Rhode Island Inclusive Network of Excellence in Science and Technology (RII-NEST)

Project List

Summer Undergraduate Research Fellowships (SURF)

May 27 – August 1, 2025

Collaborative Solutions for Cultivated Seaweed: Stakeholder Insights into Shared Processing Facilities in Rhode Island

Mentor(s)
Hayden Boettcher (Biology, PC)

Location
Providence College

Abstract
Seaweed cultivation presents a compelling opportunity for Rhode Island's thriving aquaculture industry. As a low-maintenance crop that can be grown throughout the winter off-season, seaweed offers significant ecological benefits (e.g., nutrient absorption, habitat creation) alongside access to a wide array of product markets, including industrial sectors (e.g., animal feed, cosmetics, and bioplastics), local restaurants, and innovative research fields. Despite these advantages and the global expansion of the seaweed market, Rhode Island's seaweed farming sector has remained stagnant, even as the state's broader aquaculture industry has experienced significant growth. A major impediment to the sector's development is the lack of accessible landing and processing facilities for cultivated seaweed. To put it simply, Rhode Island currently lacks the infrastructure to collect, stabilize, and process seaweed biomass efficiently. The high financial investment required to establish such infrastructure has proven prohibitive for individual stakeholders, stalling growth and innovation. This study investigates the feasibility of a Shared Processing Facility (SPF) as a collaborative solution to this challenge. Structured interviews with stakeholders—including seaweed farmers, processing technology providers, researchers, and biomass buyers—will provide qualitative insight into current commercial applications of cultivated seaweed, stabilization and processing preferences, and the potential for industry-wide cooperation. The findings will provide actionable data for state and regional stakeholders, unlocking seaweed cultivation as an additional driver of Rhode Island's growing blue economy.

Project Objectives

Objective 1: Assess the interest and technical feasibility of a Shared Processing Facility (SPF) for seaweed cultivation in Rhode Island, focusing on stakeholder needs and collaborative infrastructure solutions. Leveraging collaborative and use-inspired research, this work will investigate one of the major infrastructure challenges impeding Rhode Island's aquaculture industry. By working closely with interdisciplinary stakeholders—such as seaweed farmers, state/academic institutions, and industry innovators—this objective directly addresses sustainable aquaculture priorities and accelerates investment in Rhode Island's Blue Economy.

Objective 2: Investigate the current and potential markets and research areas for seaweed-based products (e.g., animal feed, bioplastics, fertilizers, and cosmetics) and identify strategies to optimize the seaweed value chain in Rhode Island. Cultivated seaweed must be processed before it can be brought to market (e.g., challenges with shelf life, nutrient content, particle size). This objective aims to identify the available markets and their preferred processing methods/standards. By identifying pathways for creating added-value seaweed products, this objective has the potential to attract new entrants to the seaweed market, including cultivators and processors. This expands workforce opportunities and stimulates long-term economic growth in related industries, including product innovation and research applications.

Objective 3: Disseminate research findings through the creation of tailored communication products for diverse stakeholders along the seaweed value chain, including presentations at scientific conferences, written reports for tribal/state policymakers, and engagement with the public through local events (e.g., New England Kelp Harvest Week).Relevance to Blue Economy Goals: This objective ensures findings are accessible to a broad audience, fostering greater public and industry investment in Rhode Island's Blue Economy. The student working on this project will be actively involved with the development and delivery of these communication efforts. This will provide valuable experience in translating scientific research into actionable insights, preparing them for careers in science communication and marine policy.

Ctenophore Ingestion Rates and Characterization of Flow Fields in the Presence of Microplastics

Mentor(s)
Anabela Maia (Biology, RIC)
Cassandra DeBlois (Biology, RIC)

Location
Rhode Island College

Abstract
Microplastics are rising pollutants of concern due to high residence times and the potential for bioaccumulation. Estuaries often experience high pollutant loads due to considerable population density and land use. How these pollutants affect different trophic levels including zooplankton remains unknown, especially gelatinous zooplankton such as jellies and comb jellies. This project aims to determine the effect of microplastics in a gelatinous zooplankton species present in high abundance in Narragansett Bay, the comb jelly *Mnemiopsis leidyi*. This project will collect, house, expose and record how this local comb jelly interacts with food and microplastics using high-speed video and particle image velocimetry (PIV), which allows to visualize microplastic transport and flow around the organism. Understanding how gelatinous zooplankton interacts with microplastics can provide information for bioremediation as some of these organisms are able to egest microplastics.

Project Objectives
Gelatinous zooplankton, including salps, cnidarians, and ctenophores are vital to coastal food webs. They can exhibit top-down control of ecosystem dynamics and their secretions can transport carbon to the bottom of coastal environments. However, gelatinous zooplankton are unevenly studied, with more research focused on cnidarians. When it comes to microplastics, researchers have found that adults of several jellyfish species are relatively unimpacted by microplastic ingestions and can rapidly egest the plastics in mucous within a day. However, ctenophores have recently been found incorporating microplastics, yet their feeding behavior on plastics has not been documented despite a potentially role as bioindicators for pollution in local systems and their possible use in bioremediation.

The lobate ctenophore *Mnemiopsis leidyi* (A. Agassiz 1865) is a generalist predator that can have significant impacts on zooplankton communities including trophic cascades. In Narragansett Bay, they overwinter in the upper bay and have been expanding their seasonal range, steadily increasing in abundance with blooms coinciding with peak fish spawning seasons. Their impacts on the environment make it vital to understand their ecology and feeding changes in response to external factors like climate change and microplastic pollution. *M. leidyi* uses the cilia along its lobes to generate flow fields to entrap prey between its auricles making particle image velocimetry (PIV) an effective strategy for observing their feeding. PIV uses lasers to observe and track beads or other particles in a fluid field around the animal, allowing us to see how the water moves as the animal swims, feeds, or otherwise interacts with its environment.

We hypothesize that ctenophores will have (1) decreased feeding rates when exposed to high concentrations of microplastics and will (2) change their flow fields to avoid consuming non-prey items. Lastly, (3) I expect that *M. leidyi* will be able to expel plastic accidentally ingested similar to what has been described in jellyfish. The main objectives of this project are 1) to determine if varying concentrations of microplastics impact overall feeding rates of *M. leidyi* on *Acartia*; 2) to determine if varying concentrations of microplastics impact feeding flow fields of *M. leidyi* and feeding preference using PIV, and 3) to determine if ctenophores egest accidentally ingested microplastics in mucous as has been previously observed in jellyfish.A better understanding of the impact of microplastic on zooplanktonic organisms like ctenophores can provide valuable information to bioaccumulation of microplastics throughout estuarine food webs as microplastics load increases in coastal environments. Additionally, ctenophores have been suggested to be great potential bioindicators of pollution levels in the pelagic environment of estuarine environments. Another application of this research could relate to clearing Narragansett Bay of increasing microplastic levels. Jellyfish mucus has been found as a potential substance to capture plastics and treat waters which may apply to ctenophore mucus.

Characterizing the Feeding Behavior of *Arbacia punctulata*

Mentor(s)
Carla Narvaez Diaz (Biology, RIC)

Location
Rhode Island College

Abstract
The decline of kelp forests along the New England coast represents a significant transformation of coastal marine ecosystems, with important implications for marine biodiversity and ecosystem services. In southern New England, ocean warming and marine heatwaves have severely diminished populations of kelp over the past four decades, leading to a shift toward algal turf-dominated reefs. This regime shift has important consequences for the region's Blue Economy, as kelp forests provide critical ecosystem services including fish habitat, carbon sequestration, and coastal protection. Recent research has revealed an intriguing ecological relationship between the purple sea urchin *Arbacia punctulata* and algal communities in southern New England. Unlike other temperate sea urchin species that typically consume kelp as their primary food source, *A. punctulata* appears to preferentially graze on algal turfs over kelp. This unique feeding behavior could have important implications for kelp forest restoration efforts, as these urchins might help control algal turf communities that currently dominate former kelp habitats.

Project Objectives
This research project has two primary objectives: 1) determine temporal patterns in *A. punctulata* foraging behavior by quantifying movement rates and grazing activity during day versus night periods, and 2) assess feeding preferences by comparing consumption rates between kelp and four common turf algae species. These objectives address critical knowledge gaps in our understanding of *A. punctulata* ecological role and will provide essential information for developing effective kelp forest restoration approaches in southern New England. These experiments will be conducted at Rhode Island College and will involve field work for specimen collection.

This project will engage undergraduate students in a comprehensive research experience designed to develop both technical skills and professional capabilities. The training program will unfold across three distinct phases over the 10-week period, ensuring students develop progressively from basic skills to independent research. During the initial two weeks, students will receive training in laboratory safety, sea urchin husbandry, experimental protocols, and data analysis techniques. They will learn to use ImageJ for video analysis and establish proper data collection and management protocols. This foundation-building phase will include guided practice in scientific literature review to contextualize their research within the broader field of marine ecology. The following six weeks will focus on research implementation, with students taking increasing responsibility for conducting feeding trials, collecting video data, and performing statistical analyses using R. Students will participate in weekly data presentations and discussions, developing their ability to interpret and communicate scientific results. The final two weeks will emphasize research communication, with students synthesizing their findings into a scientific poster. They will receive focused mentoring on data visualization and presentation techniques, preparing them for the research conference.

On-Site Evaluation of Boiling Water Dips for Controlling Biofouling in Eastern Oyster Bottom Culture

Mentor(s)
Hisham Abdelrahman (Marine Biology, RWU)

Location
Roger Williams University

Abstract
This project investigates the use of boiling water dips as a sustainable and cost-effective biofouling control method in Eastern oyster (*Crassostrea virginica*) bottom culture systems. The study evaluates treatment durations of 1, 3, and 5 seconds and compares them with air-drying and untreated controls. Conducted at the Roger Williams University (RWU) Ferrycliffe Aquaculture Farm in Mount Hope Bay, RI, this research assesses the environmental and economic implications of these methods, aiming to improve oyster growth, survival, and operational efficiency.Results will be presented at the Northeast Aquaculture Conference & Exposition (NACE) and the Milford Aquaculture Seminar (MAS), January 7–9, 2026, in Portland, Maine. Findings will also be disseminated through the East Coast Shellfish Growers Association (ECSGA) newsletter and submitted to the peer-reviewed journal, Aquaculture Research. By addressing a critical challenge in aquaculture, this project supports the Blue Economy through sustainable innovations, workforce development, and inclusive science communication.

Project Objectives

1. Evaluate the effects of weekly boiling water dips (1, 3, and 5 seconds) on biofouling reduction, oyster survival, and growth.

2. Assess the impact of bottom cage placement (surface, middle, bottom) on biofouling intensity and treatment effectiveness.

3. Investigate the sustainability and cost-effectiveness of heat treatments as an alternative to traditional methods, such as air-drying.

Sustainability Considerations

- Environmental Impact: Boiling water dips are chemical-free and minimize biofouling-related waste, supporting ecosystem health while maintaining productivity.
- Resource Efficiency: Heat treatments offer a reusable, low-labor alternative to manual scrubbing or air-drying, reducing operational complexity.

Cost-Effectiveness

- Operational Costs: Analysis of labor, energy, and material inputs will determine the economic feasibility of scaling these treatments.
- Economic Benefits: Improved oyster survival, growth rates, and quality will directly enhance profitability for aquaculture operators.

Enhancing Aquaculture Literacy and Diversity Through Virtual Reality: An Extension-Focused Approach

Mentor(s)
Hisham Abdelrahman (Marine Biology, RWU)

Location
Roger Williams University

Abstract
This project utilizes virtual reality (VR) and 360-degree video technologies to create immersive digital educational materials for aquaculture literacy, outreach, and Extension programming. Undergraduate students will collaborate with local shellfish farmers to produce virtual tours of the RWU Ferrycliffe Aquaculture Farm and diverse shellfish farming systems across Rhode Island. These materials will be incorporated into the RWU Initiative's Applied Shellfish Farming course (January–May annually), used in RWU Extension programming to train farmers on best practices, and shared with schools and community groups to engage a broader and more diverse audience. Participants will gain hands-on experience in VR media production and aquaculture outreach, while audiences will benefit from access to aquaculture knowledge without leaving their farms, schools, or homes. Results will be presented at Aquaculture America 2026 (February, Las Vegas) and other professional venues, demonstrating how digital media can improve education, promote diversity, and support Rhode Island's Blue Economy.

Project Objectives

1. Develop virtual tours showcasing the RWU Ferrycliffe Aquaculture Farm and a variety of shellfish farming systems across Rhode Island.

2. Train undergraduate students in 360-degree video capture, VR production, and science communication.

3. Disseminate digital materials to enhance aquaculture education, foster diversity in audience engagement, and support Extension activities.

Development of Terahertz Sensors for Microplastic Detection in Aqueous Samples

Mentor(s)
Ahmet Emin Akosman (Engineering, RWU)

Location
Roger Williams University

Abstract
Microplastics in aquatic systems pose a significant threat to marine ecosystems and the sustainability of the Blue Economy. This project aims to develop innovative Terahertz (THz) fiber sensors for detecting and characterizing microplastics in deionized water and saltwater. Towards the goal of advancing the precision and efficiency of current environmental monitoring tools, the characterization of different microplastic polymers in aqueous samples and the development of THz negative curvature fiber sensors are proposed. The outcomes will offer a unique alternative to the current detection methods of microplastics, supporting environmental health and resource sustainability crucial to the Blue Economy.

Project Objectives

1. Characterization of microplastics in aqueous samples: In this initial step, the THz absorption spectra of different microplastics polymers such as PET, PE and PP will be measured in deionized water and saltwater solutions using our THz time-domain spectroscopy (THz-TDS) set-up. This characterization will enable the assessment of the chemical footprints in the THz region; thus, the proposed sensor parameters will be adjusted such that the footprints can be within the operational regime.

2. Development of THz negative curvature fiber sensors: Based on the spectral locations of the chemical footprints of the microplastic polymers, the design parameters of our fiber sensors will be adjusted, the electromagnetic simulations of the new geometrical designs will be performed, and the sensors will be 3d printed using a UV-resin based SLA printer. Then, the developed sensors will be characterized using the THz-TDS system without the aqueous samples filled to confirm the simulated operation.

3. Testing of the sensor performance: In this step, the sensors will be filled with the aqueous samples prepared with different concentrations of microplastics solved in deionized water and saltwater, and the sensitivity and detection limits of the fiber-based THz sensors will be calculated based on the transmission and absorption spectra obtained. The project directly aligns with the RII-NEST's commitment to environmental sustainability and resource conservation. By advancing tools for detecting microplastics, the goal is to support the preservation of marine ecosystems and the health of fisheries and aquaculture industries. Additionally, the project fosters innovation in environmental sensing technologies, contributing to the sustainable development of coastal and oceanic resources.

Innovativeve electrochemical genosensors for detectng pathogenic protists and their toxins in resident shellfish in Narragansett Bay

Mentor(s)
Avelina Espinosa (Biology, RWU)
Allison Marn (Engineering, RWU)
Jennifer Pearce (Physics, RWU)

Location
Roger Williams University

Abstract
Narragansett Bay and its associated rivers provide spawning ground, nursery, and habitat for more than 60 species of fish and shellfish. An interdisciplinary team of faculty will mentor undergraduate students in the design of electrical genosensors for the detection of shellfish parasitic protists and their toxins in Narragansett Bay. This 'immersive research experience' shall prepare SURF scholars for careers in RI's coastal and mariitme sectors while developing novel efficient genosensors to detect diseased shellfishand toxin-polluted waterways. Mollusk disease-causing proitsts such as *Perkinsus marinus*, *Haplosporidium nelson*, *H. costale*, *Bonamia ostreae*, and *Mucochytrium quahogii* (QPX) affect the ecology and economy of marine communities and their habitats. *Alexandrium catenella* Group 1, and *Gymnodinium* spp. are the leading agents of paralytic shellfish poisoning (PSP) in North and South America, Europe, Africa, Australia, and Asia. Detection of these pathogenic protists informs aquaculturists about disease distribution and abundance. Current detection and identification methodsinclude histopathology, molecular (e.g., protein-based, PCR variants), or biosensing (bio-transducer) methods. Electrochemical biosensing of pathogenic bacteria and viruses is in progress, while the technology for detection of marine pathogenic protists is incipient. Collaborating faculty-student teams aim at generating practical genosensors for the detection of shellfish protistan parasites and convey the process and outcomes to diverse audiences.

Project Objectives

1. Develop electrochemical genosensors for mollusk disease-causing protists *Perkinsus marinus*, *Haplosporidium nelson*, and *H. costale*.

2. Develop electrochemical genosensors for *Alexandrium catenella* Group 1, and *Gymnodinium* spp., the leading agents of paralytic shellfish poisoning (PSP) in North-, South America, Europe, Africa, Australia, and Asia.

3. Test the efficacy of electrochemical genosensors from objectives 1 & 2 *in vitro*, *in vivo*, with parasite cells, genomic samples or environmental water samples.

4. Communicate the practical application of this Blue Economy multidisciplinary molecular biology, physics, and engineering research to diverse audiences.

The economic impact of mollusk disease-causing protists and PSP toxins in RI and the US is underestimated according to Woods Hole Oceanographic Institute (WHOI) outdated reports. Although shellfish diseases and PSP toxins are currently monitored in the Northeastern US, we propose to develop a cost-effective field device that will improve the detection and distribution of these protists in shellfish populations and in PSP-polluted waterways in RI. A collaborative interdisciplinary team led by Avelina Espinosa (molecular biology, parasitology), Allison Marn (electrosensing, engineering), and Jennifer Pearce (physics, DNA-based microfluidic devices) has the expertise to combine transducers (planar, polymers, wires/fibers, nanostructures, arrays), electrochemical signals (impedance sensing), and platforms (paper-, flow-, and droplet-based) to develop electrochemical genosensor devices. The purpose is to design genosensors that are portable, disposable, easy to use for specimen collection, environmentally friendly, affordable, sensitive, specific, rapid, and equipment-free for the detection of shellfish protistan parasites. A practical, low-cost genosensor would also increase accessibility of this technology for research and education practices.

Assessing Atmospheric Microplastic Contributions to the Narragansett Bay

Mentor(s)
Lillian Jeznach (Engineering, RWU)

Location
Roger Williams University

Abstract
Microplastics pollution is a growing pollution concern for the state of Rhode Island, especially given the high urban land cover and importance of the surrounding marine environment to the local blue economy. Several local studies have focused on quantifying and characterizing microplastic pollution and its impacts to wildlife in the Narragansett Bay. It is also relatively well understood, although not entirely quantified, that runoff and freshwater rivers are a source of microplastics to the bay. Atmospheric deposition of microplastics is also a growing area of interest, especially in urban areas, however there is very limited data on this globally and none in New England. This project will analyze atmospheric microplastic concentrations in the Narragansett Bay watershed. Students will use two methods to collect air samples from the Roger Williams University campus, immediately adjacent to the Narragansett Bay. An atmospheric microplastic fallout collector will capture dry deposition samples. In addition, a total suspended particulate sampler (TSP high volume air sampler) and PM2.5 sampler will measure weekly air quality. Samples will be processed and stained with Nile Red to be visually enumerated under a microscope and with FTIR/Raman analysis. Ultimately, this data will be used to estimate atmospheric loading of microplastics to the Narragansett Bay.

Project Objectives
Plastic pollution from freshwater and atmospheric sources into coastal and marine environments is complex and the extent is largely unquantified. Universities situated along the coasts are uniquely positioned to help contribute to the collection and analysis of microplastic data. Such data can help to fill in the gap of knowledge of marine microplastic sources, which in collaboration with local partners and experts in the field, will help us develop solutions to reduce these pollution sources and their impacts to the Narragansett Bay.

The research objectives for this project are:

1. Collect atmospheric microplastic samples by deposition methods and by a TSP high volume sampler located on Roger Williams University's campus.
2. Analyze the samples using visual and chemical analysis methods to determine microplastic concentrations.
3. Approximate atmospheric microplastic loading to the Narragansett Bay.
4. Communicate the results of the research to a local audience.

The project objectives align with the blue economy goals of RII-NEST because this project will contribute to an understanding of the atmospheric deposition of microplastics into the marine environment, which is an important resource for the people of Rhode Island and blue economy. The ultimate goal of this work is to help provide data that will ultimately contribute to technical, social, and policy solutions to decrease microplastic pollution within the Narragansett Bay.

Microbiome Implications of Climate Change-Induced Dormancy Loss in the Temperate Coral *Astrangia poculata*

Mentor(s)
Koty Sharp (Marine Biology, RWU)
Mia Sarris (Environmental Science, RWU)
Sean Grace (Biology, Southern Connecticut State University)
Anya Brown (Evolution & Ecology, University of California-Davis)

Location
Roger Williams University

Abstract
Over the past ten years, students in our laboratory have studied the microbiome diversity and dynamics in the local population of the temperate coral *Astrangia poculata* here in Narragansett Bay. Our studies suggest that its microbiome exhibits a level of stability and predictability that is much greater than that documented in tropical coral microbiomes (Sharp et al. 2017). In winter months, *A. poculata* undergoes quiescence, a dormancy induced by winter temperatures, typically in December-March, when temperatures go below 5°C (Grace 2017). The microbiome composition shifts across seasons: it repeatedly recovers from a winter dormancy period, retains a signature "core" group of microbes throughout all seasons, and exhibits a predictable pattern of microbiome reassembly/succession following quiescence that can be replicated via laboratory-induced quiescence (Sharp et al. 2017; Brown et al. 2022; Brown et al. *in prep*). This regular microbiome reshuffling is thought to be an important source of stability and maintenance of the coral's beneficial microbial associates (Brown et al. 2022). In winters of 2022-2023 and 2023-2024, our collaborators documented a lack of *A. poculata* dormancy, which is likely due in part to elevated sea surface temperature (SST). It is not yet known whether that lack of dormancy has implications on the microbiome assembly, and, ultimately, on the animal host. As part of an ongoing research collaboration with Dr. Sean Grace and Dr. Anya Brown, our lab is using high-throughput gene sequencing to characterize microbiomes in A. poculata across seasons, detailing the *A. poculata* microbiomes in specimens collected in a time series spanning the two non-quiescence winters. The aim of the proposed project is to characterize the microbiomes in *A. poculata* colonies across a time series in which the corals do not undergo quiescence. Comparative analyses with previously documented microbiomes in *A. poculata* during "typical" quiescent winters will inform new models of how A. poculata's microbiome, and more broadly, how animal microbiomes shift in response to climate change in Narragansett Bay, and lead to new methods for monitoring coastal ecosystem change.

Project Objectives
The proposed work is part of an ongoing, funded collaboration, in which undergraduate students in the Sharp Lab (RWU) will work to process collected specimens for DNA extraction, PCR, and high-throughput 16S amplicon sequencing. SURF student(s) working on the project in Summer 2024 will process the remaining samples that need to be extracted (DNA extraction, specific PCR reaction prep and analysis) and submit the resulting products for sequencing. Students will spend much of their time learning and performing bioinformatics analysis of the sequencing results. The aims of the labwork include the following:

Aim 1: Process previously collected and summer collections of *A. poculata* specimens: complete DNA extraction, PCR amplification, and preparation/cleanup of amplification products for submission to URI Genomics & Sequencing Center for high-throughput sequencing.

Aim 2: Use bioinformatics to characterize the taxonomic composition of the microbiome of *A. poculata*, along a high-resolution time series surrounding two winter periods (Dec 2023-March 2024; Dec 2024-March 2025), using QIIME pipelines and protocols previously developed and customized in the Sharp Lab (Brown et al. 2022). Perform comparative analysis with previously documented datasets from *A. poculata* specimens that have exhibited quiescence.

Student(s) working on these aims will gain transferable skills in molecular biology, microbiology, and bioinformatics. Another major component of this experience is student-led field collections, in which students will be able to gain training in scientific collection in the marine environment. Together, these skill sets are broadly applicable across a variety of careers, especially including the region's rapidly growing fields of applied marine research and life sciences. Information gained from this summer's research can serve as a platform for a public awareness campaign about climate change in Narragansett Bay and can provide a touchstone for future scientific communication initiatives. The student(s) on this project will be charged with not only presenting the data, but practicing communication of the results in a way that is digestible to the public and relates relevance back to land use and policies that can impact climate change.

This project is part of an ongoing collaboration among Drs. Sharp, Grace, and Brown. The bulk of the benchwork and sequence analysis will be led by the undergraduate students. Sharp will train the students in all benchwork and analysis in intensive meetings at the start of the summer, and progressively throughout the summer, as the student(s) gain more experience and independence, the students will lead the project. Sharp will mentor the student(s) using an approach that she has been employing for nearly ten years at RWU. Student mentoring includes not only regular time together at the benchwork demonstrating and teaching laboratory techniques, but also requires regular in-person meetings, both in person with Sharp and via Zoom with our collaborators. At weekly meetings, the student(s) will review goals set in the previous week, share findings/progress of the previous week, and set goals with Sharp for the week to come. The discussions will evolve from informal at the start of the summer to more formal, structured presentation by the end of the summer, so that the student(s) will be prepared to present a short talk/poster describing their research progress by the end of the 10-week period. Such presentations provide students with the opportunity to present the results of their research to a familiar group of investigators, while receiving feedback that will enable them to make research progress and to prepare successful formal presentations.

References

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Biological exploration of deep-sea hydrocarbon seeps

Mentor(s)
Roxanne Beinart (Oceanography, URI)

Location
University of Rhode Island

Abstract
Hydrocarbon seeps are vibrant deep-sea ecosystems that play a critical role in the globalmethane cycle. These habitats support commercially valuable marine species and intersect withindustrial activities such as gas and oil extraction, as well as potential offshore wind developmentlocations. In U.S. waters, including off the coast of Rhode Island, hydrocarbon seeps are widespreadand ecologically significant. Through a collaboration with the Florida Institute of Oceanography's Peerside program, a student will join the Beinart Lab to gain expertise in: 1) Planning andparticipating in deep-sea research operations using advanced ocean exploration technologies, such asremotely operated vehicles (ROVs) and 2) Assessing deep-sea biodiversity using genetic andmorphological methods. As part of this project, the student will take part in a six-day deep-searesearch expedition to hydrocarbon seeps in the Gulf of Mexico. They will collect biologicalspecimens, including animals and microbiota, and use genetic barcoding and/or morphologicaltechniques to identify deep-sea organisms. Additionally, the student will develop inclusive sciencecommunication skills by contributing to the development of a free, publicly accessible digitaltextbook on deep-sea biology. This resource is being collaboratively created by Professor Beinart, theUniversity of Rhode Island's Inner Space Center, and marine scientist experts from around thecountry.

Project Objectives

1. Plan and participate in deep-sea operations using advanced ocean exploration technology(remotely operated vehicles)

2. Assess deep-sea biodiversity through genetic and other methods

3. Contribute materials to a free, publicly accessible digital textbook on deep-sea biology

Application of real-time environmental monitoring to improve the resilience, production, and sustainability of the local aquaculture industry

Mentor(s)
Jane Carrick (Biology, URI)

Location
University of Rhode Island

Abstract
To aid in the growth and sustainability of Rhode Island's aquaculture industry, the interdisciplinary SEA-BREED-IN initiative aims to apply environmental monitoring of local waterquality to allow researchers and aquaculture practitioners to maximize shellfish health andenvironmental resilience, and improve synergies with local industry and researchers at URI. Bydeploying ocean sensors and developing real-time data transmission to users, researchers atthe URI Graduate School of Oceanography will empower collaborators and stakeholders torespond rapidly to water quality threats to improve stock health and production withinaquaculture farms. A participating RII-NEST summer intern will have the opportunity to work onthis project alongside a dynamic team of faculty and staff mentors to develop skills in appliedmarine technology, data collection and analysis, and fieldwork, all while contributing to the localblue economy.

Project Objectives
The Marine Ecology and Technology (marecotec) research group at the University of Rhode Island's Graduate School of Oceanography (URI GSO) is seeking a motivated student interested in hands-on fieldwork, marine technology, and data analysis to support the SEA-BREED-IN initiative (Enhancing SEAfood security through precision BREEDing, (epi)genome design, *IN situ* smart monitoring, and high-performance computing/artificial intelligence). This initiative aims to enhance the safety, sustainability, and resilience of Rhode Island's local aquaculture industries through an interdisciplinary approach of environmental monitoring, prescriptive intervention, and selective breeding/genome design of commercially important organisms.

Seafood consumption in the United States has been on the rise, in part a reflection of an increased awareness of the health and environmental benefits of fish, shellfish, and algae. Moreover, due to population growth, seafood demand is expected to increase by at least 60% by 2050. Great potential for a sustained increase in US seafood production exists throughwell-managed fisheries and a sustainable aquaculture industry that preserves natural ecosystems, supporting enhanced food production and other ecosystem services without increasing the environmental footprint. In Rhode Island, aquaculture generates more than $570 million in sales and supports more than 3,100 jobs within the state. Sustainable seafood production to meet demand is threatened by challenges imposed by disease, climate change, and environmental pollution. A better understanding of the potential for acclimation andadaptation to climate change in aquaculture species will aid in the development of innovative practices and technologies to enable sustainable growth in food production.

Foundational to this work is the real-time surveillance of local waterways that support aquaculture systems in order to (1) assess changes in water quality and overall habitat health, (2) explore connections between environmental conditions and stock performance/resilience, and (3) allow for rapid responses to water quality impacts such as disease, pollution, or climate impacts. To meet these objectives, we will deploy two state-of-the-art oceanographic sensors at facilities that support research and commercial shellfish hatcheries: the University of Rhode Island Bay Campus and the Matunuck Shellfish Hatchery Center for Research and Innovation. Harnessing advancements in cellular network telemetry, data will be made available rapidly to collaboratorsto provide real time water quality metrics.

Comparing Low-Cost Flow Imaging Planktoscope with Traditional Microscopy and DNA Metabarcoding for Monitoring Harmful Algal Bloom Species in Narragansett Bay

Mentor(s)
Drajad Seto (Cell & Molecular Biology, URI)
Bethany Jenkins (Cell & Molecular Biology, URI)

Location
University of Rhode Island

Abstract
Harmful algal blooms (HABs) in coastal waters pose significant threats to ecosystems, human health, and economies (Grattan et al. 2016; Trainer et al. 2012). These phenomena can occur as a result of toxin-producing phytoplankton (Grattan et al. 2016), which accumulate through the food web. Monitoring the prevalence of HAB species is critical to safeguarding blue economies reliant on fisheries and preventing health and environmental crises. Traditional methods for phytoplankton monitoring rely on microscope-based identification, requiring sample collection, concentration, and preservation, involves toxic preservatives, and relies on small sample volumes, which is increasing uncertainty. Advances in imaging technologies, such as FlowCam (Owen et al. 2022) and Imaging FlowCytobot (IFCB) (Olson and Sosik 2007), provide quantitative and qualitative data efficiently but are very expensive and logistically challenging in field conditions. Molecular techniques like DNA metabarcoding offer high sensitivity and taxonomic resolution but involve lengthy processing and analysis times (Gong and Marchetti 2019). An assuring alternative is the Planktoscope, a low-cost, open-source flow-imaging device (Pollina et al. 2022). It enables real-time, portable imaging of planktonic organisms, making it accessible to scientists, educators, and citizen scientists. Despite its potential, the Planktoscope has not been rigorously compared to traditional microscopy or DNA metabarcoding methods for phytoplankton monitoring.

Project Objectives
Harmful Algal Blooms (HABs) result in significant economic losses, estimated at $10-100 million annually in the United States. To help mitigate these impacts, this project proposes a comprehensive comparative analysis of the Planktoscope alongside traditional microscopy and DNA metabarcoding for monitoring phytoplankton in Narranganset Bay. By integrating these methods, we aim to evaluate the efficacy and reliability of the Planktoscope and identify uncertainties associated with its use, therefore, informing more effective detection and management of HAB species in the region.

Field sampling will be conducted two times in June at a fixed station in Narragansett Bay, collecting surface water samples each time and splitting them for three separate processing streams (4 liters each): microscopy, Planktoscope imaging, and DNA metabarcoding. For microscopy, each 4 L sample will be concentrated to 200 mL and preserved with Lugol's solution, from which a triplicate of 1 mL subsample will be examined using inverted microscopy to identify phytoplankton taxa following standard taxonomy keys and counting protocols. For Planktoscope imaging, a similarly concentrated 200 mL aliquot will be processed following established protocols, with raw images stored for subsequent automated classification using open-source software (EcoTaxa: https://ecotaxa.obs-vlfr.fr) and manual validation to refine species identification accuracy. For DNA metabarcoding, seawater sample will be filtered through 5 µm and 0.2 µm filters to capture a broad range of phytoplankton sizes, and DNA will be extracted and amplified using universal eukaryotic 18S rRNA primers before high-throughput Illumina sequencing. Bioinformatic processing will include quality filtering, amplicon sequence variant (ASV) clustering, and taxonomic assignment against reference databases.Outcomes The research will generate phytoplankton compositional data from three complementary methods with focus on Harmful Algal Bloom species. The data will highlight the strengths, weaknesses, and complementary nature of each approach. The findings will be presented at scientific forums and deposited in accessible repositories.

Bioaccumulation and biosorption of Platinum Group Elements by marine macroalgae: Assessing macroalgae as indicators of pollution and for potential recovery of critical elements in estuaries.

Mentor(s)
Kayla Kurtz (Environmental Engineering, URI)

Location
University of Rhode Island

Abstract
This project will design and test a protocol for assessing the abundance of Platinum Group Elements (PGEs)in macroalgal indicator species in the Narragansett Bay Estuary. PGEs (platinum, rhodium, and other related metals) are considered "critical elements", are very rare, and are used in many industrial settings including in electronics, catalytic convertors, and the refining of crude oil (among others). Additionally, they are known environmental pollutants and their entry into waterways via stormwater runoff has been well established. However, our knowledge of the concentration of PGEs in Narragansett Bay estuary waterways, and, in turn, their concentrations in estuarine organisms, is very limited. Recent studies have shown the ability of macroalgae to absorb PGEs (Abdou, et al. 2023; Pinto, et al. 2021; Rauch and Morrison 2008; Turner, et al. 2007). Thus, the ability of macroalgae to accumulate these compounds can make them attractive targets for recovering these very rare, critical elements. Here, we propose using the model species *Ulva* (green macroalgae) and *Gracilaria* (red macroalgae) in the highly urbanized Narragansett Bay Estuary to determine the concentrations of PGEs in Narragansett Bay to: 1) support the Blue Economy in Rhode Island by assessing the capability of local macroalgae to accumulate rare, critical elements; and 2) determine the prevalence of these known environmental pollutants in our waterways. This project will entail field collection of the macroalgae from various locations throughout the Narragansett Bay, laboratory research (with a focus on environmental engineering, marine ecology, and analytical chemistry), data analysis, and science communication.

Project Objectives
Our proposed research plan has two main objectives:

1. Establish the best protocol for determination and quantification of PGEs (platinum and rhodium) from macroalgae in the Narragansett Bay Estuary; and
2. Assess the concentrations of PGEs in macroalgae in this estuary across spatial and temporal frameworks.

For both objectives, we will use the rapidly growing *Ulva* (green macroalgae) and *Gracilaria* (red macroalgae) that occur throughout this estuary (Thornber, et al. 2017) and similar temperate estuaries worldwide. We will utilize the known pollution gradient in Narragansett Bay from North (high) to South (low) to assess the distribution of PGEs from highly impacted areas and their downstream counterparts (Oczkowski, et al. 2018). We will then share the findings of our research with the scientific community via presentations and other science communication tools (e.g., ArcGIS StoryMaps).

Designing near-infrared optical sensors of seawater contaminants using carbon nanotubes

Mentor(s)

Daniel Roxbury (Chemical Engineering, URI)

Location

University of Rhode Island

Abstract

Current methods to detect seawater contaminants such as heavy metals generally involve bulky and expensive equipment, prohibiting their use in portable on-site testing. Single-walled carbon nanotubes are an ideal candidate in the construction of next-generation sensors. Their intrinsic fluorescence is exceptionally photostable, with emission properties that are responsive down to the single molecule level. It has been demonstrated that the fluorescence from nanotubes responds to the accumulation of electrical charge in the immediate vicinity (less than 3 nm) of the nanotube's surface. Additionally, in the near infrared imaging window of 900-1400 nm, there exist >20 species (chiralities) of nanotubes that can be separated from a mixture, functionalized, and utilized for multiplexed optical sensing. Here, we will create a family of functionalized nanotubes to quantify concentrations of seawater contaminants. Nanotubes appropriately functionalized with small-molecule or aptameric chelators of target ions will have the capacity to simultaneously monitor bulk concentrations of up to 20 distinct species. Upon specific binding of a target ion to the chelator-nanotube complex, a characteristic red-shift is expected in the near-infrared emission spectrum due to perturbations in the localized dielectric environment of the nanotube. By sequentially separating by nanotube species and conjugating specified chelating agents, we propose to engineer specificity and selectivity to the optical nanosensors. A field deployable device incorporating an LED excitation source and NIR emission detector will be investigated to measure the optical responses of the nanosensors in real-time.

Project Objectives

1. Separate single-walled carbon nanotubes by species using state-of-the-art aqueous two-phase extraction protocols.

2. Functionalize the nanotubes to specifically sense heavy metal ionic species (namely, mercury, cadmium, and cobalt).

3. Investigate the sensor capabilities including limit of detection, response time, reversibility, and robustness

Characterizing foraminifera, an environmental indicator, in Rhode Island's salt marshes

Mentor(s)

Ying Zhang (Cell & Molecular Biology, URI)

Location

University of Rhode Island

Abstract

Foraminifera are important environmental indicators and have been frequently used for assessing environmental health. However, little is known about the abundance and distribution of benthic foraminifera in Rhode Island's coastal environment. In this project,we aim to establish an inventory of local foraminifera using microscopic imaging and molecular biomarker sequencing. Students will gain hands-on experiences in field sampling, microscopic imaging, and various molecular techniques such as DNA extraction, PCR, and sequencing. This study will provide a deeper understanding of morphological and biomarker diversity of foraminifera populations in coastal Rhode Island.The establishment of a well-curated inventory across different field sites will bring insights into the future applications using foraminifera as environmental indicators.

Project Objectives

Benthic foraminifera are important "environmental sentinels" and are used for the long-term monitoring of ecosystems health. They are reliable indicators of anthropogenic stressors and have been frequently used for the monitoring of organic overloading, sea water intrusion, and sea level rise. However, the diversity and distribution of benthic foraminifera in Rhode Island's coastal environment is largely unknown, limiting their applications in the formulation of an environmental index. This SURF project will fill an important gap in our understanding of local benthic foraminifera by providing a well curated inventory linking foraminifera morphological data with their molecular biomarkers. This inventory will contribute the future development of biomonitoring technologies for enabling the management and informing decision-makings in a blue economy.

Sustainable seafood production in the future

Mentor(s)
Coleen Suckling (Fisheries, Animal & Veterinary Science, URI)

Location
University of Rhode Island

Abstract
This project focuses on building resilience in our sea food systems. This will be achieved by establishing practices in relation to emerging species known to be resilient to climate change (e.g. scallops and sea urchins). It will also integrate sea urchins and their grazing habits to tackle problematic biofouling in shellfish aquaculture to reduce grower efforts and presence at farms, which in turn we hope will improve social acceptance of aquaculture in RI. The SURF Fellow will participate in transferrable skills development and application through the maintenance of research aquaria, monitoring marine animal health, assisting in physiology assessments, and managing seawater parameters, with data contributed to a shared database to enhance data-sharing skills. Additional responsibilities include conducting experimental design and implementing pilot trials and assisting in sea urchin fieldwork and sample processing to explore climate change impacts on reproduction and potential applications in aquaculture biofouling management and social acceptability of aquaculture. This project offers a comprehensive learning experience in resilience-building for ecosystems and seafood production in Narragansett Bay and New England.

Project Objectives

1. Enhance seafood resilience: Identify practical tools and strategies to mitigate climate change impacts on seafood production systems.
2. Strengthen research aquaria operations: Develop skills in animal health monitoring, husbandry, and physiology assessments.
3. Advance data management capabilities: Build proficiency in monitoring seawater parameters and managing experimental data in shared databases.
4. Support experimental and technological development: Gain hands-on experience in experimental design, pilot trials, and aquaculture innovation.
5. Evaluate sea urchin applications: Examine climate change impacts on sea urchin reproduction and their potential role in mitigating aquaculture biofouling issues.
6. Foster ecosystem and food production resilience: Contribute to broader efforts aimed at building resilience in marine ecosystems and food production systems in New England.

Occasional weekend may be required to conduct quick basic routine checks on the animals and seawater systems, and this will be scheduled in agreement with the research team across the project time. The fellow would also be expected to assist as needed on other projects such microplastics aquarium and/or field sampling. This project would be best suited for candidates with access to a vehicle for regular trips across campus and field work locations.

Blue Carbon in Succotash Salt Marsh

Mentor(s)
Erin Peck (Oceanography, URI)
Emily Hall (Oceanography, URI)

Location
University of Rhode Island

Abstract
Rhode Island salt marshes provide valuable ecosystem services but are threatened by climate and land-use change. To combat losses, state and federal agencies as well as non-profit organizations are using restoration to buy time for these important ecosystems. Succotash salt marsh in East Matunuck, RI is one such ecosystem that will undergo restoration efforts in the next ~2 years. Pre-restoration monitoring, especially of salt marsh sediment characteristics including accumulation rates are needed to inform restoration goals and decision making. Through analysis of sediment cores, the SURF undergraduate student will measure sediment and carbon accumulation rates, as well as identify potential stressors (such as sediment limitation) on salt marsh health. Their findings will be presented to state and federal partners.

Project Objectives
Succotash salt marsh, 182-acres located in the Village of East Matunuck, RI, is considered highly degraded and in danger of total loss due to rising sea levels. Restoration through sediment addition across the marsh surface is planned at Succotash in the next 1-2 years. Currently the salt marsh is being monitored by a number of state and federal agencies; however, additional data are needed. Specifically, Succotash salt marsh is currently being monitored for sediment accumulation rates using Sediment Elevation Tables (SETs); however, longer term accretion rates over the last century would provide insight into historic patterns of marsh growth and resilience to sea level rise. These rates of vertical salt marsh growth could help set a target for post-restoration accumulation rates. Further, identification of the primary contributor to elevation – the accumulation of mineral or organic matter – would improve understanding of past vulnerabilities to sea level rise (e.g., the degree of sediment limitation) and predictions for how the salt marsh will adjust with artificially added sediment during restoration. Three sediment cores (6.4-in diameter, ~0.3-m long) were collected in December 2024 by the PIs from Succotash salt marsh co-located with existing SETs. Two of these cores are within regions that will be restored and one is in a salt marsh that will serve as a control site. During summer 2025, the undergraduate student will section the cores at 1-cm increments and measure a number of sediment characteristics to determine rates of sediment and carbon accumulation and sources of sediment.

Salt marshes provide important ecosystem services, including flood protection for vulnerable coastal communities, habitat and nursery grounds for economically and culturally valuable fauna, and biogeochemical filtration of pollutants. Salt marshes are especially efficient sinks of carbon, thereby buffering climate change. Despite their economic and cultural value to Rhode Island, ~50% of the state's salt marshes have been lost over the last two centuries, and those that remain are threatened by rising sea level, encroaching invasives, and direct anthropogenic alteration. The proposed work would help support the ongoing pre-restoration monitoring efforts in Succotash salt marsh, thereby improving goal setting and decision making for restoration efforts.