RUTGERS

2025 RIOS Projects

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Synergistic effects of warming and nutrient limitation on Southern Ocean phytoplankton

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Swimming Behavior of Atlantic Surfclam Larvae

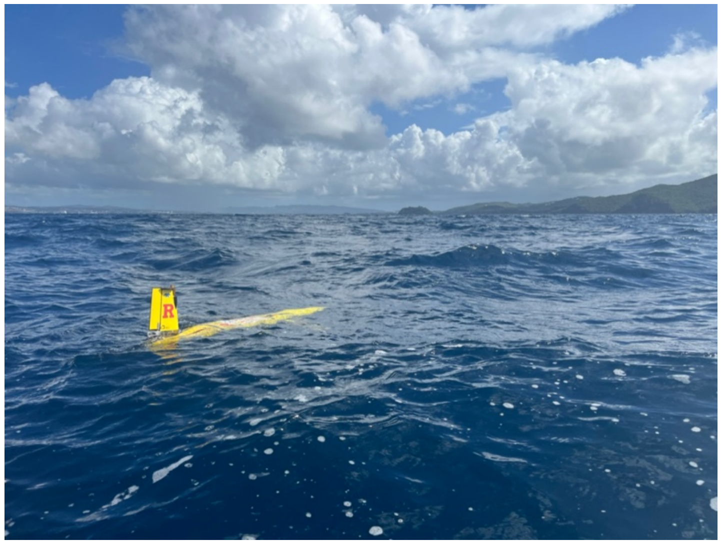
Investigating links between sea ice decline and Antarctic food webs.

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

Determining whether Atlantic surfclam subspecies can hybridize and evaluating their tolerance to ocean warming

Interannual variability and trends in ocean bottom temperatures in the northwest Atlantic continental shelf

Understanding diversity in marine microbial communities.

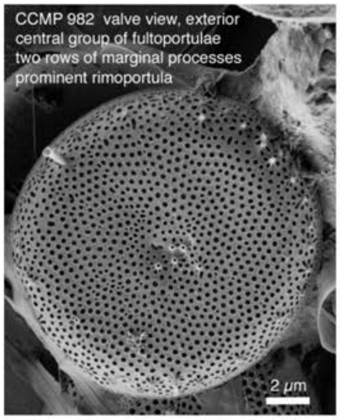


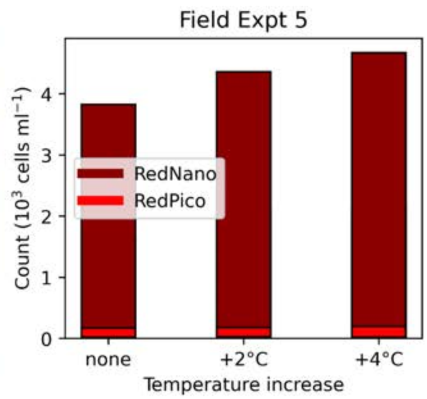
Water Mass Mixing in the Caribbean Through-Flow

Dr. Joe Gradone, Department of Marine and Coastal Sciences

The Caribbean Through-Flow (CTF) plays a crucial role in Earth's climate by moving large amounts of heat, salt, and freshwater from two key ocean circulation systems: the North Atlantic Subtropical Gyre (NASTG) and the Atlantic Meridional Overturning Circulation (AMOC). Recent studies suggest that changes in the NASTG and a possible slowing of the AMOC could have significant societal impacts as the AMOC helps transport about 25% of the northern hemisphere's heat through the ocean. Any disruption in this oceanic circulation could lead to major shifts in the climate, affecting ecosystems, human health, livelihoods, and global food and water security. The properties of water masses leaving the Caribbean through the Yucatán Straits are formed by mixing waters from the North and South Atlantic. These waters primarily flow into the Caribbean through the Eastern Caribbean Island passages. However, how these waters mix within the Caribbean Sea and in what proportions is not fully understood or closely monitored.

This summer you will be working with a team of scientists studying who have been deploying autonomous underwater gliders to study the mixing of these water masses in the Caribbean over the past few years. Our current research is focused on comparing data from these gliders with high-resolution ocean models to better understand the mixing processes at play. This project will specifically examine the water mass mixing patterns in selected glider data sets.





Synergistic effects of warming and nutrient limitation on Southern Ocean phytoplankton

Dr. Corday Selden & Heshani Pupulewatte
Department of Marine and Coastal Sciences

Phytoplankton are single-celled organisms that form the foundation of ocean ecosystems. Ocean warming is expected to increase the growth rates of phytoplankton in places like the Southern Ocean where most primary producers currently live below their temperature optima. However, phytoplankton growth across most of the surface ocean is already restricted by the availability of essential nutrients. The most common limiting elements are nitrogen, which is required for construction of proteins and DNA/RNA, and iron, which acts as a protein co-factor and helps drive the flow of energy through cells. Understanding how nutrient-limited phytoplankton will respond to ocean warming is essential to predicting how ocean ecosystems will respond to climate change.

This project will explore the effects of short-term warming on the growth of nutrient-limited Southern Ocean phytoplankton. As a RIOS student in our group, you will learn how to design experiments, grow algal cultures (including sterile and nutrient-clean techniques), measure nutrients and fluorescence, and perform other laboratory techniques relevant to studying photosynthesis, growth and nutrient utilization. You will receive training in visualizing data and conducting basic statistics using Python. At the end of the summer, we will work together to contextualize your data with results from field experiments conducted by our group and collaborators in the Southern Ocean. This project will contribute to our understanding of the synergistic effects of environmental stressors on primary production in a warming ocean.

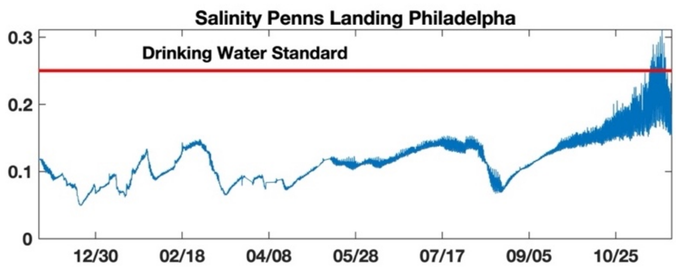
 

Shellfish Ecology and Pathology

Dr. 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 shellfish disease, aquaculture, and fisheries as well as the role of shellfish in living shorelines and their general ecology. Interns would experience daily life at a research station as they gain experience in both field and laboratory investigations. A 2025 RIOS intern would likely focus on the biosecurity of shellfish in aquaculture, that is how can shellfish aquaculture practices prevent the spread of shellfish pathogens. Opportunities for additional learning and experience may include evaluating shellfish-based living shoreline strategies, assisting with shellfish population assessments. The intern will work in the laboratory, the field and a shellfish hatchery that may include working in wet and muddy environments, on boats, or outdoors during inclement weather.



Salt intrusion threats to drinking water

Dr. Bob Chant, Department of Marine and Coastal Sciences

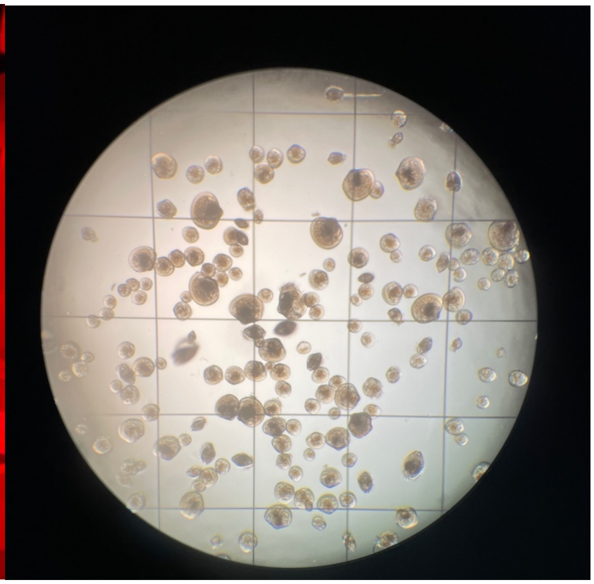
Drinking water for the City of Philadelphia is drawn from the Delaware River approximate 10 km upstream from the City's Center. During the drought of 2024 salt intruded up to the city of Philadelphia (Figure 1) where salinity levels exceeded drinking water quality standards of 0.25 parts per thousand. To keep the salt from penetrating further upstream to the drinking water intakes, water is released upstream from reservoirs to push the salt down stream. These reservoirs provide drinking water to New York City and thus drinking water from the Delaware River is shared by New York and Philadelphia. The landward intrusion of salt threatening fresh water supplies is occurring in many rivers globally and this is exasperated by climate change and by channel deepening to accommodate shipping for the every growing global commerce. During the drought of 2024 we deployed an array of moorings to measure salt intrusion in the Delaware River in the vicinity of Philadelphia PA. Together with data from the United States Geological Survey we have documented in detail the intrusion of salt into the Philadelphia reach of the river. With these data sets and numerical models we are quantifying processes that drive this landward salt flux in this "oligohaline" reach where salinities are between 0.5 -5 parts per thousand. Remarkably, there are very few studies of salt transport mechanism in oligohaline reaches of estuaries and the insights that we gain from our work in the Delaware river work will have implications globally

Nature-based Solutions for Coastal Protection and Shellfish Ecology

Jenny Shinn, Haskin Shellfish Research Laboratory

The implementation of nature-based solutions (NbS), including living shorelines, to mitigate shoreline loss and maintain coastal ecosystem function are on the rise. These eco-centric methods can be a preferred alternative to shoreline armoring tactics like vertical seawalls or bulkheads, which can disrupt the resilience and ecology of estuarine systems. Constructed oyster reefs (CORs) made of shell, concrete, stone, and other materials are one living shoreline tactic that is widely utilized. Conducting evaluations and monitoring of these tactics is a critical component to understanding how and when they function most effectively to meet the project goals. Opportunities are available for RIOS students to participate in ongoing projects investigating various components of CORs including materials, colonization by bivalve shellfish and vegetation, and utilization by mobile organisms. Additionally, opportunities exist for an intern to produce science communication products (outdoor interpretive signage, brochures, etc.) about living shorelines for the public, restoration practitioners and other stakeholders. Research would occur at a field station in both field and laboratory investigations that may include working in wet and muddy environments, on boats, or outdoors during inclement weather.

Swimming Behavior of Atlantic Surfclam Larvae

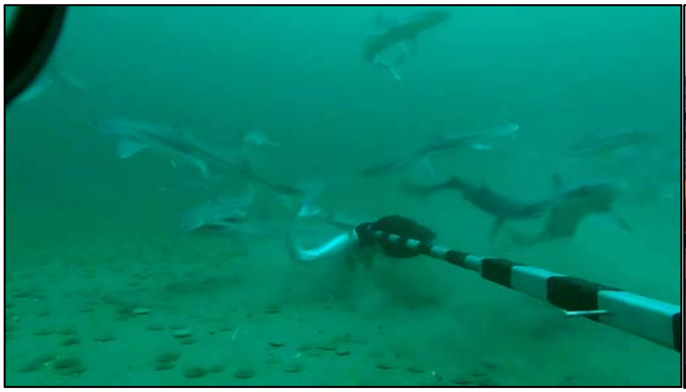
Dr. Daphne Munroe, Hails Tanaka
Haskin Shellfish Research Laboratory

The Atlantic surfclam lives from the Gulf of St. Lawrence, Canada, to North Carolina, USA. As a commercially important species, many aspects of the surfclam life cycle are of interest to fishers, managers, and scientists alike. The Atlantic surfclam has a biphasic life cycle, wherein the early life stages are spent in the water column as swimming larvae before they settle to the bottom, digging into the sediment, and metamorphose into juveniles. The larval stage is important to population connectivity and determines the population abundance and distribution. The water in which larvae swim can impact larvae through its biological, chemical, and physical properties. Current flow move the microscopic larvae, who are unable to swim sufficiently fast to overcome these large-scale water movements, to different areas of the ocean. However, the Atlantic surfclam larvae can swim fast enough to change their vertical position in the water column. By examining larval swimming behavior in various water conditions, we can learn how the species is interacting with the ocean around it and anticipate how changes in swimming translates to population-level changes. The goal of this project is to work with surfclam larvae through videos and laboratory experiments to better understand swimming behavior within the species.

Investigating links between sea ice decline and Antarctic food webs.

Dr. Oscar Schofield
Rutgers Center for Ocean Observing and Leadership

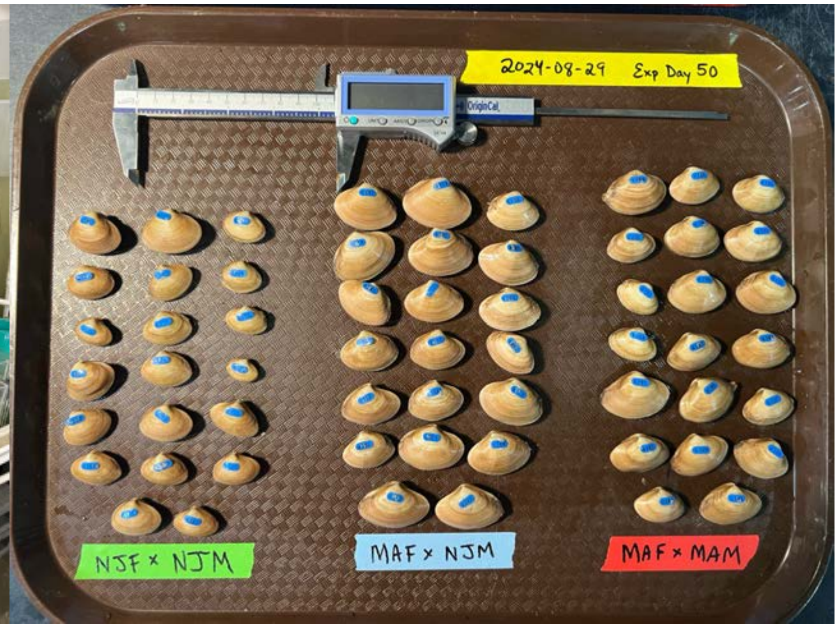
I am interested in how global warming is affecting polar ecosystems. This work is anchored by multiple programs studying the linkages between wind, sea ice, and plankton dynamics in oceans around Antarctica. These efforts include long term (>30 years) food web studies along the West Antarctic Peninsula which is one of the fastest warming locations on Earth. This project is documenting how declines in sea ice is rippling through the food web from plankton to penguins. I am also part of a team building a robotic profiler network throughout the Southern Ocean. These robots collect a suite of data all of which is available in real-time and allows scientists to study plankton ecology, ocean acidification, or transport of carbon to the deep sea. Both projects are open to interested students.



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

Drs. Sarah Borsetti and Douglas Zemeckis
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.



Determining whether Atlantic surfclam subspecies can hybridize and evaluating their tolerance to ocean warming

Dr. Michael Acquafredda
Haskin Shellfish Research Laboratory & the NJ Aquaculture Innovation Center

There are two Atlantic surfclam subspecies. The northern subspecies (*Spisula solidissima solidissima*) supports the federal fishery and is abundant on the continental shelf north of Cape Hatteras. The southern subspecies (*S. s. similis*) is predominantly found south of Cape Hatteras, but is also found in shallow, patchy, northern areas, such as coastal Virginia, Long Island Sound, and southern Massachusetts. However, the taxonomic rankings of these clams remain controversial. Recent genetic evidence suggests they could be distinct, but closely related species. Given the surfclam's vulnerability to climate change and its economic importance to commercial fishing and aquaculture industries, the uncertainty around its taxonomic classification must be resolved. Therefore, the goal of this project was to determine whether the surfclam subspecies have the ability to hybridize and to study the surfclam's adaptive capacity to ocean warming. For this project, the intern will help carry out experiments related to these questions. The intern will compare the growth, survival, and physiological responses of surfclams reared under two temperature conditions (ambient and elevated). The intern will gain skills in bivalve husbandry, data collection, data analysis (R programming language), and scientific presentation/communication. The intern will also have the opportunity to design outreach and extension materials that will be shared with the public.

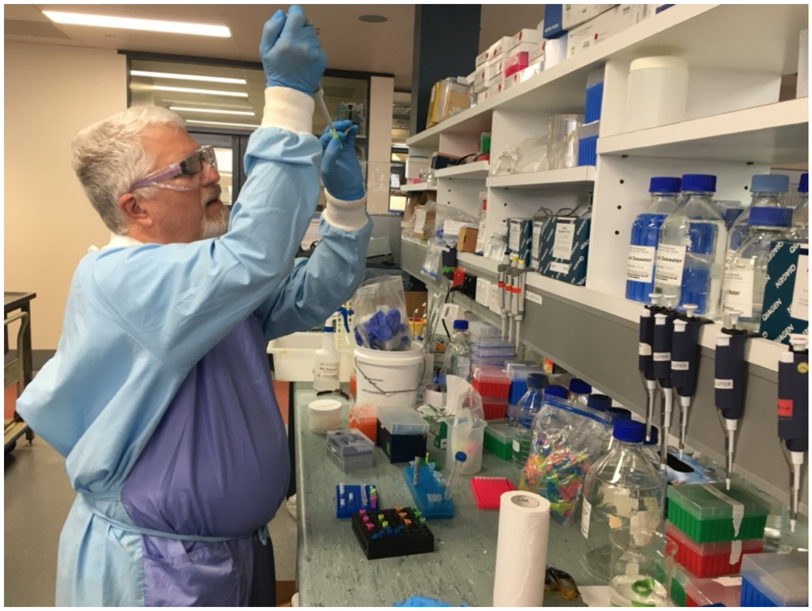
Interannual variability and trends in ocean bottom temperatures in the northwest Atlantic continental shelf

Dr. John Wilkin, Department of Marine and Coastal Sciences

The Rutgers Ocean Modeling Group (OMG) has computed a nearly 20-year long reanalysis of ocean temperature, salinity and circulation of the northwest Atlantic Ocean continental shelf (from Cape Hatteras to Nova Scotia) using a hydrodynamic circulation model in conjunction with an advanced system for assimilating ocean observations from satellites, autonomous vehicles and floats, moored instruments, and shore-based radar systems. The resulting analysis provides a "best estimate", in a statistical sense, of ocean conditions throughout the full water depth on time scales of days to years.

Observations that have not been incorporated into the reanalysis, and therefore represent independent data for verification and skill assessment, include temperature readings from animal tags attached to turtles and sensors affixed to trawl fishing nets. The project would undertake a comparison of these novel temperature data to the model analysis to assess the model's ability to capture ocean variability in regions of ecological importance. The project would continue with an analysis of seasonal and interannual variability and climate trends in ocean temperatures that might drive changes in species distributors on long time scales, but also identify shorter episodes of anomalously acute high temperatures, so-called marine heat waves, that might impact regional ecosystems.

Activities will entail a mix of model and observation data analysis, and will introduce the student to large ocean simulation model datasets from High Performance Computing systems and modern techniques for applied data science.



Understanding diversity in marine microbial communities.

Dr. Lee Kerkhof, Department of Marine and Coastal Sciences

My research has focused on understanding the mechanisms driving microbial diversity and biogeochemical processes and elucidating the active microbes in a variety of complex environments. Current research focuses on using nucleic acids to characterize marine microbial communities by profiling entire ribosomal operons using the Oxford Nanopore MinION (for review see Kerkhof 2021; Kerkhof L, et al. 2022; Qiang et al. 2021). Projects for this RIOS 25 summer would include fine scale mapping of prokaryotes/eukaryotes along an oxic/anoxic gradient in the Black Sea, detection of oyster pathogens in samples from the Gulf of Mexico, and construction of a eukaryotic rRNA operon database from marine and terrestrial samples.