthy, resilient coastal ecosystems, provide a plethora of ecosystem functions, and are the lowest impact form of animal-based food production. Farms commonly use structures in nearshore waters, including cages, bottom netting, or floating structures to prevent predators from accessing crops. These structures will alter small-scale coastal sedimentary processes – the nature of these interactions is poorly characterized and understood. This project will use shallow-water oyster farms in coastal bays as a model system to study sediment stability and shoreline protection. Understanding this complex interaction is crucial for farm siting and management decisions that will ensure continued health of nearshore habitats that rely on sedimentary processes. Likewise, with a global population in excess of 7.5 billion, continued development of marine farms and healthy local food production is a cornerstone for future human health.



11. Long term Changes in Polar Ecology

[Oscar Schofield](#)

The West Antarctic Peninsula is one of the fastest winter warming locations on Earth, and our group has been studying the ecological implications of these changes on food webs. Our team has been part of a time series project that has been studying those changes for 30 years, spanning from plankton to the higher trophic levels (penguins to whales). For this project we want to work with the RIOS intern to analyze



long term climate trends and their role in changing marine food webs. Specifically for the effort this year, we will work as a team to explore how the diversity of the marine plankton is responding to changes in the sea ice in our study location. The sea ice is regulated by a range of climate scale forcing functions, and we want to unravel how these processes drive phytoplankton diversity. The focus will be on using existing long term data sets that are documenting ongoing climate change in one of the planet's most impacted regions.

12. To Go Where Ships Cannot Go in Antarctica

[Oscar Schofield](#)

The Antarctic ocean is very remote and harsh, which is limiting humans ability to measure seasonal dynamics. As part of a large international effort, the National Science Foundation is deploying a Southern hemisphere ocean observing network consisting of autonomous robotic profiling floats capable of measuring ocean physics, chemistry (oxygen, pH), and biology (plants and particles). Robots are tough and don't get sea sick, and thus provide a tool to get data when humans can't. These floats can last for five years and collect data under the winter ice which have rarely been studied by humans. This project will focus on using these floats to explore under the ice sheet to assess the biological/chemical patterns and if there is any evidence of change in the last decade.

