RI SURF 2016 - RI NSF EPSCoR Projects

1. Temperature-mediated changes in blue crab abundance in the Narragansett Bay and its trophodynamic effect on winter flounder populations
2. Public perceptions of dam removal and migratory fish passage in an era of climate change
3. Estuarine microbiomes of Narragansett Bay
4. Impacts of legacy and emerging chemicals of concern on elasmobranch fishes
5. Monitoring harmful algal blooms in Narragansett Bay via ecological and aerial technology approaches and determining the impacts of climate change on the physiology of bloom-forming macroalgae
6. Fluid mechanical basis of universal natural propulsor bending
7. Approaching a holistic understanding of coral bleaching: using the coral *Astrangia poculata* to understand how the coral microbiome is influenced by *Symbiodinium*
8. Heat Shock Protein Hsp70 in *Geukensia demissa* and Climate Change in Narragansett Bay
9. Is neoplasia in hard clams infectious?
10. Testing resilience of coastal wetlands: “Experiments” to reverse nitrogen loading and sea level rise
11. Impacts of nitrogen and warming on shellfish pathogens and nitrogen cycling
12. Impacts of increased CO_2 on carbon mineralization at microbe-mineral interfaces
13. Building the Genome of *Ulva* spp. involved in Macroalgal Blooms
14. Understanding and quantifying disease resistance in selectively-bred oysters
15. Detection and *In Situ* Fluorescence-Based Monitoring of Hydrocabon Food Sources in Complex Marine Environments
16. Response of near shore marine macroinvertebrate and small fish populations to climate driven sea level rise and associated abiotic conditions.
17. Gene expression analyses of siphonophore growth and development
18. Trace Metal Uptake by Seaweed in Urban Intertidal Zones
19. *Entamoeba* spp. as models to explore the effects of environmental stress due to climate change in marine protists
20. Metallporphyrin-based chemosensors for the marine aqueous detection of thiocyanate ions by electrochemistry and spectrophotometry
21. Temperature effects on marine invertebrate physiology
22. Impacts of macroalgal accumulation on salt marsh environments
23. Do food-web changes explain population declines of coral reef fishes?
24. Evaluating oyster growth performance in upwellers under varying environmental conditions.
25. Allelopathic effects of macroalgae on shellfish larvae in RI under current and projected sea surface temperatures
26. Exploring Host-Microbiome Interactions in Marine Plankton

Projects by Primary Mentor Institution

Brown University

17. Gene expression analyses of siphonophore growth and development

Bryant University

3. Estuarine microbiomes of Narragansett Bay
18. Trace Metal Uptake by Seaweed in Urban Intertidal Zones

Providence College

6. Fluid mechanical basis of universal natural propulsor bending

Rhode Island College

4. Impacts of legacy and emerging chemicals of concern on elasmobranch fishes
8. Heat Shock Protein Hsp70 in *Geukensia demissa* and Climate Change in Narragansett Bay

Roger Williams University

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University of Rhode Island (main campus)

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University of Rhode Island (bay campus)

26. Exploring Host-Microbiome Interactions in Marine Plankton

Project Code: 1

Project Title: Temperature-mediated changes in blue crab abundance in the Narragansett Bay and its trophodynamic effect on winter flounder populations

Project Mentor(s): David Taylor (Roger Williams University)

Project Description:
There is growing concern over declining winter flounder populations in southern New England estuaries, including the Narragansett Bay (RI, USA). Although overexploitation was paramount in their initial population decline, several other factors could continue to adversely affect winter flounder recruitment, and thus keep adult populations at depressed levels. The precipitous decline in winter flounder abundance in the Narragansett Bay, for example, coincides with a significant warming trend in northern-temperate estuaries. Elevated temperatures, in turn, may intensify the predator-induced mortality of juvenile flounder by increasing the metabolism and consumption rate of local predators. Moreover, subtle increases in temperature may cause a poleward shift in the distribution of more southerly-located species, including the blue crab; hence, resulting in a spatio-temporal overlap with juvenile winter flounder in the Bay and newly established competitive and/or predator-prey interactions.

The decline in winter flounder abundance in Narragansett Bay, coupled with changes in climatic conditions, has raised the question of whether these previously overexploited stocks can recover in the face of altered trophic dynamics. To this end, the primary objectives of the proposed research are twofold: (1) assess the functional significance of Narragansett Bay (including associated tidal rivers and coastal lagoons) as habitat for juvenile winter flounder and blue crabs, and therefore quantify the spatio-temporal overlap between species, and (2) examine the putative biotic interactions between winter flounder and blue crabs using conventional stomach content analysis and biochemical techniques, i.e., polymerase chain reaction (PCR)-based molecular methods for detecting prey DNA.

Project Significance:
The products of this research may identify an important source of mortality for winter flounder in the Narragansett Bay, and further explain how temperature-mediated changes in trophic dynamics prevent flounder stocks from recovering to historical levels.

This project involves **both field and lab work**

Required/preferred skills:
Ability to work under adverse field conditions
Highly organized with great attention to detail
Strong writing and presentation skills

Students involved in this project will use/learn the following techniques:
<u>Field work:</u>

- Seining to collect flounder and crabs
- Measuring water quality parameters, including temperature, salinity, and dissolved oxygen
- Small boat handling

<u>Lab work:</u>

- Flounder and crab dissection
- Soft tissue extraction and preparation, the latter including lyophilization
- Flounder otolith extraction
- Visual analysis of flounder and crab stomach contents using dissecting scopes
- PCR analysis of crab stomach contents

Data analysis:

- Spreadsheet development and management using Excel
- Statistical analysis using SAS
- Visual representation of data using GIS

Project Code: 2

Project Title: Public perceptions of dam removal and migratory fish passage in an era of climate change

Project Mentor(s): Caroline Druschke (University of Rhode Island)

Project Description:
The SURF fellow will work under the direction of Dr. Caroline Gottschalk Druschke (Depts. of Natural Resources Science and Writing & Rhetoric, University of Rhode Island). Summer research includes textual and discourse analyses of news media, environmental impact statements, and semi-structured interviews, and might include either preparation for or execution of interviews, focus groups, and surveys with dam stakeholders and scientific team members. Students will focus on the major arguments that public stakeholders offer related to dam removal, and how impacts of dam removal on downstream estuaries may shift due to climate change.

Project Significance:
Scientific findings and forecasts in the area of climate variability and marine life can only be made more accessible to the public if we cultivate a better understanding of public perceptions about issues like migratory fish species and dam removals in an era of climate variability and change. This research will use news media, environmental impact statements, and existing interviews to gather baseline data about public perceptions of dams and dam removals.

This project involves **primarily lab work**

Required/preferred skills:
The ideal student will have an interest in New England dams, migratory fish species, and/or environmental rhetoric and communication and be interested to work on a cross-disciplinary project that fuses social and ecological perspectives.

Students involved in this project will use/learn the following techniques:
Students will gain familiarity with NVivo qualitative analysis software, training in rhetorical analysis, media discourse analysis, and possibly in qualitative interviews and survey design. Students will also receive training in how to create and present a scientific poster related to their work and will gain useful skills in working as part of a large-scale, multi-state, collaborative team.

Project Code: 3

Project Title: Estuarine microbiomes of Narragansett Bay

Project Mentor(s): Christopher Reid (Bryant University)

Project Description:
This study proposes to look at the microbiome of the Providence river estuary, in particular we will continue to focus on the identification of the species present and quantifying key microbial genera. This work is tied to Dr. Parmentier's work on the Providence River and metal contamination into the intertidal regions of Narragansett bay. We will be utilizing next-generation sequencing to identify members of the microbial community through 16srDNA sequencing.

Project Significance:
Through combining our data with that on the alterations on fate and transport of contaminants (Dr. Parmentier) in the estuary due to climate change and that of similar estuarine environments in New England we will be able to identify microbial species that are either impacted or augment the levels of these contaminants entering the bay.

This project involves **both field and lab work**

Required/preferred skills:

Students involved in this project will use/learn the following techniques:

- genomic DNA extraction
- polymerase chain reaction
- FISH fluorescence microscopy
- bioinformatics

Project Code: 4

Project Title: Impacts of legacy and emerging chemicals of concern on elasmobranch fishes

Project Mentor(s): Rebeka Merson (Rhode Island College)

Project Description:
The overall goals of the project are to assess impacts of environmental pollutants on elasmobranch fishes inhabiting Narragansett Bay (sharks and skates). Many chemical pollutants cause toxicity by interacting with proteins that regulate gene expression. The aryl hydrocarbon receptor (AHR) is a transcription factor that binds to and is activated by many environmental chemicals. This project is to investigate the impacts of chemicals known to act through the AHR using the little skate excasing model of elasmobranch development, which we have established is sensitive to environmental AHR ligands. Students work on every aspect of this project, including animal husbandry, experimental design and implementation, dissection and tissue collection, image analysis, and biochemical assays.

Project Significance:
This research addresses impacts of environmental pollutants on apex predators that inhabit marine habitats in Rhode Island. Increases in precipitation and frequency of heavy precipitation events expected with the changing climate will move contaminants into Narragansett Bay via roadway run-off and releases of waste from wastewater treatment plants that occur when plants are over handling capacity. Many of these chemicals enter the food webs, accumulate, and magnify with increasing trophic level. This project seeks to assess the sensitivity of elasmobranch fishes, apex predators that assert top-down regulation of food webs, to the toxicity of legacy and emerging chemicals of concern.

This project involves **primarily lab work**

Required/preferred skills:
High level of motivation, dedication, and curiosity; keen observation skills and attention to detail; good oral and written communication skills; team player

Students involved in this project will use/learn the following techniques:
- process of science (experimental design, hypothesis testing, record keeping);
- animal husbandry;
- digital imaging and analysis;
- enzyme assays;
- microscopy

Project Code: 5

Project Title: Monitoring harmful algal blooms in Narragansett Bay via ecological and aerial technology approaches and determining the impacts of climate change on the physiology of bloom-forming macroalgae

Project Mentor(s): Lindsay Green (University of Rhode Island), Carol Thornber (University of Rhode Island), & Stephen Licht (University of Rhode Island)

Project Description:
This project will be conducted under the guidance of Dr. Lindsay Green (URI), Dr. Carol Thornber (URI) and Dr. Stephen Licht (URI). We are currently investigating the formation and regulation of algal blooms and testing the accuracy of recently developed aerial technology. The fellow's project will involve frequent fieldwork to conduct surveys of, and experiments on, bloom physiology and development, as well as work with image analysis and aerial photography. The student will spend the significant time at URI Kingston, at the URI Marine Life Sciences Facility (URI/Narragansett), and at field sites in Narragansett Bay.

Project Significance:
Blooms of macroalgae (seaweed) frequently occur in estuarine systems worldwide. Macroalgal blooms can cause serious ecological and economic impacts on nearshore marine communities and are thus of considerable interest to scientists, managers, and coastal human populations. As climate change occurs, the magnitude and duration of blooms is predicted to increase, which may also have strong impacts on the structure and functioning of coastal marine food webs. This project will focus on: 1) monitoring the occurrence of macroalgal blooms in Narragansett Bay and 2) determining the response of bloom-forming macroalgae to predicted climate change scenarios with a focus on the impacts of increased precipitation

This project involves **both field and lab work**

Required/preferred skills:
Required skills for this project include an ability to work carefully and independently, comfort in working outside in inclement weather, a valid driver's license and transportation to URIs main campus daily, a flexible work schedule as some weekend and early morning/late evening work may be required, and a familiarity with Microsoft Excel. It is preferred that the student has experience in identifying marine macroalgae (seaweed).

Students involved in this project will use/learn the following techniques:

- Learn how to identify bloom-forming macroalgae using morphological and likely molecular approaches, algal culturing techniques, and ecological field protocols.
- Gain extensive experience setting up, maintaining, and analyzing data from laboratory-based seawater experiments.
- Work collaboratively with ocean engineers (Dr. Licht's lab).

Project Code: 6

Project Title: Fluid mechanical basis of universal natural propulsor bending

Project Mentor(s): Jack Costello (Providence College) & Sean Colin (Roger Williams University)

Project Description:
Other than body streamlining, there are few morphological examples of natural solutions for propulsion in fluids that are as ubiquitous among animals as stereotypic bending kinematic patterns. Bending location and extent are remarkably similar across disparate animal lineages moving in different fluid media and integrate a variety of phylogenetically determined propulsor sizes and materials. However, current approaches to understanding propulsor flexibility offer little insight into why such diverse animal propulsors bend with such predictable regularity. We suggest that swimming and flying animals have converged on constrained bending kinematics due to fluid dynamic forces that affect maneuvering in fluids. We propose to use animal models to document: 1) the fluid mechanical foundations of these patterns, 2) organizing principles for application of these forces, and 3) the constraints on application of these fluid dynamic forces to propulsor bending. By identifying the relationships between bending kinematics and force generation, we will test the general hypothesis that the magnitude and position of propulsor bending predictably determines propulsive forces. We will then test whether patterns determined from these analyses are evident in propulsor kinematics across a broad spectrum of the animal kingdom.

Project Significance:
Movement patterns of animals are strongly affected by temperature and fluid density patterns that may be associated with climate change.

This project involves **primarily lab work**

Required/preferred skills:
Some quantitative training
genuine interest

Students involved in this project will use/learn the following techniques:
- Image analysis
- Fluid dynamic measurements

NOTE: This project will be carried out at the Marine Biological Laboratory in Woods Hole, MA

Project Code: 7

Project Title: Approaching a holistic understanding of coral bleaching: using the coral *A. poculata* to understand how the coral microbiome is influenced by *Symbiodinium*

Project Mentor(s): Koty Sharp (Roger Williams University)

Project Description:
We will use wild, *in situ* sampling from local sites in Narragansett Bay and aquarium experiments to explore the influence of the photosynthetic symbiont *Symbiodinium* on the prokaryotic microbiome in the coral *Astrangia poculata*. Molecular approaches (16S amplicon sequencing, metagenomics, and advanced microscopy) will be used to characterize the taxonomic and functional diversity of bacteria and archaea in wild samples of brown (high *Symbiodinium* density) and white (low *Symbiodinium* density) colonies of *Astrangia poculata*. In addition, *Astrangia poculata* colonies will be collected from local sites and brought back to the laboratory for controlled manipulations of *Symbiodinium* in aquaria. The response of the microbiome to shifting *Symbiodinium* densities will be analyzed using 16S amplicon sequencing and metagenomics.

Project Significance:
Coral reefs are among the most ecologically important ecosystems in the ocean, but they are declining on a global scale in response to climate change. In response to increasing sea surface temperature, corals "bleach," or lose their obligate photosynthetic symbionts, *Symbiodinium* spp. We now know that diverse but specific groups of bacteria are also involved in coral health and responses to climate change, and that Symbodinium appears to influence the coral microbiome composition. In our lab, we study the local, facultatively symbiotic coral *Astrangia poculata*, which offers a unique opportunity to identify functional linkages in multi-partner coral symbioses, particularly among *Symbiodinium*, bacteria, archaea, and the coral host. Our results will inform studies of less experimentally tractable coral holobionts, including reef-building species for which coral bleaching critically destabilizes the coral-associated microbiome, with important consequences for holobiont health and biogeochemical cycling.

This project involves **both field and lab work**

Required/preferred skills:
Required:
Ability to participate in fieldwork (either in the water or onshore support)

Preferred:
Basic aquarium husbandry experience
Molecular benchwork experience

Students involved in this project will use/learn the following techniques:
- Microbiology and molecular biology fieldwork/collection techniques
- Sterile technique
- Basic aquarium husbandry
- Bioinformatics & sequence analysis
- Molecular benchwork, including DNA extraction and polymerase chain reaction (PCR)
- Dissecting and Epifluorescence Microscopy
- Fluorescence in situ hybridization (FISH) of microbes in animal tissue
- Data processing/generation of figures

Project Code: 8

Project Title: Heat Shock Protein Hsp70 in *Geukensia demissa* and Climate Change in Narragansett Bay

Project Mentor(s): John Williams (Rhode Island College)

Project Description:
We will continue our study of *Geukensia demissa* as an indicator climate change and the overall health of the ecosystem of Narragansett Bay. The target organism, commonly known as the Atlantic ribbed mussel, is an intertidal bivalve native to Narragansett Bay and found along the coast from the St. Lawrence river to Texas. When exposed to heat stress, these organisms express heat shock proteins (Hsp). Heat shock proteins are a class of chaperone protein which refold and protect other proteins from heat damage. They also identify and dispose of irreparably damaged proteins. Specifically, this study involves heat shock protein 70 (Hsp70) of molecular weight 70kD. Organisms are collected from sites along the bay and either acclimated to room temperature, heat treated, or dissected on-site before being analyzed for protein expression. Collection sites are Passeonkquis, Warwick, RI; Watchemoket, East Providence, RI; and Fox Hill, Jamestown, RI. The tissue samples are homogenized, extracted, isolated by gel electrophoresis and imaged by Western blotting and antibody labeling to quantify the expression of Hsp70.

Project Significance:
Expression of heat shock proteins in intertidal ectotherms occurs during summer and periods of unseasonably warm weather. These are chaperon proteins that are expressed as a survival response that protects constitutive proteins from denaturing or removes irreversibly damaged ones from the cell. Earlier appearance, later subsidence and higher amounts of expression are indicators of temperature elevation onset and duration in the aqueous environment. In addition to threatening survival of the extant individual organisms, this may also put evolutionary pressure on populations to which they cannot respond if the rate of increase and elevation of ambient temperature are too high, or the duration of heating too long.

Monitoring the temperature using *G. demissa* as a sentinel species and comparing absolute values and trends with climate records of past decades will reference the data to the present. This project can lead to a long-term study in which several generations of undergraduate and graduate students can participate to generate significant climate-change monitoring data for Narraganset Bay.

This project involves **both field and lab work**

Required/preferred skills:
Advanced (above entry level) biology and/or chemistry courses. A course in biochemistry is desirable but not necessary.

Students involved in this project will use/learn the following techniques:
Tide monitoring, sample collection, maintaining viable samples in the lab, dissection, homogenization of tissue, extraction of protein, gel electrophoresis, Western blotting, primary and secondary anti-body labeling, dark room exposure of blots, identification and quantification of samples on film, statistical analysis of results, keeping a laboratory notebook, maintaining a working laboratory environment, ordering and managing chemicals and supplies, presentation of results at our research group meetings, preparing posters and presenting them at public meetings, contributing to manuscripts for submission to journals

Project Code: 9

Project Title: Is neoplasia in hard clams infectious?

Project Mentor(s): Roxanna Smolowitz (Roger Williams University)

Project Description:
In the summer of 2009, a neoplastic disease was observed in hard clams (*Mercenaria mercenaria*) from Wellfleet, MA when large quantities of adults, 2-3 years old, began to surface and die. Studies performed on these animals showed the presence of a few to abundant large, unusual cells in the vascular system. The tumorous cell caused obstruction of the vascular system and was associated with a loss of normal hemocytes (clam blood cells). This disease had not been indentified in hard clams previously and it is though that a changing environment may be partly responsible for it's appearance in the MA harbor. Hard clams purchased from three different hatcheries, that are not infected when placed into the harbor, develop the disease when cultured in the MA harbor. These recent findings indicate the disease may be infectious and may be promoted by increased temperature in the harbor. Over the succeeding years, the disease prevalence and intensity has increased and spread throughout clams in the harbor resulting in significant loss of income to the aquaculturists. Additional, there is great concern about this disease spreading to other hard clam growing areas. The disease is similar to the disseminated sarcoma found in soft shell clams. Recent work on the tumor in soft shell clams has implicated an infectious cell, not a virus, bacteria or fungus as the cause of the disease. It is possible that the disease noted in hard clams may have similarities in cause to that of soft shell clams. The objective of this project is to pursue two avenues of investigation. First, we need to determine the ploidy of the tumor cells and second, we would like to investigate the infectivity of neoplastic cells for naïve hard clams at different temperatures.

For the first objective, work will be conducted at Roger Williams Aquatic Diagnostic Lab (ADL) and with use of the RWU Fluorescence Activated Cell Sorter (FACS). In 2015, we harvested several samples of neoplastic cells from individuals examined as part of our monitoring work of hard clams with Barnstable County Cooperative Extension. Additional animals will be collected and examined in the spring of 2016. This disease is seasonal with the highest proportion of neoplastic clams found in the spring to early summer. Clams are collected around May/June. Collected clams are "bled" by removing approximately 0.4 ml of hemolymph with a 1 ml syringe and examining hemolymph preparations (similar to a blood smear) to identify affected and unaffected individuals. Animals from known infected areas have then been bled a second time to collect additional cells for FACS examination. These cells have been archived in alcohol. In 2016, additional animals will be evaluated (over the number routinely examined for disease prevalence) and normal and abnormal animals will be identified by making the shells with permanent ink and holding them in small aerated tanks in the isolation room of the ADL for later use. These animals can be used later for fresh hemolymph sample collection and can be used in the second objective of this study.

In the second part of this study, we will attempt to cause the infection in naïve hard clams by exposing them to infected animals, to neoplastic cells that have been removed from an infected animal and suspended in sea water and to neoplastic cells injected into the pericardial sac. This work will be conducted at two different temperatures. This work will occur in our isolation unit within the RWU Aquatic Diagnostic Laboratory. The person involved in this work will also participate in the everyday diagnostic laboratory functions conducted by other students, the technician and the mentor in the laboratory.

Project Significance:
If this disease results from changes in environment, it is possible we may see an increase in the coming years and in different locations. Since the disease has significant effected on the aquaculture industry, it is important the we understand it to prevent or mange it in the future.

This project involves **primarily lab work**

Required/preferred skills:
An upper level biology student with strong interests in disease and or marine biology.

Students involved in this project will use/learn the following techniques:
The student will learn to use A FACS, an important instrument for the study of cells. The student will also learn to conduct experimental infection studies that can fulfill Koch's postulates. Additionally, the laboratory engages in various qPCR and other diagnostic methods in which the student will be able to participate.

Project Code: 10

Project Title: Testing resilience of coastal wetlands: "Experiments" to reverse nitrogen loading and sea level rise

Project Mentor(s): Serena Moseman-Valtierra (University of Rhode Island) & Katelyn Szura (University of Rhode Island)

Project Description:
Coastal wetlands play major roles in global carbon cycles and nutrient cycling and they are valued for many other reasons (habitat for wildlife, coastal protection). However, they are strongly impacted by rising sea levels and human impacts such as nutrient loading. In RI, unique efforts are underway to save coastal ecosystems such as wetlands, by reducing nitrogen loads from sewage to Narragansett Bay. Our lab is studying the ecology and function of RI marshes and their responses to: (A) major recent reductions in nitrogen loads to Narragansett Bay and (B) experimental efforts to reduce sea levels by draining standing water off of marsh surfaces. We are asking: (1) How do changes in nitrogen loads and/or sea level affect the ability of coastal marshes to remove CO_2 from the atmosphere? (2) Under which environmental conditions do marshes emit other greenhouse gases (methane and nitrous oxide)? Two undergraduates are sought to develop projects related to these two on-going studies of coastal wetland ecosystems in Rhode Island.

Project Significance:
This research will directly assess active coastal restoration efforts by revealing how carbon and nitrogen cycling in the wetlands change following reduction of nitrogen loads or slowing/ reversal of sea level rise. They contribute to the broader scientific understanding about limits of ecosystem function amidst global stressors by testing potential for wetland resilience. This also contributes to limited data thus far about greenhouse gas fluxes in coastal ecosystems, which is needed to support coastal restoration activities and to potentially connect them to financing that is available in voluntary carbon markets.

This project involves **both field and lab work**

Required/preferred skills:
Successful completion of general chemistry required.
Preferred completion of an Ecology course.

Students involved in this project will use/learn the following techniques:

- Cavity ringdown spectroscopy real-time greenhouse gas analyzer (Picarro Labs) to measure greenhouse gas fluxes from the marsh surface
- Soil parameter measurements: pH, soil moisture, oxidation-reduction potential, porewater collection and sulfide analyses, salinity
- Plant measurements: stem density, percent cover, salt marsh species identification
- Collection of soil cores and proper storage for molecular analyses
- Data analysis in Matlab or R, JMP (stastistical analysis), Excel

Project Code: 11

Project Title: Impacts of nitrogen and warming on shellfish pathogens and nitrogen cycling

Project Mentor(s): Serena Moseman-Valtierra (University of Rhode Island) & Ashley Hogan (University of Rhode Island)

Project Description:
Shellfish are important components of coastal ecosystems and they play major roles in nitrogen cycling. Yet, they are threatened by climate change and pollution of coastal waters. This collaborative project will test the impacts of warming and nitrogen loading on health of oysters and their roles in nitrogen cycling. One student is sought to assist a graduate student with examining oyster responses in a field-based nitrogen addition experiment in Point Judith pond and in laboratory mesocosms that will be exposed to a 2-factor gradient of nitrogen levels and temperatures.

Project Significance:
Coastal managers need better understanding of how multiple stressors such as nitrogen loading and climate change may alter the health of shellfish, because of their ecological, cultural, and economic significance. We are assessing direct impacts on pathogen loads and testing potential links to nitrogen cycling that need to be better understood to protect and manage these valuable resources.

This project involves **both field and lab work**

Required/preferred skills:
Successful completion of general chemistry (required), successful completion of a course in Marine Biology (preferred).

Students involved in this project will use/learn the following techniques:

- gas chromatography
- YSI probe
- aquarium maintenance
- quantitative PCR
- colorimetric nutrient analyses

Project Code: 12

Project Title: Impacts of increased CO_2 on carbon mineralization at microbe-mineral interfaces

Project Mentor(s): Dawn Cardace (University of Rhode Island) & Abigail Johnson (University of Rhode Island)

Project Description:
Using the Geochemist's Workbench geochemical modeling program, the researcher will structure a series of microbe-mineral colonization experiments designed to highlight differences in energy availability to marine microbial communities that depend on mineral substrate and ocean chemistry. The researcher will then build and carry out experiments that pertain to the model, using naturally occurring minerals (felsic, mafic, and ultramafic igneous minerals, plus sedimentary phases) common to coastal seabeds. Polished mineral surfaces prepared by the researcher will be observed for cell adhesion to mineral surfaces and small degrees of secondary mineral precipitation (via microscope-assisted FTIR and possibly SEM).

Project Significance:
The capacity of microbes to fix carbon under increasing CO_2 conditions may be controlled by available mineral substrates in coastal seafloor environments. A suite of minerals that are common to coastal marine sedimentary settings will be evaluated at varying pH conditions. Microbial colonization strategies and carbon fixation potential will be assessed.

This project involves **primarily lab work**

Required/preferred skills:
Required qualifications: commitment to geobiological research
Preferred qualifications: completion of GEO320 [Earth Materials] or equivalent course with mineralogy content.

Students involved in this project will use/learn the following techniques:

- Geochemist's Workbench software use
- Rock polishing/grinding in a rock lab
- Microscope use
- Fourier-Transform Infrared Spectroscope use
- Possible SEM work

Project Code: 13

Project Title: Building the Genome of *Ulva* spp. involved in Macroalgal Blooms

Project Mentor(s): JD Swanson (Salve Regina University)

Project Description:
This project will leverage genomic and transcriptomic data (Pac Bio and Illumina) recently acquired through high throughput sequencing methods. Our goal is to assemble and annotate that *Ulva* genome to define it as an example species for the blooming macroalgae in the Narragansett bay.

This project will use bioinformatics as well as "wet" methods (including PCR, sanger sequencing, and qPCR) to verify the asembly.

Project Significance:
This project is highly significant as it represents a comprehensive look into the genome of *Ulva*. This will step our project forward significantly as it will be able to leverage our previous work on identifying genes that are causative in the formation of blooms in the Narragansett bay. In particular, a genome will allow promoter information to become accessible for genes that we have found are responsive to high and low light conditions, seeming one of the major drivers for blooms.

This project involves **primarily lab work**

Students involved in this project will use/learn the following techniques:

- Bioinformatics
- DNA/RNA Extraction
- PCR
- qPCR
- primer design
- gel electrophoresis
- DNA quantification.

Project Code: 14

Project Title: Understanding and quantifying disease resistance in selectively-bred oysters

Project Mentor(s): Tal Ben-Horin (University of Rhode Island) & Dina Proestou (USDA Agricultural Research Service)

Project Description:
Oyster aquaculture is a booming industry across the Atlantic coast, including Rhode Island. This industry faces a number of serious challenges, including naturally-occurring diseases such as Dermo, caused by the protozoan parasite *Perkinsus marinus*. This parasite, originally restricted to southern, warmer waters, has recently spread as far north as Massachusetts, coincident with increased temperatures in western Atlantic estuaries. The effects of Dermo disease, exacerbated by global climate change, have led to major losses in oyster production in recent decades, threatening the economic viability of this industry. The genetic improvement of oyster lines for resistance to naturally-occurring pathogens is an attractive option to reduce the impacts of disease on oyster production. In this study we will combine laboratory and field experiments to 1) quantify the variability in the phenotypic responses of selectively-bred oysters to Dermo disease, including variability in gene expression profiles and 2) identify potential genetic markers associated with disease resistance.

Project Significance:
Dermo disease is temperature-dependent and is predicted to increase in occurrence and severity as water temperatures increase along the New England coast. This project addresses how oyster hosts respond to pathogens and develops tools to alleviate disease impacts on the oyster aquaculture industry.

This project involves **both field and lab work**

Required/preferred skills:
Introductory biology and chemistry.

Students involved in this project will use/learn the following techniques:
Students will gain experience working as part of an interdisciplinary team in the laboratory and field. Specific skills include animal husbandry and aquaria maintenance, water quality monitoring, cell culture, DNA/RNA isolation and polymerase chain reaction (PCR).

Project Code: 15

Project Title: Detection and *In Situ* Fluorescence-Based Monitoring of Hydrocabon Food Sources in Complex Marine Environments

Project Mentor(s): Mindy Levine (University of Rhode Island)

Project Description:
As a result of the ongoing and accelerating pace of climate change, there is a pressing need to study the food supply of marine organisms in response to such change. Many of these marine organisms consume hydrocarbons, including n-alkanes, branched alkanes, aromatic hydrocarbons, and a variety of poorly characterized polymeric hydrocarbon species. The abundance of these hydrocarbons in marine ecosystems as well as their distribution, availability, and solubility are all affected by climate change; as such, developing methods for the sensitive, selective, and rapid detection of broad categories of hydrocarbons in complex marine environments is a crucial tool in understanding the effect of climate change on marine ecosystems.

Currently used detection systems rely on mass spectrometry, which has a number of drawbacks including the need for tedious sample preparations and the fact that it is often difficult to distinguish structural isomers with identical molecular weights in a high-throughput fashion. Moreover, because of the exquisite sensitivity of mass spectrometry-based methods, extraneous spectral signals are often present. As a result, in order to conduct high throughput screening of contaminated environments in a rapid time frame, one needs *a priori* knowledge of the toxicant(s) of interest. Such knowledge is often not available.

Our group has developed a fluorescence-based method for the facile detection of aromatic and non-aromatic toxicants in complex environments, including marine environments. This method relies on the use of a non-toxic commercially available sugar molecule, cyclodextrin, as a supramolecular scaffold to promote non-covalent interactions between the toxicant of interest and a high quantum yield fluorophore that leads to toxicant-specific fluorescence responses that are sensitive to low levels of the toxicant, selective to generate unique response patterns for each toxicant of interest, generally applicable for broad classes of toxicants in multiple complex environments, and rapidly able to generate a fluorescence response signal. This detection system has resulted in 11 peer-reviewed publications over the past 4 years describing the successful detection of toxicants and toxicant metabolites in seawater, crude oil collected from the site of an oil spill, human urine, and human breast milk.

The EPSCOR-funded undergraduate student will gain hands on research experience with real-world applicability. Working in a well-established chemistry laboratory will make the students more safety conscience and vastly improve his/her laboratory citizenship and experimental techniques. This will, in turn, significantly enhance his/her knowledge of chemistry and broaden his/her analytical skills. As such skills and experience are a necessity, early exposure to these methods will strengthen the student's background when applying to graduate schools and acquiring future jobs. Specifically, the undergraduate researcher will learn about the basic theory and applications of fluorescence spectroscopy and supramolecular chemistry. This will be implemented through the student's work on the use of this method for the detection, quantification, and monitoring of polycyclic aromatic hydrocarbons and non-aromatic linear and branched alkanes in complex marine environments. He/she will study the effect of temperature on the amount, distribution, and availability of these hydrocarbons, which are crucial food sources for a wide variety of marine organisms. He/she will use these results to obtain a significantly improved understanding of how climate change has, and will continue to have, measurable impacts on the complex marine ecosystems, specifically through disrupting the food supply of such organisms.

Project Significance:
Climate change that occurs as a result of global warming poses significant risks and stressors to the wide variety of marine organisms. As the temperature increases, the availability of polycyclic aromatic hydrocarbons

(PAHs) and non-aromatic hydrocarbons increases as a result of their marked solubility increase. Organisms that consume these PAHs, namely green algae and cyanobacteria, in turn, have a markedly increased food supply. These organisms are food sources for several species of fish, and changes in the population of this algae and bacteria will have rippling effects throughout the food chain. There is a need to be able to rapidly, sensitively, and selectively detect PAHs and related hydrocarbons to preserve the ecosystems of marine organisms. Currently used mass-spectral based detection systems are expensive and time consuming. Our research group has developed a novel fluorescence-based detection method, and the EPSCOR-funded undergraduate student will work on applications of this detection method for the improved understanding of climate change and its effects on marine organisms, their food supply, and the complex marine food webs.

This project involves **primarily lab work**

Required/preferred skills:
An interest in chemistry and marine life!

Students involved in this project will use/learn the following techniques:

- Fluorescence spectroscopy
- Array-based detection
- Statistical analysis
- Pattern-based recognition
- Temperature-dependent spectroscopy

Project Code: 16

Project Title: Response of near shore marine macroinvertebrate and small fish populations to climate driven sea level rise and associated abiotic conditions.

Project Mentor(s): Jameson Chace (Salve Regina University)

Project Description:
The team will complete the assessment of population habitat modeling in the near shore environment of Narragansett Bay and measurement of near shore abiotic conditions. Conditions include substrate quanitification in the intertidal, subtidal and supratidal zones, water quality conditions (D.O., pH, temperature, salinity), and quantification of organisms across the marine food web, from phytoplankton to sea ducks. Students will use small boats, modified fish traps, substrate sampling techniques and GPS units to model the current habitat associations and predict changes associated with projected sea level rise. Students will have an opportunity to use GIS to map and analyze over five years of data.

Project Significance:
Sea level rise will affect abiotic conditions and change the abundance and distribution of available habitat for marine near shore organisms which will likely affect the community composition in space and time. Trophic cascading effects are predicted as a result of climate change in the near shore environment of Narragansett Bay.

This project involves **primarily field work**

Required/preferred skills:
- Biology, Environmental Science or Environmental Studies Majors
- completed Sophomore year
- valid drivers license and a car
- Have passed the DEM boating safety course BEFORE June 1, 2016
- Ability to swim
- Have at least some small boat handling skills

Students involved in this project will use/learn the following techniques:
- small boat handling
- population sampling design
- quantification of abundance, richness and diversity
- habitat analysis and measurement of species specific habitat use models
- Use of YSI water quality tools
- Applications of statistical software and statistical analysis
- Some use of GPS and GIS equipment and software

Project Code: 17

Project Title: Gene expression analyses of siphonophore growth and development

Project Mentor(s): Casey Dunn (Brown University)

Project Description:
Gelatinous zooplankton are an important component of the marine pelagic food web. Siphonophores in particular are important - they are highly abundant in the epipelagic and mesopelagic zones and are active predators. Despite their abundance and importance in marine ecosystems, little is known about many aspects of their biology. We seek to close this gap by describing fundamental features of the molecular mechanisms of siphonophore development that are already well studied in many other organisms. We will achieve these goals by investigating the spatial location of gene transcripts in the polygastric (colony) stage of the siphonophore *Nanomia bijuga*. In particular, we are interested in genes involved in axial patterning, that is, genes that are thought to be involved in or driving, breaks in symmetry during development.

Siphonophores are colonial and are composed of genetically identical zooids (bodies) that are considered to be homologous to solitary individuals. Siphonophores grow from one or two growth zones, where new bodies bud and grow along an elongating stem. Each of these buds is packed with undifferentiated stem cells, which become more restricted as the bodies mature. The molecular mechanisms that underlie the development and differentiation of different body types is not yet characterised. We will use molecular tools, including in-situ hybridization methods, to gain a preliminary understanding of how primary and perhaps also secondary axes are established.

Project Significance:
To gain a better understanding of the stress responses and evolutionary potentials of siphonophores in response to climate change, it is important to first gain a baseline understanding of the ways in which different siphonophores grow and develop. Unlike other non-colonial organisms, siphonophores consist of many different functionally specialized body parts at various levels of development. Our current understanding of their development is poor, which in turn impedes studies of their life history that are fundamental to understanding and predicting their population dynamics and resource allocation under different environmental conditions.

This project involves **primarily lab work**

Required/preferred skills:
Basic molecular lab experience (pipetting, PCR, running a gel) is preferred, but not required.

Students involved in this project will use/learn the following techniques:
An undergraduate working on this project will gain new skills throughout the duration of the project. During probe development, they will gain experience with computational skills (identifying genes, gene trees, homologous sequences), primer design, PCR, Sanger Sequencing, Cloning, *in-situ* hybridization, and siphonophore systematics and anatomy.

Project Code: 18

Project Title: Trace Metal Uptake by Seaweed in Urban Intertidal Zones

Project Mentor(s): Julia Crowley Parmentier (Bryant University)

Project Description:
This proposal builds on previous studies that have demonstrated preferential uptake of trace metals, including Ar, Zn, Cu, Cd, and Pb in seaweed growing in the intertidal zone adjacent to industrial sites on the Providence River, RI at the head of the Narragansett Bay. In this study we will investigate the potential for impact on species that feed on the seaweed, and whether the seaweed acts as a cycling mechanism transferring metals from the sediment to the water.

We will be collecting seaweed, sediment and water samples from previously sampled sites at different times in the tidal cycle. We anticipate that trace metal concentrations would be higher in seaweeds collected after low tides as the water is coming in, than in those collected (after high tide, as the tide is going out. We will also be collecting samples of dry seaweed to see whether these still retain high metal concentrations, thus could contribute to contaminant uptake by marine organisms in the form of suspended or colloidal particles in the water.

Project Significance:
Climate change forecasts for the Northeastern U.S. predict increased precipitation and more severe storm events. This is likely to result in increased flushing of contaminants from shoreline industrial sites into the Providence River and subsequently into Narragansett Bay. To the extent that increased temperatures are likely to promote growth of seaweed, understanding their role in the cycling of trace metal contaminants is an important component to assessing long term impacts to the structure and function of the marine food web .

This project involves **both field and lab work**

Required/preferred skills:
Students should be interested in the project and willing to work hard.

Students involved in this project will use/learn the following techniques:
An undergraduate working on this project will learn both field and laboratory techniques. We will be collecting samples, and taking field measurements of parameters such as temperature, pH, conductivity and dissolved oxygen. In the lab, the student will have the opportunity to use an Milestone Ethos Microwave to digest samples, and an Agilent ICP Mass Spectrometer to analyze for metals.

Project Code: 19

Project Title: *Entamoeba* spp. as models to explore the effects of environmental stress due to climate change in marine protists

Project Mentor(s): Avelina Espinosa (Roger Williams University)

Project Description:
The *Entamoeba* lineage belongs to the Amoebozoa, one of six major divisions of eukaryotes. *Entamoeba trophozoites*, similar to other protists, actively capture ingest and digest bacteria thorough anaerobic pathways that process diverse energy sources. Little is known about the basic biology of marine and fresh water amoebozoans, their complex behaviors and interactions, or the effect of climate change on these unexplored groups. Many Amoebozoa alternate a unicellular trophozoite stage with transitional stages. The most common is the formation of a dormant cyst in response to environmental stress. *Entamoeba* varieties have evolved specific traits to adapt to free living, parasitic or commensal life styles; which require biochemical, behavioral and molecular approaches to elucidate the interactions at play. Chemical interactions that deter feeding on prokaryotic cells may be common, and may contribute to population- and community-scale processes, affecting trophic structure, easily disrupted by environmental stresses (e.g. due to climate change). Most free-living protists, including marine eukaryotes, are non-culturable in the laboratory. The *Entamoeba* lineage is an ideal model to analyze comparative cell signaling between/among amoeba with morphological, multi-gene, and ecological studies in a laboratory setting. We hypothesize that chemical signaling between diverse *Entamoeba* will be limited because they live under different ecological conditions. Understanding chemical signaling at the unicellular level will help us understand the effect of environmental stresses, including climate change on fresh water, marine and parasitic marine protists.

Project Significance:
The aims are directly connected to the research question selected above:

1. Signaling mechanisms secreted by *Entamoeba* spp. in response to environmental stress. Generalizations can be made on the effects of climate change in marine amoebozoans.

2. Explore mutations in AdhE enzymes on potential adaptive strategies under stressful conditions (oxygen, temperature, or pH) as consequence of environmental stress (due to climate change)

This project involves **primarily lab work**

Required/preferred skills:
- Strong interest in molecular microbiology
- Sophomore status for summer 2016

Students involved in this project will use/learn the following techniques:
- Combinatorial strategies will include bioinformatics (i.e. *Entamoeba* genome projects), scientific visualization (fluorescence dyes and microscopy), and behavioral patterns to explore the interaction of climate stresses on *Entamoeba* strains, as models of anaerobic free-living or parasitic marine amoebozoans.

- Fluorescence labeling and protein characterization: Fluorescent labeling of *Entamoeba* cells. CellTracker Red and Green CMFD (Invitrogen, Carlsbad, CA) will be used to fluorescently label *Entamoeba* cells, as detailed in Espinosa & Paz-y-Miño-C (2012). Cells will be incubated at 25 °C for 36 h and analyzed at 12, 14, 18, and 36 h following the dyeing procedure. Mass Spectrometry and Proteomics: The media collected -'conditioned media'- will be added to fresh amoeba cells. Gel samples will be analyzed for bands that differ between the fresh media and the 'conditioned' media

samples, to identify unique secreted proteins. These proteins will be isolated and identified using the MALDI technique in conjunction with proteomics qualitative profiling. In addition, proteins from different strains will be analyzed when used in different cultures to determine if proteins from different strains also induce aggregation. Preliminary results obtained from the 2015 EPSCoR funding identified putative signaling molecules essential for signaling (Espinosa et al. submitted). Identified proteins will be cloned, expressed and added to media and tested under different environmental stresses (oxygen, temperature, or pH).

- Kinetic analyses: One of the major gaps in addressing environmental stress effects on metabolic enzymes is the limited data about the ADHE enzymes' structure and biochemistry. The expression of an oxygen sensitive recombinant EhADH2 that remains active during purification is now possible due to shorter purification time and improved protein stability (Espinosa et al. 2001, 2004, 2009, unpublished). The gene/protein-fusion hypothesis predicts two autonomous ADH and ALDH activities with separate co-factor binding, substrate binding, and catalytic sites. Two EhADH2 homologous genes, *Entamoeba invadens* alcohol dehydrogenase EiADHE-IP1 and EiADHE-VK-1:NS are more tolerant to oxygen stress and good models for iron kinetics and stability studies in contrast to the oxygen sensitive EhADH2

- Site-directed mutagenesis. Mutational analysis of EhADH2 remains one of the best tools for analyzing structure/function relationships to determine which amino acids are crucial for EhADH2 enzymatic activities (ALDH and ADH) in the AdhE homologs. Mutations will be generated in the ALDH domain of the ADHE homologs. EhADH2 mutational analyses have demonstrated that the invariant cysteine in position 252 (Cys252) is the catalytic residue, assisted by a glutamate in position 350 (Glu350). Four other conserved amino acids seem crucial to the activity of ALDH: asparagine (Asn121); glycine (Gly249); and both leucine (Leu352) and proline (Pro354). Glycines 431, 433, 436 appear to be conserved for NAD+ binding in a fusion model. We will replace each of the three glycines with alanine with the phusion mutagenesis Kit (Thermo Scientific, NY). Protein expression will be shown by SDS–PAGE and immunoblots using an anti-EhADH2 monoclonal antibody (Espinosa et al. 2001, 2004, 2009, unpublished). Kinetic assays could resolve if there are one or two catalytic sites for ADH/ALDH activities.

Project Code: 20

Project Title: Metallporphyrin-based chemosensors for the marine aqueous detection of thiocyanate ions by electrochemistry and spectrophotometry

Project Mentor(s): Clifford Murphy (Roger Williams University)

Project Description:
This project is a continuation of the project begun last year to synthesize metalloporphyrins to incorporate into electrochemical and photochemical sensory devices for the detection of thiocyanate ions in marine environments. Thiocyanate ion is important a toxin in its own right, as well as a metabolite released by fish that have been exposed to cyanide. We have successfully synthesized functionalized porphyrins with a variety of metal centers (Co, Cu, Fe, Mn) that were coordinated to fluorine doped tin oxide (FTO) and used for optical and electrochemical detection of thiocyanate in seawater. Preliminary results show electrochemical sensitivity to thiocyanate with the iron porphyrin down to 1.1 ppb. To move this project forward we will extend the porphyrin synthesis to additional metals (Zn, Ru), and work to incorporate these materials into a portable device suitable for field tests.

Project Significance:
Our initial interest in this work is to have the ability to detect thiocyanate in seawater easily in the field so we could attempt to detect possible leeching of abiotic compounds from antifouling paints and coatings. Leeching of thiocyanate is expected to be more prevalent in warmer waters, so climate change could be a factor. Looking more globally, cyanide is used illegally to stun tropical fish that are then sold to aquaria. This practice is illegal, and particularly dangerous to live coral. A portable chemosensor for thiocyanate has potential use in the stewardship of a variety of marine environments.

This project involves **primarily lab work**

Required/preferred skills:
Ideal qualifications include students who have completed a full year of both general chemistry and organic chemistry for the material and chemical synthesis portion of the project. Additionally, a student with experience in electrical engineering and/or circuit theory is desired to help with transitioning promising materials to a device prototype.

Students involved in this project will use/learn the following techniques:

- Chemical synthesis and characterization (TLC, NMR, UV-Vis spectrophotometry)
- Materials synthesis (doctor blading method, silanation) and characterization (cyclic voltammetry, contact angle measurement, UV-Vis)
- Circuit design

Project Code: 21

Project Title: Temperature effects on marine invertebrate physiology

Project Mentor(s): Steven Irvine (University of Rhode Island)

Project Description:
Temperature is a major influence on the physiology of marine invertebrates, and is changing due to global warming. This project will examine the effects of temperature stress on the reproductive health of ascidians (sea squirts) and look for hidden effects on the reproductive proteome - the set of proteins expressed in the reproductive organs. We have data, which the 2015 SURF students helped to gather, on the differences between the ovarian proteomes of animals reared at normal and elevated water temperatures, which will form the basis of hypotheses to be tested by the SURF students using molecular techniques unique to ascidians. We plan to extend this work to the effects on the male reproductive organs as well.

Project Significance:
This project will test directly one of the main effects of climate change - namely the effect of elevated temperature on reproductive health.

This project involves **both field and lab work**

Required/preferred skills:
- Basic lab experience preferred but not required
- Need to be willing to dissect marine invertebrates

Students involved in this project will use/learn the following techniques:
- Protein extraction and analysis
- Transgenics
- Aquarium culture (at GSO)
- Invertebrate zoology technique

Project Code: 22

Project Title: Impacts of macroalgal accumulation on salt marsh environments

Project Mentor(s): Danielle Perry (University of Rhode Island), Carol Thornber (University of Rhode Island), Serena Moseman-Valtierra (University of Rhode Island)

Project Description:
This will be a collaborative project between the labs of Dr. Carol Thornber and Dr. Serena Moseman-Valtierra. Overall, we will be attempting to identify effects of macroalgae accumulation on salt marsh habitat and their potential impact on the ecosystem. The project will involve researching the response of salt marsh plants to macroalgae accumulation and other climate change effects. Potential research includes studying the impact of macroalgae on salt marsh biogeochemical processes. The project will contain a lab study with the potential for field work.

Project Significance:
Macroalgae blooms are expected to increase globally as a result of climate change. This is a cause for concern since macroalgae blooms have been known to cause serious economic and ecological impacts on coastal communities. Large macroalgae accumulations have been witnessed in salt marsh environments. Since salt marshes perform vital ecological services the effects of macroalgal blooms and the response of salt marsh vegetation to macroalgal accumulation are important to understand. Excessive macroalgae has the potential to disrupt the natural ecosystem processes that salt marshes perform; this can lead to further environmental problems.

This project involves **both field and lab work**

Required/preferred skills:
Required qualifications for this project are the ability to work carefully and independently, being comfortable working outside, a flexible schedule with possible weekend work availability, and familiarity with Microsoft Excel.

Preferred qualifications include previous experience in lab and field settings, identifying common salt marsh plant and macroalgae species, and data collecting and analysis. Familiarity with other statistical software, besides Microsoft Excel, is also preferred.

Students involved in this project will use/learn the following techniques:
The undergraduate will learn to identify common salt marsh plant and bloom-forming algae species, to set up and maintain a long-term laboratory experiment, and to perform field techniques such as transect and quadrat sampling. They will also gain experience in data collecting and analysis.

Project Code: 23

Project Title: Do food-web changes explain population declines of coral reef fishes

Project Mentor(s): Graham Forrester (University of Rhode Island)

Project Description:
The goal of the SURF project is to test whether interactions between small fishes (prey) and mid-level predators (meso-predators) have altered over the past 25 years. Changes in meso-predator abundance and behavior are predicted because the large predators (apex predators) that prey on meso-predators are known to have declined. Comparing the results of past and present studies will allow us to infer which causal factors have changed since the 1990s.

Project Significance:
Coral reef communities are being progressively altered by a mix of local and global human activities, the most important of which are overfishing and climate change. Understanding the relative effects of different agents of change is important to design conservation strategies for reefs. Most Caribbean fishes have been in population decline since the 1990s. The students would participate in a project designed to isolate causes of long-term change in the abundance of small reef fishes.

This project involves **primarily field work**

Required/preferred skills:
- A passport and willingness to spend 4 weeks of the summer at a Caribbean field site
- The ability to obtain AAUS research diver certification before the field trip. See http://www.gso.uri.edu/diving/index.htm for diving requirements. Applicants with current AAUS research diving certification and some experience (e.g. > 50 logged dives) may be preferred.
- A strong academic background in ecology and marine biology, and an interest in marine conservation. Willingness to read primary scientific literature and contribute to project design.
- Familiarity with the animals and plants that occupy Caribbean coral reefs is a plus but not essential. The ability to recognize fish species visually may be preferred.
- The ability to perform physically demanding field work for long hours each day in a team setting under sometimes stressful field conditions
- An understanding of basic statistical principles and familiarity with MS Excel is preferable

Students involved in this project will use/learn the following techniques:
The project will include a mix of analyzing existing data that was collected in the mid 1990s and early 2000s, and the collection of new data in the field during summer 2015. I will hold regular meetings with the fellow during which I will first assist with the location of primary research literature and help them write a short proposal outlining their project. I will provide training in data management and analysis. Fieldwork in the Virgin Islands will be for 4 weeks in June-July (final dates to be determined). I will be present at the field site working with the student full-time, every day. The student will observe behavioural interactions between predators and prey on SCUBA, documenting prey behavior (movements, feeding, and agonistic encounters) and predator behavior (search patterns, attack rates, encounters with other predators). Before and during the trip I will provide training and supervision on methods for the safe performance of SCUBA-based research, following URI diving safety training procedures. I will also help with graphical and visual presentation of the results, writing of the poster, and possible preparation of the results for publication.

Project Code: 24

Project Title: Evaluating oyster growth performance in upwellers under varying environmental conditions.

Project Mentor(s): Dale Leavitt (Roger Williams University) & Matt Griffin (Roger Williams University)

Project Description:
Upweller nursery systems for shellfish culture rely on the natural productivity of the estuary to enhance the growth rate of cultured oysters. However, the conditions within the estuary are changing as a result of increasing temperature and altered productivity. We propose to evaluate the performance of juvenile oysters in field based upwellers under ambient conditions and following manipulations of water chemistry.

Project Significance:
Our estuaries are changing where primary productivity and ambient temperature are being impacted by a variety of environmental and water chemistry changes associated with alterations of our climate. We propose to counter some of the growth conditions in an upweller shellfish nursery by altering the water chemistry to attempt to compensate for potential changes in estuarine waters.

This project involves **both field and lab work**

Required/preferred skills:
No preferred qualifications are necessary although a familiarity with shellfish culture practices would be a help.

Students involved in this project will use/learn the following techniques:
The student involved in this project will be involved in upweller maintenance and shellfish aquaculture techniques. They will work with analytical instrumentation including dissolved oxygen, flow meters and fluorometer. Lab techniques will include shell hardness testing, condition index monitoring, particulate organic content measurement, and measuring shellfish growth rates.

Project Code: 25

Project Title: Allelopathic effects of macroalgae on shellfish larvae in RI under current and projected sea surface temperatures

Project Mentor(s): Marta Gomez-Chiarri (University of Rhode Island), Lindsay Green (University of Rhode Island) & David Rowley (University of Rhode Island)

Project Description:
This project will be conducted under the guidance of Dr. Marta Gomez-Chiarri (URI), Dr. Lindsay Green (URI) and David Rowley (URI). We are currently investigating the allelopathic effects of macroalgae (Ulva spp.) on shellfish larvae. The fellow's project will involve laboratory work to conduct shellfish larval survival assays, as well as extensive microscopy work to determine larval survival. The student will spend the significant time at URI Kingston, at the URI Marine Life Sciences Facility (URI/Narragansett) to conduct temperature experiments.

Project Significance:
Harmful macroalgal blooms occur worldwide, generally in shallow low-wave energy environments. These blooms can have deleterious impacts on the ecosystem by reducing seagrass, perennial algae, and overall community diversity. Macroalgal blooms have been increasing worldwide and are projected to increase in frequency and severity due to climate change. Species of green macroalgae (Ulva) have been shown to inhibit the growth of growth of co-occurring macroalgae in Narragansett Bay and may be having deleterious impacts on other organisms. This project will focus on determining the effects of Ulva allelochemicals on the survivorship of quahog and oyster larvae. It will also investigate the effect of warming sea surface temperature on the susceptibility of shellfish larvae to allelochemicals.

This project involves **primarily lab work**

Required/preferred skills:
An ability to work carefully and independently, excellent organizational skills, a flexible work schedule as some weekend/night work may be required, an ability to work with microscopes for long periods of time, and a familiarity with Microsoft Excel.

Students involved in this project will use/learn the following techniques:
- How to establish and maintain macroalgal cultures.
- How to set up and maintain laboratory-based shellfish larval mortality experiments
- How to determine survivorship of shellfish larvae via microscopy
- How to work collaboratively with biomedical scientists (Dr. Rowley's lab)

Project Code: 26

Project Title: Exploring Host-Microbiome Interactions in Marine Plankton

Project Mentor(s): Olivia Ahern (University of Rhode Island - GSO) & Kristen Hunter-Cevera (University of Rhode Island - GSO)

Project Description:
Interactions between plankton and bacteria have the potential to influence plankton diversity and abundance and the presence of certain bacteria can help us differentiate between healthy and unhealthy states. In order to understand these interactions, we will be exploring the relationship between marine plankton and their microbiome bacteria and see how different bacteria influence the plankton's life cycles and growth rates. Over the summer, we will be culturing different bacteria and plankton together and assessing their health through a variety of techniques including microscopy, growth rate calculations, and photography.

Project Significance:
Marine phytoplankton and bacteria play a role in global biogeochemical cycling by influencing rates of primary production and phytoplankton community structure. Climate change has the potential to alter these interactions by affecting nutrient cycles and increasing ocean stratification. We are exploring the evolutionary potential of diatoms and their associated bacteria in different stress environments in order to assess how diatoms can adapt to changing ecosystems

This project involves **primarily lab work**

Students involved in this project will use/learn the following techniques:

- Microscopy and photography techniques
- Cell Culturing
- Growth Rate Calculations
- Sterile Lab Procedures
- Read and Discuss Current Literature