Southern Connecticut State University

Werth Center for Coastal and Marine Studies

WCCMS Annual Report 2019-2020

Prepared by:

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Prepared for:

The Werth Family Foundation, Woodbridge, CT

March 2020

CCMS Annual Benchmark/Evaluation Report 2019-2020

Each year the participating faculty of the WCCMS prepares and submits to the Werth Family Foundation an annual report describing the Center activities. This report is made available in both electronic and hard copy form. The report provides definitive information and detailed summaries of all yearly projects, events, activities, forums, and accomplishments conducted/achieved by the Center and its personnel.

The WCCMS Annual Report is submitted to the Werth Family Foundation during February/March of each year. Contents of the WCCMS 2019-2020 Annual Report are described below.

I. Research Projects

Water Quality Monitoring in New Haven Harbor

Faculty Dr. Vincent T. Breslin
Environment, Geography and Marine Sciences

Student Participants

Summer 2019; Fall 2019; Spring 2020

Cassandra Bhageloo, Graduate, Chemistry
Renee Chabot, Undergraduate, Chemistry
Maeve Rourke, Undergraduate, Environment, Geography and Marine Sciences
Ian Bergemann, Environment, Geography and Marine Sciences

Long Island Sound is an ecologically diverse environment with rich and varied ecosystems for marine organisms while also providing important environmental and recreational services for Connecticut and New York residents. Despite its ecological and economic importance, water quality throughout the Sound is vastly under-monitored, particularly in the especially vulnerable and densely populated coastal embayments. The Long Island Sound Study recently highlighted the importance of expanding and integrating water quality monitoring efforts throughout the Sound to provide uniform, reliable near-shore monitoring data to watershed managers and the broader scientific/technical community. The students and faculty of the Werth Center for Coastal and Marine Studies at SCSU established a long-term water quality monitoring program at Long Wharf Pier, New Haven harbor in January 2012. Weekly water quality testing at this location occurs once per week coinciding with high tide. Water quality and meteorological parameters measured include salinity (ppt), specific conductance (mS/cm), dissolved oxygen (mg/L), air and water temperature (°C), wind speed (m/s), relative humidity (%), light intensity (lux), secchi disk depth (m), turbidity (NTU), Chlorophyll *a* and pH.

Results to Date/Significance

The WCCMS recently completed the eighth year of water quality monitoring at the pier at Long Wharf, New Haven. Spring 2020 monitoring efforts will be supplemented by the participation of the students in the MAR 460 Field and Laboratory Techniques in Marine Studies. Results of our monitoring show that water temperature (-0.8 to 26.8°C) displays a seasonal trend. Dissolved oxygen concentrations (1.65 to19.18 mg/L) at this location also vary with temperature as oxygen solubility in water is a function of water temperature (greater solubility at lower water temperature). Additionally, there have only been three instances (8/16/12, 7/24/13 and 9/11/15) when the dissolved oxygen level measured below the threshold suitable to sustain marine life (3 mg/L). Salinity at this location at high tide varies within a narrow range (9.8 to 30.5 ppt). Water clarity, as measured using a secchi disk, varies from 0.30 to 2.5 meters. Chlorophyll-a concentration measured using UV/Vis spectrophotometry and fluorescence range from 0.13 to 80.6 µg/L. The ranges of these values for these water quality parameters are typical for similar parameters reported for Long Island Sound coastal embayments.

Examining the Beach Dynamics of the Connecticut Shoreline and Their Implications for Coastal Zone Management

Faculty Dr. James Tait
Department of the Environment, Geography and Marine Sciences

Student Participants

Summer 2019; Fall 2019; Spring 2020

Brooke Mercaldi, Undergraduate Student, Environment, Geography and Marine Sciences
Research Coordinator, Coastal Processes Lab

Lauren Brideau, Undergraduate Student, Environment, Geography and Marine Sciences

Volunteers

David Bakies, Undergraduate Student, Environment, Geography and Marine Sciences
Shayla Peterson, Undergraduate Student, Environment, Geography and Marine Sciences
Liz Heikkinen, Undergraduate Student, Environment, Geography and Marine Sciences

Project Description

Ongoing multi-year research focused on testing for seasonal beach profiles on the Connecticut coast has been concluded with documentation of the lack of any significant seasonal beach profiles on five beaches that span the length of the Connecticut shoreline. The beaches include Sherwood Island State Park, Bayview Beach in Milford, Hammonasset Beach State Park, Rocky Neck State Park, and Ocean Beach in New London.

Previous studies by Werth Center researchers have pointed to lack of energy in the fair-weather wave field as being responsible for chronic erosion of Connecticut beaches and exposing coastal structures and infrastructure to damages. Geomorphic evidence for such a hypothesis is the absence of shoreward transport of sediment resulting in beach profile rebuilding. In other words, there is a lack of seasonal beach profiles.

This non-textbook behavior of Connecticut beaches calls for commensurate adjustments in Connecticut's coastal management policies. Current policies have been examined and recommendations for policy changes that enhance adaptive capacity have been articulated by Ms. Mercaldi.

Results to Date/Significance

Measurement of beach profiles at 5 locations along the Connecticut shoreline have been completed. Profiles indicate that there is little cross-shore movement of sediment such as would be expected if Connecticut's beaches adhered to established seasonal beach dynamics.

The final analysis shows that Connecticut's beaches, and the structures located behind them, are particularly vulnerable to erosion and damages due to storm waves because erosion (narrowing of the beach) is not counter balanced by beach recovery during the non-storm season. Currently, eroding Connecticut beaches are periodically replenished by importing sand and placing it on the eroded beach to build the beach back out. This approach is becoming extremely expensive. *A more sustainable strategy to maintaining coastal resilience to storms is suggested by this research.* We have termed this *beach reclamation.* In this scenario, sand eroded from the beach and transported offshore into nearshore sand bars is reclaimed and returned to the beach using basic coastal engineering technology. In more general terms, our recommendation is that beach sand be subject to *sediment management* where high-quality sediment is placed on the beach and subsequently managed rather than being replaced when it moves offshore during large storms.

This research has led to a series of policy recommendations for the State Legislature and for the Department of Energy and Environmental Protection. General recommendations included updating the language of Connecticut's most prominent policy documents, such as the *Connecticut Coastal Management Manual* and the *Overview of the Connecticut Coastal Management Program,* to reflect the unique dynamics of Connecticut's shoreline to ensure maximum policy effectiveness. Also, the language should be updated to emphasize the *urgency* of maintaining Connecticut's. beaches.

More specific recommendations include:

- Increasing the importance of beach maintenance as an integral part of building coastal resilience,
- Passing legislation in the Connecticut General Assembly to incentivize the regular maintenance of beaches by coastal communities,
- Creating 5-year permits allowing coastal communities to manage their sediments with expedited approval from the DEEP,

- Focusing beach monitoring around periods associated with large storms because the current research suggests that profile change (e.g., beach width and volume) under other conditions is largely static.

WCCMS Aquarium Operations and Animal Husbandry

Faculty Dr. Vincent T. Breslin
Environment, Geography and Marine Sciences

Student Participants

Summer 2019; Fall 2019; Spring 2020

Maeve Rourke, Undergraduate, Environment, Geography and Marine Sciences
Melissa Beecher, Undergraduate, Biology
Cassandra Bhageloo, Undergraduate Student, Chemistry
Renee Chabot, Undergraduate Student, Chemistry
Ian Bergemann, Undergraduate, Environment, Geography and Marine Sciences

Fall 2019; Spring 2020

Nicole Woolsey, Graduate Student Biology
Owen Cassidy, Undergraduate Student, Chemistry

Werth Center facilities include two large (approximately 2500 gallon each) display aquaria, touch tank (500 gallons) and associated laboratory (SCI 111). WCCMS students and staff have supervised the conditioning of the aquarium system and the introduction of fish and invertebrates. Marine fish were first introduced to the aquarium in December 2015 (Tank #2 coastal aquarium) and January 2016 (Tank #1 open water aquarium). The aquaria were designed to mimic Long Island Sound ecosystems and contain only local fish and invertebrate species. Student interns have performed frequent water quality testing (4-5 days per week) and fish and invertebrate condition observations (6-7 days per week). Student interns are also responsible for daily feeding of the fish and invertebrates in each aquarium and touch tank.

Results to date/Significance

WCCMs student interns have completed four years of water quality measurements on the aquarium system. These records show that during that time we have maintained water quality in the aquarium system to support the health and growth of the fish and invertebrates in the aquarium and associated touch tanks. We continue to add new fish and invertebrates to the aquarium facility. Most recently, a toadfish was donated by the Maritime Aquarium at Norwalk. We have also established a relationship with the Marine Resource Center (https://www.mbl.edu/mrc/) at the Marine Biological Laboratory, Woods Hole, MA. We have placed orders from the MBL for invertebrates for the aquarium touch tanks in past years. This year was the first year we purchased and transported fish specimens (hake, scup, toadfish) from the MBL for the large display tanks. The MBL will be an important resource for future fish acquisitions.

We renewed our Institutional Animal Care and Use Committee (IACUC) certification during the spring 2019. The IACUC certification is required for the use of mummichog fish in our coastal marine studies courses (MAR 210). The IACUC certification also informs our oversight of the water quality and the health of the fish in the display tanks. We have also added four of the students working in the aquarium lab to the protocol. The students had to pass several exams on fish handling and laboratory regulations and oversight to qualify for listing on the protocol. We have added a 270-gallon aquarium to the aquarium lab 111A to house approximately 100 mummichogs for use in our marine studies courses. We also renewed our CT DEEP Specimen Collection Permit (6/1/2019-5/31/2022) allowing our students to continue to collect invertebrates and fish from local habitats.

The WCCMS aquarium laboratory continues to host SCSU Open House and public educational programming. Our student interns host SCSU students from throughout the campus and provide tours of the facilities allowing students to learn about LIS fish and invertebrates.

Macroalgae as Bioindicators for Mercury Contamination in Long Island Sound

Faculty Dr. Sean Grace
Biology
Dr. Vincent Breslin
Department of the Environment, Geography and Marine Sciences

Student Participants

Summer 2019; Fall 2019; Spring 2020

Cassandra Bhageloo, Undergraduate Student (Chemistry)

Characteristics that make macroalgae good bioindicators for metal contamination include wide distribution and abundance, ease of collection and identification, year-round availability, and tolerance of a wide variety of temperatures and salinities. In addition, the use of biological species such as macroalgae to monitor for marine pollution allows for the assessment of effects of contamination on living organisms and their environment as well as their potential for use as a means of bio-remediation. Furthermore, studies focused on the use of macroalgae as bioindicators for trace metal contamination such as mercury show that the concentration of metal in the sediment, water column, and macroalgae are typically proportional. The objective of this study was to determine the effectiveness of macroalgae as bioindicators for mercury contamination in Long Island Sound. The presence of a west to east decreasing trend of mercury in the Sound proportional to anthropogenic sources of contamination was also examined. Characteristics that make macroalgae good bioindicators for metal contamination include wide distribution and abundance, ease of collection and identification, year-round availability, and tolerance of a wide variety of temperatures and salinities.

This study focused on determining the mercury content of seven species of macroalgae including green (*Ulva lactuca, Codium fragile*), brown (*Fucus vesiculosus, Fucus distichus*) and red

(*Chondrus crispus*, *Grateloupia turutura, Gracilaria tikvahiae*) algae sampled from seven locations (Stamford to Westbrook) in fall 2017 along the Connecticut shoreline. Freeze-dried algae tissue samples (0.100-0.250 g) were analyzed directly for mercury by thermal decomposition amalgamation and atomic absorption spectrophotometry using a Milestone DMA-80 direct mercury analyzer.

Results to Date/Significance

Results showed that macroalgal tissue mercury concentrations varied by species but no significant west to east trends in algal tissue mercury were observed. Mercury concentrations were typically lowest in green algae species, intermediate in red algae species and highest in brown algae species. Graduate student Cassandra Bhageloo recently completed her MS thesis proposal and will expand her studies to include sugar kelp (*Saccharina latissima*), an important algae in the emerging aquaculture industry in LIS. This study is designed to address the following research questions: (1) Are there differences in mercury concentrations in kelp sampled from native New England kelp beds and kelp aquacultured from regional LIS aquaculture farms? (2) Does kelp mercury concentration vary during the growing season? (3) Are aquaculture kelp mercury concentrations lower than the pending CT safe consumption level of 0.1 mg/kg? and (4) Are temporal variations noted in mercury concentrations of representative species of algae sampled from the same LIS locations as 2017? Addressing these questions will aid in understanding how water quality in LIS may affect the regional algal aquaculture industry.

Gross and Microscopic Anatomy of the Olfactory System of a Grey Seal, *Halichoerus grypus*

Faculty Dr. Meghan Barboza
Biology

Student Participant(s)

Summer 2019

Gabriella Restrepo, Undergraduate, Biology

During the summer of 2019, Gabriella Restrepo completed the gross examination of the grey seal head and further developed our understanding of the nasal cavity in reference to the location and extent of maxilloturbinates and ethmoturbinates. Grossly, the seal does appear to have a vomeronasal organ, well developed ethmoturbinates, and a large olfactory nerve (CN1). Histologically we have identified respiratory and olfactory epithelium. The histology of the VNO is still being examined. Overall the grey seal has very intricate ethmoturbinates and a potential VNO which is comparable to that of the olfactory system of canines. This anatomy would explain seals' behavior during reproductive periods and represents the first examination of the olfactory system of a pinniped.

Results to date/Significance

Through this fellowship, Gabriella compiled all of her previously collected experimental information along with the data collected over the summer into a comprehensive 24 page report. This report, which includes methods, results, and some interpretation of those results will be used to provide continuity as this research is completed on additional samples and eventually developed into a peer-reviewed research paper. The results of this research were also presented at the 2019 World Marine Mammal Conference in Barcelona, Spain, December of 2019.

Assessment of the Walk Bridge Construction on the Water Quality of the Norwalk River

Faculty Dr. Vincent Breslin
Department of the Environment, Geography and Marine Sciences

Student Participant

Summer 2019; Fall 2019; Spring 2020

Renee Chabot, Undergraduate, Chemistry

Walk Bridge in Norwalk is a four track, 123-year old swing railroad bridge, connecting Washington D.C., New York, and Boston. This rail line is the most used in America with over 125,000 daily riders. It carries Metro-North's New Haven line, Amtrak, and freight services. The bridge was electrified in 1907 and added to the National Register of Historic Places in 1987. Walk Bridge is notorious for its aged mechanical mechanisms that have failed time and time again, delaying transportation on and below it on the Norwalk River. The Walk Bridge Project will greatly increase the dependability of service rail, but presents a challenge to the ecology of the Norwalk Harbor.

The Harbor's active shellfishing industry has a large economic and cultural importance to the area; civic leaders and shellfish industry representatives are calling for water quality monitoring to protect the natural resources and shellfish beds during bridge construction. WCCMS researchers have shown that the sediment below the bridge is contaminated with metals of environmental concern. Bridge construction activities may re-suspend contaminated river sediment and transport the sediment to the outer harbor oyster beds. The re-suspended sediment may be ingested by the oysters and cause unacceptably high metal contamination in their tissues.

The goal of this study is to determine the potential adverse consequences to the Norwalk River's water quality during bridge replacement construction. This will be carried out through sampling of suspended sediment north and south of bridge construction. Initially, there will be 6 stations selected in the Norwalk river and sediment at each station will be analyzed for grain-size and metals (mercury, copper, and zinc). Suspended sediment sampling in the river will occur on at least two occasions north and south of the bridge construction for water quality. These stations will test the suspended sediment that could theoretically move to the outer harbor. Water quality parameters (salinity, dissolved oxygen, pH) will also be measured.

Results to Date/Significance

Sediment metal contamination (copper, zinc, and mercury) for the Norwalk river area is particularly high around the Walk bridge. Contaminant point sources include the sewage treatment plant, the highway (I95), the marinas, and the abandoned landfill. Furthermore, contaminated metals in sediment tended to co-vary. Where copper concentration was high, zinc and mercury concentration were also high. Mercury is extremely high, ranging from 0.248-1.17 mg/kg, while copper exceeds 100 mg/kg. In comparison, sediment metals in the outer harbor are presently at or slightly above their crustal (natural) abundance, which is 0.06 mg/kg for mercury and 25 mg/kg copper. These high metal concentrations in the river directly correlate to the presence of silt-to-clay grain-size of the sediment. This is important because once construction on the bridge starts, these fine sediment grains may be resuspended into the river water and may be transported downstream. The river is tidal influenced, so sediment can flow both north and south in the river away from the construction site, affecting marine life and estuary habitats.

Renee Chabot has applied for an Undergraduate Summer Research grant ($3,000) for summer 2020 to continue her research. Her research will focus on the fate and transport of suspended particulate matter under different river flow conditions to examine the potential transport of contaminated sediment away from the bridge construction to outer harbor oyster beds.

Subtidal Recruitment and Settlement of the Temperate Scleractinian Coral *Astrangia poculata*

Faculty Dr. Sean Grace
Biology

Student Participant(s)

Academic Year 2015, 2016, 2017, 2018, 2019

Gabriella DiPreta, Biology, Graduate Student

The recruitment and settlement of temperate corals will be examined at 12m depth at Fort Wetherill, Jamestown, RI. The frequency of settlement of corals on temperate reefs is unknown as is the preferred orientation of settlement substrate (vertical or horizontal). Temperate corals represent a unique model system for tropical species who recruit and settle at specific times throughout the year.

Results to Date/Significance

In summer 2017, terra-cota tiles have been placed in situ at 12 m depth at Fort Wetherill. Tiles have been secured to the horizontal and vertical substrate with z-spar (splash zone compound). At monthly intervals, the tiles have been photographed and all species settling on the tiles identified to species. Additionally, temperature measurements have been made in situ using Onset Hobo-temp recorders set to record temperature at 5 minute intervals from the initiation of the study till the end of the student (December 2018). Gabriella has collected all data and is

currently writing her MS thesis. She has analyzed all videos and pictures and developed an underwater lighting system (that she wrote code for) to investigate coral behaviors and is currently writing. Gabriella's research resulted in the first ever examination of community development on the northern range of the mid-Atlantic bight. Fine macroalgae settle first, then bryozoans, tunicates, and sponges make up a majority of the successional community structure. Gabriella defended her MS thesis in April 2019 and is currently writing up the results for publication in the Journal of Experimental Marine Biology and Ecology.

GIS Maps of Connecticut Coastal Harbor Sediment Metal Contamination

Faculty

Dr. Vincent Breslin
Department of the Environment, Geography and Marine Sciences

Student Participant

Summer 2019; Fall 2019; Spring 2020

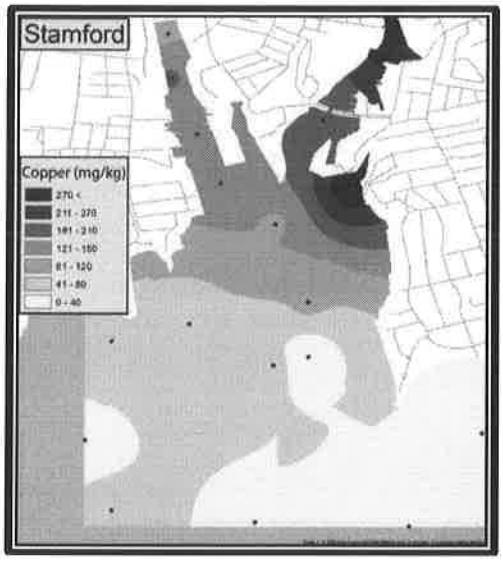
Ethan Mehlin, Undergraduate, Geography

Over the past 16 years, researchers from the Werth Center for Coastal and Marine Studies (WCCMS) have examined the spatial trends of contaminant metals in surface sediments in every major harbor in Connecticut. This sediment database contains the results of the physical and chemical analysis of over 600 sediment samples collected from 14 different Connecticut harbors and is the largest, most comprehensive, sediment metal database for Connecticut coastal embayments. The database includes sediment metals (copper, zinc and iron) and physical properties (% organic matter) and each sediment station is geo-referenced (latitude and longitude). This database represents an excellent opportunity to resolve the physical and chemical factors controlling the spatial distribution of metals in regional coastal harbors. This project will focus on preparing a visualization of the harbor sediment metal contamination using GIS mapping software. The goal is to prepare contour maps for each Connecticut harbor showing the spatial trends in sediment grain-size, organic carbon and contaminant metals. The location of each of the harbor sediment samples collected over the years has been defined by latitude and longitude. This allows for the preparation of maps identifying the location of each sample in a harbor and the use of GIS software to prepare contour maps showing the trends of sediment physical and chemical properties within each harbor.

Results to Date/Significance

Sediment metal concentrations and physical properties (grain-size and loss on ignition) were mapped in ArcMap 10.5.1 according to categories defined using sediment quality guidelines and known sediment grain-size categories. These points were analyzed using inverse distance weighting, resulting in maps that were then edited in Arcmap to have the same color scheme and comparable scale categories. Each parameter scale was created with seven or eight categories;

the highest range for metals was defined by the Effects Range Median for each respective metal while the lowest category was equal to or less than each metals' respective crustal abundance. These maps can be useful in identifying areas within harbors for shellfish habitat restoration/expansion, identifying areas of concern for dredging projects, inform harbor development activities, and highlight areas of concern for sediment resuspension (storm events).



Coastal Vulnerability to Storm Wave Impacts and Recommendations for Enhancing Resilience

Faculty Dr. James Tait
Department of the Environment, Geography and Marine Sciences

Student Participants

Spring 2020

Shayla Peterson, undergraduate student, Environment, Geography and Marine Sciences, Lead Researcher.

Project Description

Previous research (see above) has indicated that the Connecticut coast, particularly those areas fronted by sandy beaches, is highly vulnerable to beach erosion and structural/infrastructural damages associated with large storms. Part of the problem is that state policies and practices do not adequately reflect the urgency of the problem nor the unique dynamics of the Connecticut coast, the cause this vulnerability.

Results to Date/Significance

This research has just recently begun. At present, we have been examining the impacts that large storms have had on various coastal communities, steps that different coastal communities have

taken to improve their resilience, and our assessment of current vulnerabilities including beach dimensions, shoreline urbanization, and coastal infrastructure. We are also looking at steps that organizations such as the Connecticut Institute for Resilience and Climate Adaptation, the CT Department of Energy and Environmental Protection and the Nature Conservancy have taken.

Seasonal Variations in Microplastic Abundance in Treated Wastewater from the Meriden and North Haven Wastewater Treatment Facilities

Faculty

Dr. Vincent Breslin
Department of the Environment, Geography and Marine Sciences

Student Participant

Summer 2019; Fall 2019; Spring 2020

Anthony Vignola, Graduate Student, Environment, Geography and Marine Sciences

Municipal wastewater treatment facilities have been identified as primary sources of microplastics to tributary rivers and coastal estuaries through the direct discharge of treated wastewater. At present, little is known about the composition and quantity of microplastics discharged from WWTFs into tributary rivers flowing into Long Island Sound. Additional studies are necessary to better understand and quantify the magnitude of the effluent as a source of microplastics. Previous studies have shown the WWTFs may remove as much as 95-99% of microplastics in wastewater entering WWTFs. However, the large quantity of effluent discharged from these facilities still results in significant quantities of microplastics entering receiving bodies of water. Five WWTFs discharge treated wastewater into the Quinnipiac River, contributing tens of millions of gallons of treated effluent to the river daily.

The goal of this proposed research is to determine the seasonal variation in the composition and quantity of microplastic particles discharged in the effluent from two WWTFs along the Quinnipiac River: Meriden and North Haven. These WWTFs were selected based on differences in the plant design, wastewater capacity, the size of the populations served, and the ease of access to effluent discharge channels for sampling. It is hypothesized that microplastic concentrations and composition will differ among the WWTFs sampled and vary within each facility seasonally (summer, fall, spring and winter).

Results to Date/Significance

Seasonal sampling of wastewater for microplastics was completed for both the Meriden and North Haven WWTFs. Measured microplastic concentrations in treated wastewater ranged from 0.0081 p/L (North Haven; winter) to 0.0296 p/L (North Haven; summer). These concentrations are within the range of microplastic concentrations in treated wastewater measured in previous national and international studies. In general, 60-80% of the plastics identified are fibers, with lesser quantities of film, fragments and microbeads. Only one microbead was identified (North

Haven WWTF; summer sample) in the seasonal wastewater samples. The absence of microbeads in the wastewater samples suggests that the microbead bans (CT and Federal) applied to consumer cosmetic products have reduced the presence of microbeads in treated wastewater.

Examination of Atlantic Herring (*Clupea harengus*) for the Presence of Microplastics

Faculty

Dr. Vincent Breslin
Department of the Environment, Geography and Marine Sciences

Student Participant

Fall 2019; Spring 2020

Maeve Rourke, Undergraduate, Environment, Geography and Marine Sciences

Microplastics, plastics < 5 mm diameter, are an emerging contaminant and represent a growing threat to coastal ecosystems due to their ability to accumulate hydrophobic contaminants and their ingestion by pelagic and benthic marine organisms. Atlantic herring, due to its mode of feeding and importance as food, is an ideal marine organism for microplastic studies. Atlantic herring occupy an important ecological niche in the LIS ecosystem as they primarily feed on plankton suspended in the water column and are an important prey for large predatory fish and birds and are directly consumed by humans. Herring are able to use their gill rakers to filter-feed on suspended particulates (phytoplankton and zooplankton) and they are also likely extracting and ingesting microplastic particles they encounter in the water column. Herring therefore, represent a direct pathway for the transfer of microplastics from coastal waters to humans and/or predatory marine organisms. Herring are also a primary food for captive seals and sharks at the Maritime Aquarium at Norwalk. As such, aquarium administrators are concerned about the potential long-term exposure of captive animals to microplastic contamination from consuming Atlantic herring. This study will test the following hypotheses: (1) Atlantic herring gills and digestive systems will contain microplastic particles and (2) LIS captured herring will show a higher prevalence of microplastic contamination compared to herring captured offshore (Mid-Atlantic-Gulf of Maine).

Results to Date/Significance

Atlantic herring (30 fish) were obtained from the Maritime Aquarium at Norwalk for use in this study. Maeve Rourke has developed dissection protocols to remove the alimentary canal (esophagus, stomach, intestines and pyloric caeca) from each fish. The dissected fish tissues (gills and digestive tract) are digested separately using 70% nitric acid according to Claessens et al. 2013). The digest solutions are then vacuum filtered through a 0.4 μm nitrocellulose membrane to isolate any microplastic particles. To date, 20 herring have been dissected to remove the gills and digestive tract. Acid digestions of the herring digestive tracts are in progress. Microplastic particles will be counted and categorized (film, fiber, bead) using a

dissecting microscope equipped with a digital camera (Troupview software) at 45x magnification. Maeve Rourke has applied for an Undergraduate Summer Research grant ($3,000) for summer 2020 to expand her research to include menhaden. Menhaden are an important species in the food chain in Long Island Sound and also feed on plankton in the water column.

Coastal Erosion and Sediment Management at Hammonasset Beach State Park, Connecticut: A Sustainable Approach to Beach Maintenance

Faculty Dr. James Tait
Department of the Environment, Geography and Marine Sciences

Student Participants

Summer 2019, Fall 2019 and Spring 2020

Lauren Brideau, Undergraduate Student, Environment, Geography and Marine Sciences
Lead Researcher, Hammonasset Beach State Park

Brooke Mercaldi, Undergraduate Student, Environment, Geography and Marine Sciences
Research Coordinator, Coastal Processes Lab

Volunteers

David Bakies, Undergraduate Student, Environment, Geography and Marine Sciences
Shayla Peterson, Undergraduate Student, Environment, Geography and Marine Sciences
Liz Heikkinen, Undergraduate Student, Environment, Geography and Marine Sciences
Ian Bergemann, Undergraduate Student, Environment, Geography and Marine Sciences
Edith Plancarte-Solorio, Undergraduate Student, Environment, Geography and Marine Sciences
Derek Faulkner, Undergraduate Student, Environment, Geography and Marine Sciences

Project Description

This research initiative has evolved into a two-part project located at Hammonasset Beach State Park. The first part is *Assessing the Effectiveness of a U.S. Army Corps of Engineers Beach Replenishment Project at Hammonasset State Beach.* In October of 2017, the state of Connecticut initiated a $9 million beach replenishment project at Hammonasset Beach State Park, located in Madison, Connecticut. This plan involved placing 174,000 cubic meters of sand along the western beaches at Hammonasset in order to increase the width of the existing beach. Hammonasset has had chronic erosion problems, particularly along the western beaches.

The beach replenishment assessment was part of a larger project concerned with developing a beach sediment management plan for Hammonasset Beach State Beach, based in part, on observations of sediment erosion, deposition and transport. The object of this research was to find a sustainable alternative for addressing beach erosion problems at Hammonasset that could ultimately be exported to other state beaches. The basic plan was to use 27 beach profiles

distributed along the length of the beach to 1) measure the volumes of sand and the beach width, 2) measure erosion, deposition, and infer transport pathways, and 3) articulate a plan that can be used by the CT DEEP (the agency that manages the park) to address erosion problems. To put it simply, the basic strategy is to monitor beach erosion, determine where the sand goes and to put it back. This is the essence of *sand management* and *reclamation.*

Results to Date/Significance

There were a number of issues with the C.O.E. replenishment. The most salient was cost. For example, *approximately two thirds of the $9 million consisted of the cost of transporting the sand by barge 33 miles from its source at the mouth of the Housatonic to the beach at Hammonasset.* In terms of the larger beach as a whole, there was a mixture of erosion and accretion of individual profiles both in terms of beach width and beach volume. Individual profiles could accrete during some periods between surveys and erode during others. There are two principal mechanisms by which erosion or accretion at an individual profile can occur, cross-shore transport and alongshore transport. If gradients in littoral drift are considered to be the sole driver of accretion and erosion, then gains and losses along the beach, should sum to zero in order to conserve mass. Since there is a net erosion of 347, 180 m^3, it is assumed, given that losses to the dunes are minimum, that this volume of eroded sediment is lost offshore. While this amount appears to be a reasonable estimate of net offshore losses during the period of the study, the timing and exact location of offshore losses is not known.

Compensating for offshore losses to the system and for alongshore losses to the western end of the beach is an expensive prospect. Again, state taxpayers spent approximately $6 million simply transporting the sand. This is two-thirds of the project cost. Obtaining suitable (grain characteristics) sand and transporting it to the target beach has become increasingly economically unsustainable. Result of this research, as well as that of Mercaldi (see above) suggest that adopting the practice of local *sediment management*, of which *sediment reclamation* plays a fundamental role, would be an economically and materially sustainable alternative to traditional beach nourishment practices in which sediment is exported from outside sources.

II. Center-Directed/Sponsored Seminars

A goal of the Center is to conduct interactive faculty/student research and educational outreach programs that elucidate findings and provide public education on Long Island Sound and environs at all levels, including public schools, parochial schools, communities, and governmental agencies. As such, the Center sponsors an annual seminar series in the spring of each year. Center faculty invited three regional experts during the spring 2019 to discuss topics concerning the health and quality of Long Island Sound and its environs as part of the Fifteenth Annual Seminar Series on Environmental Issues of Long Island Sound 2019.

The seminar series consisted of four separate one-hour seminars by invited experts on Long Island Sound environmental issues during the spring 2019 semester. The list of speakers and topics is given below. A number of faculty teaching marine science, marine biology, geography, zoology, environmental science and earth science courses during the spring 2019

semester attended and encouraged their students to attend the seminar series. A primary goal of the seminar series is to distribute information about Long Island Sound research among faculty and to encourage interdisciplinary collaborative research at SCSU.

Wednesday, March 6th, 1:00 - 2:00 pm, Academic Science Building 210

Coleen Suckling, Assistant Professor, Department of Biology, University of Rhode Island

A Slow Growing Perspective on Multi-Generational Responses to Future Change

Our oceans are changing, becoming increasingly undersaturated with respect to carbonates as atmospheric CO_2 concentrations increase. Predicting how organisms will respond to these changes has become a major area of research, particularly for those species needing to maintain homeostatic and biomineralizing processes. In recent years there has been a shift in focus from shorter (hours-weeks) towards assessing responses over longer term exposure periods (months-years) advancing our understanding in this field. Given that predicted changes span across years and decades, and that organisms will be producing offspring, a greater consideration for even longer time scales (multiple years) and multi-generational responses are needed to better understand how organisms will respond under future climates. For many species, this is still in its infancy with the majority of focus using short time scales or on organisms with rapid life cycles. In an experimental context this is convenient as numerous generations can be achieved within weeks/months. However, they cannot be a substitute for higher trophic level organisms that have much more complex life cycles, developmental and physiological processes. High trophic levels typically comprise of slower growing organisms with longer life cycles and deferred maturity (i.e. years). With these, rearing multiple generations becomes time-consuming, difficult and almost unfundable within normal grant time-scales (i.e. 3 years). This presentation will address this knowledge gap by discussing the responses of a slow growing benthic invertebrate, the European Green Sea Urchin (*Psammechinus miliaris*), bred across several generations under IPCC predicted CO_2 conditions. This sea urchin species currently has a low level of commercial interest within Europe, but our results indicate that this could change!

Wednesday, March 27th, 1:00 - 2:00 pm, Academic Science Building 210

Dianna Padilla, Professor, Department of Ecology and Evolution, Stony Brook University

Population Differences in Resilience to Climate Change: Responses of Blue Mussels to Ocean Acidification

Ocean acidification (OA) conditions have already been shown to affect a wide variety of marine organisms. Shoreline systems, including estuarine areas where most shellfish aquaculture is conducted, experience greater rates of change in water chemistry than are seen or projected in the open ocean. In some cases, differences among individuals within a given species in response to OA stressors have been found, indicating variation in the capacity to respond to OA. Thus,

predicting the impacts of OA on coastal systems and species, including species used in aquaculture, remains challenging.

Most research to date suggests that bivalve molluscs are particularly sensitive to the impacts of ocean acidification (OA). But, at present we do not know whether differences among local environmental conditions has selected for animals with different sensitivities to stressors. Similarly, we do not know whether responses to environmental stressors are phenotypically plastic, allowing animals with broad physiological tolerances to be robust to environmental stress. Therefore, blue mussels, Mytilus edulis, were collected from sites around Long Island Sound (LIS) with different water quality conditions to test whether mussels from more stressful environments are more resilient to the impacts of OA. We found that mussels from different populations show different responses to OA (manipulating aragonite saturation) in terms of larval survivorship and growth, juvenile growth and shell structure, thickness and breaking strength. We also found differences in heart rates among individuals from different populations in response to OA stress. In addition, these different response metrics were not always concordant for animals exposed for different levels of OA stress. Preliminary results from mussels reared for a second generation under OA stress indicates that in some cases robustness to OA stress was masked in the first generation but was revealed in the second generation. As a whole, these results suggest that there is variation in both genetic and phenotypically plastic robustness to OA stress in blue mussels. Experiments to test whether such variation is found in other species of bivalves, especially commercially important species, are needed.

Wednesday, April 10th, 1:00 - 2:00 pm, Academic Science Building 210

Liz Burmeister, Restoration Ecologist, Billion Oyster Project, New York Harbor

The Billion Oyster Project: Challenges, Lessons & Opportunities in Restoring Oysters to an Urbanized Environment

The New York Harbor (NYH) represents a complex marine ecosystem impacted by dynamic and dramatic human use. Specifically, this ecosystem once supported the largest known population of the eastern oyster (*Crassostrea virginica*), creating a reef system that is estimated to have covered 220,000 acres. Today, NYH supports a diverse population of over 8.5 million people and a functionally extinct population of oysters. The Billion Oyster Project (BOP) is a non-profit organization dedicated to the improvement of NYH and the restoration of its once native oyster population through education and community engagement. Challenges to the restoration and conservation of NYH are socially and physically complex and include raw sewage discharge, heavy use by marine and shipping vessels, a lack of natural shoreline, and urban pollution. Toward that end, BOP engages students and community members across community reef projects, community nurseries, oyster hatchery nurseries, restoration pilot projects, and planned oyster restoration projects as well as through 105 partnering schools, 75+ oyster research stations, and 6 career and technical education programs in association with the New York Harbor School. This presentation will explore the challenges, lessons, and opportunities associated with marine restoration in an urbanized environment, specifically in relation to BOP's (1) ecological and restoration, (2) community engagement, and (3) educational goals and efforts.

Wednesday, May 1st, 1:00 - 2:00 pm, Academic Science Building 210

Mary Beth Decker, Associate Research Professor, Yale University

Bering Sea Jellyfish Blooms: Jellyfish Population Fluctuation and Ecosystem Impacts

The eastern Bering Sea is a productive and economically valuable ecosystem, supporting rich populations of zooplankton, fish, marine birds and mammals. This ecosystem also supports large populations of jellyfish, which have fluctuated substantially over the past 4 decades. Jellyfish, both predators and competitors of fish, respond to physical and biological conditions with other planktonic organisms, and thus, provide important clues to understanding changes in the Bering Sea ecosystem.

Many of the world's largest fisheries target planktivorous forage fish, which are important trophic links between plankton and upper-level consumers, such as fish, birds and mammals. Because plankton also drive jellyfish production, forage fish and jellyfish tend to overlap in space, time and diet. This overlap can lead to predatory and competitive interactions, because jellyfish feed on early-life stages of fish and zooplankton. Furthermore, the harvest of forage fish potentially releases jellyfish from competition and is hypothesized to increase jellyfish production. To understand the roles of forage fish and jellyfish, we are using ecosystem models to explore how functional group productivity is altered in various coastal ecosystems under high jellyfish and low fish harvest scenarios. We propose that ecosystem-based management of forage fish stocks include jellyfish as an independent, empirical 'ecosystem health' indicator.

III. Collaborations and Partnerships

As part of our continuing efforts to strive for excellence in research and public education and outreach the Center will focus on establishing working relationships with different local, state, and federal groups and agencies that share this common interest and focus. Each year, the Center provides information concerning the number and nature of collaborations established. Examples of recent and on-going Center partnerships include:

Long Island Sound Coastal Embayment Water Quality Monitoring Program: WCCMS researchers are participating partners in the Long Island Sound Study funded Long Island Sound Embayment Monitoring Project. This program, now referred to as the Unified Water Study, is organizing and standardizing water quality measurements in the region to assure reliable, high quality water monitoring data for researchers and managers. This program is a collaboration between WCCMS, the Long Island Sound Study, New England Interstate Water Pollution Control Commission, The Maritime Aquarium, UCONN, Save the Sound and the Citizens Campaign for the Environment.

Sound School, New Haven and UCONN Avery Point vessel operations: WCCMS researchers chartered ship time aboard vessels from the Sound School and the Maritime Aquarium at

Norwalk. These collaborations are especially valuable as our students gain experience conducting research in Long Island Sound and as long-term users, we have been granted in-house charter rates with both organizations. WCCMS researchers are also collaborating with Sound School faculty and students in monitoring water quality in New Haven harbor.

The Maritime Aquarium at Norwalk and SCSU have developed and signed a memorandum of understanding to facilitate collaborations among faculty, staff and students of our two institutions. At present, Maritime Aquarium staff are assisting Dr. Breslin with the stocking and maintenance of the two large display aquaria associated with the Werth Center in the new science building. The Maritime Aquarium has generously donated most of the fish species currently on display in the aquaria. We anticipate increasing student internships at the aquarium due to the experience our students are gaining monitoring water quality and feeding the fish and invertebrates in the Werth Center Aquaria. This past year, Maritime Aquarium Research Scientist David Hudson collaborated with Renee Chabot and Vincent Breslin in conducting the Walk bridge research in Norwalk harbor. Maritime Aquarium staff are also collaborating with Maeve Rourke by providing herring and bunker in support of her work with microplastic accumulation in LIS fish.

Evaluation of Biofouling Communities on Wind Turbine Foundations at the Block Island Wind Farm, Rhode Island: Dr. Grace is collaborating with Drs. John King and Zoe Hutchinson (University of Rhode Island), Paul English (Fugro GB Marine Ltd.) and Anwar A. Khan (HDR) to re-examine (year 2) the community structure of sessile and mobile organisms on the offshore wind mill farm at Block Island, Rhode Island. This is part of a U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs Grant. A preliminary report was submitted on 2-14-20 and results were presented at the OSM (Ocean Sciences Meeting) in San Diego a week thereafter. A final report for publication will be submitted by May 1, 2020.

Similarities and differences between genomes of temperate and tropical corals: Dr. Grace is collaborating with Drs. (Ilaina Baums, Katie Barott, Kathryn Stankiewicz, Sheila A. Kitchen, and Meghann K. Devlin-Durante: Department of Biology, Pennsylvania State University; Koty Sharp: Roger Williams University; Hollie Putnam: University of Rhode Island; Randi Rotjan, Sarah Davies, John Finnerty, and Leslie Kaufman: Boston University) to determine the genome of the temperate coral *Astrangia poculata*. By determining the order of DNA nucleotides (the genome) in this coral species which, unlike tropical corals, exists over a large geographic and temperature range (0° – 30° C) we will be able to examine the factors that are expected to affect corals and their survival in the future when sea-water temperatures and pCO2 levels are expected to increase. As of January 23rd, 2018 Dovetail has completed the sequencing and have begun the initial assembly of the genome. By late November 2019, we found that the genome a complex genome which will require more editing. At present the genes sequences are in Jean-François Flot's research laboratory at the Université Libre de Bruxelles. Jean Francoise is well known for his skills in "weird genome assemblies" which is not surprising for this unique coral. We are hopeful this work will be completed by mid-June.

The Rise of Turfs: Phase shifts in macroalgal dominance affecting hard bottom reefs in Narragansett Bay and Long Island Sound: Dr. Grace is collaborating with Dr. Colleen Feehan (Montclair State University) examining the ecological consequences of a change in the dominant macroalgal species in local coastal waters. Typically, Southern New England hard bottom reefs are dominated by the kelp (*Saccharina latissimi*) however this species and all its benefits (increased biodiversity and productivity) has been replaced locally with r-selected 'rattier' turf macro-algal species. This collaboration examined hard bottom reefs to document changes and determine factor responsible for these changes. This work has culminated in a publication in Scientific Reports in May 2019 (see publications).

Cities of West Haven and East Haven: Dr. Tait and student research assistants are working with Mark Paine, Assistant Commissioner of Public Works for the city of West Haven, in documenting and assessing on-going beach erosion and other problems. Dr. Tait, Dr. Mathew Miller (EGMS geographer) and student researchers are also working with Kevin White, City Engineer for the city of East Haven, on a comprehensive coastal vulnerability assessment and coastal resilience plan. The goal is to improve the city's resilience to storms and sea level rise with tools such as beach nourishment and a system of raised levee's that would serve as recreational space as well as flood control measures.

IV. Community Outreach, Education, and Research Communication

A continuing goal of the Center is to establish and maintain a variety of community outreach programs that include educational activities at many levels, as appropriate. An important function of the Center is to prepare and distribute educational materials, including new curricula that focuses on the importance of Long Island Sound and environs. Communication of research results is an important role for this Center. It is an expectation that all participating faculty and students will communicate the results of their research to the scientific community, appropriate government agencies and the local community. A list of 2019-2020 research and outreach presentations is listed below:

Presentations

Tait, James F. (Oral Presentation). Stationarity, Transformation and Adaptive Capacity. Society for Ecological Restoration, New England Regional Conference, Southern Connecticut State University, October 11-13, 2018.

Mercaldi, Brooke, M. (Poster). Testing for Seasonal Beach Profiles Along the Connecticut Coast. Society for Ecological Restoration, New England Regional Conference, Southern Connecticut State University, October 11-13, 2018.

Brideau, Lauren. (Poster). Coastal Management on an Eroding Shoreline: An Alternative Restoration Technique. Society for Ecological Restoration, New England Regional Conference, Southern Connecticut State University, October 11-13, 2018.

Tait, James F. (Oral Presentation). Building Coastal Resilience in the State of Connecticut via Strategic Sediment Management. Annual Meeting of the American Association of Geographers, Washington, D.C., April 3-7, 2019.

Mercaldi, Brooke M. (Oral Presentation). Examining the Dynamics of the Connecticut Shoreline and their Implications for Coastal Zone Management. Annual Meeting of the American Association of Geographers, Washington, D.C., April 3-7, 2019.

Brideau, Lauren. (Oral Presentation). Coastal Management on an Eroding Shoreline: An Alternative Restoration Technique. Annual Meeting of the American Association of Geographers, Washington, D.C., April 3-7, 2019.

Mercaldi, Brooke and Lauren Brideau (Oral Presentation). Storms and Beaches on the Connecticut Coast. Joyride Charters, Westbrook, Connecticut. November, 2019.

Mehlin, E. and Breslin, V.T. 2019. GIS Color Contour Mapping of the Spatial Trends in Sediment Physical Properties and Metal Contamination in Connecticut Harbors. The New England-St. Lawrence Valley Geographical Society (NESTVAL) Conference, Framingham State University, Framingham, MA. October 18, 2019.

Mercaldi, Brooke and J. Tait. (Invited). Research at the Werth Center for Coastal and Marine Studies Coastal Lab. Singles Under Sail. Norwalk, CT April 18, 2019.

Breslin, V.T. Seminar (Invited). Plastics are invading our oceans worldwide. What are the impacts internationally and in Connecticut? Environmental Issues Seminar Series, Three Rivers Community College, Norwich, CT. April 17, 2019.

Barboza, M.L., Restrepo, R. (Presentation). Gross and microscopic anatomy of the olfactory system of a grey seal, *Halichoerus grypus*. World Marine Mammal Conference. Barcelona, Spain. December, 2019.

Grace, S. Co-Organizer with Drs. Koty Sharp (Roger Williams University) and Randi Rotjan (Boston University). 5th Annual Astrangia Working Group Conference on Temperate Corals. May 2019. Roger Williams University, Bristol, Rhode Island. Astrangia History; *Arbacia punctulata* opening space for temperate corals; Marine heatwaves and species distributions.

Grace S. and DiPreta, G. (Presentation). NEERS (New England Estuarine Research Society). Successional state of benthic communities in the rocky subtidal zone and the effects of increased prey availability in *Astrangia poculata*. York Harbor, Maine. April 2019.

Grace, S. and Hedreen, R. Creation of a gamefish occurrence dataset from public-focused informational newsletters. 75th Northeast Fish and Wildlife Association Conference. Groton, CT. April 2019.

Bhageloo, C., Grace, S. and Breslin, V.T. (Poster Presentation). 19th Annual Long Island Sound Research Conference. Macroalgae as Bio-indicators for Mercury Contamination in Long Island Sound. Danfords Inn, Port Jefferson, NY. March 2019.

Grace, S.,Veilleux, D., Feehan, C. and Narvaez, C. *Arbacia punctulata* Aquaculture, A Possible Control for the Rise of Turf Macroalgae. 11th Annual Northeast Aquaculture Conference & Exposition and the 39th Milford Aquaculture Seminar. January 2019. Boston, Massachusetts.

Woosley, N. (Poster Presentation). That's Astrangia Thing to Eat: Temperate Coral Predators in Connecticut. 5th Annual Temperate Reef Working Group. May 2019.

Gabriella DiPreta (Oral Presentation). Successional state of benthic communities in the rocky subtidal zone and the effects of increased prey availability in *Astrangia poculata*. 5th Annual Temperate Reef Working Group in May 2019.

Gabriella DiPreta (Poster Presentation) Successional state of benthic communities in temperate coral dominated habitats. 5th Annual Temperate Reef Working Group in May 2019.

Breslin, V.T. (Invited). Plastics in the Ocean: Global and Local Consequences. Connecticut Valley Garden Club, Hill-Stead Museum, Farmington, CT, June 19, 2019.

Breslin, V.T. (Invited). Plastics in the Ocean: Global and Local Consequences. Fairfield Garden Club, Fairfield Museum and History Center, January 28, 2020.

Breslin, V.T. (Invited). Plastics in the Ocean: Local and Global Consequences. Willoughby Wallace Library, Branford, CT. April 6th 2020.

Breslin, V.T. (Invited). Microplastics/Macro-Problems: The Environmental Consequences of Consumer Plastics in Long Island Sound. Laboratory Analysts of Connecticut (LabACT). Connecticut Department of Environmental Protection Training Center, Old Lyme, CT. December 6, 2019.

Publications

Filbee-Dexter, K., T. Wernberg, S.P. Grace, J. Thormar, S. Fredriksen, C.N. Narvaez, C.J. Feehan, and K.M. Norderhaug. (in review). Marine heatwaves and the collapse of North Atlantic kelp forests. Proceedings of the Royal Society B: Biological Sciences.

S.P. Grace, and C.J. Feehan. (accepted 9-19-19). Temperate urchins clearing space for corals. Frontiers in Ecology and the Environment.

Feehan, C.J., S.P. Grace and C.A. Narvaez. 2019. Ecological feedbacks stabilize a turf-dominated ecosystem at the southern extent of kelp forests in the Northwest Atlantic. Scientific Reports. https://doi.org/10.1038/s41598-019-43536-5

Hedreen, R., and Grace, S.P. 2019. Creation of a gamefish occurrence dataset from public-focused informational newsletters. https://doi:10.31230/osf.io/85tf4

Grace, S.P., M. LaFrance-Bartley, P. English, J.W. King, and A.A. Kahn. 2019. Evaluation of Biofouling Communities on Wind Turbine Foundations at the Block Island Wind Farm, Rhode

Island. Draft Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019.

Grants

Astrangia poculata as an Aquatic Symbiosis Model System. Pre-proposal submitted to the Gordon and Betty Moore Foundation Symbiosis Model Systems Solicitation. (November 18, 2019). Sean Grace collaboration with Koty Sharp (Lead Investigator-Roger Williams University), Randi Rotjan (Boston University), Frank Stewart (Georgia Institute of Technology), and Colleen Cavanaugh (Harvard University).

Evaluation of Biofouling Communities on Wind Turbine Foundations at the Block Island Wind Farm, Rhode Island. $19,279.00. Sean Grace collaboration with John King (University of Rhode Island Graduate School of Oceanography).

A Documented Phase-Shift on Temperate Reefs in Long Island Sound: from Kelp to Turf Dominance. CSU-AAUP, Faculty Research Grant. PI- S. Grace. Total Funds $4,000.

Characterization and Quantification of Microplastics in Wastewater Treatment Facility Effluent. 2018 CSU-AAUP Research Grant. Project Duration: June 1, 2018– May 30, 2019. PI – V.T. Breslin. Total Funds $4,250.
Characterization of Microplastics in Treated Wastewater Effluent Discharged to the Quinnipiac River. Submitted to the Quinnipiac River Fund, Community Foundation for Greater New Haven. Project Duration: May 2019-October 2020. PI - V.T. Breslin. Total Funds: $16,000.

Examination of Atlantic Herring (*Clupea harengus*) for the Presence of Microplastics. 2019 CSU-AAUP Research Grant. Project Duration: June 1, 2019– May 30, 2020. PI – V.T. Breslin. Total Funds $5,000.

Chabot, R. (Funded). Impacts of the Walk Bridge Construction on the Norwalk River Water Quality. Undergraduate Research Grant. Southern Connecticut State University. Summer 2019. Total Funds $3,000.

Brideau, L. (Funded) Coastal Sediment Dispersal Patterns at Hammonasset Beach State Park: Implications for an Alternative Beach Restoration Technique. Southern Connecticut State University Undergraduate Research Grant, Summer 2019. Total Funds $3,000.

Chabot, R. (Submitted). Impacts of the Walk Bridge Construction on the Norwalk River Water Quality. Undergraduate Research Grant. Southern Connecticut State University. March 2020. Total Funds $3,000. Status: Pending.

Rourke, M. (Submitted). Determination of microplastics in Menhaden in Long Island Sound. Undergraduate Research Grant. Southern Connecticut State University. March 2020. Total Funds $3,000. Status: Pending.

Participation

Grace, S.P. 2019. Dr. Grace was co-host and co-organizer for the 5th Annual Temperate Reef Ecology Meeting held at Roger Williams University in summer 2019 (May 28-29). This meeting introduced over 100 coral scientists/students to temperate corals and how these corals may be used as a model system to study tropical reef systems that are currently under threat. A fifth meeting is planned for summer 2020 as well.

Brideau, Lauren; Mercaldi, Brooke; Bakies, David; Tait, J. (Presentation) Visiting Scholars Event, Amity High School. Research at the Werth Center for Coastal and Marine Studies Coastal Lab. December 17, 2018.

Breslin, V.T. and Bhageloo, C. Milford Aquaculture Seminar, Courtyard by Marriott, Shelton, CT. January 13-15, 2020.

Student Theses and Reports/Advisors

Student	Thesis Title	Completion Date
Gabriella DiPreta	Early Successional Community Structure and Coral Behavior on Rhode Island Rocky Reefs	May 2019
Anthony Vignola	Seasonal Variations in Microplastic Abundance in Treated Municipal Wastewater from North Haven and Meriden Wastewater Treatment Facilities	May 2020
Rebecca Hedreen	Creation of a gamefish occurrence dataset from public-focused informational newsletters.	Dec 2020
Brooke Mercaldi	Examining the Beach Dynamics of the Connecticut Shoreline and their Implications for Coastal Zone Management	May 2020
Lauren Brideau	Coastal Sediment Management on an Eroding Shoreline: An Alternative Beach Restoration Technique	May 2020
Maeve Rourke	Examining Microplastics in Filter Feeding Fish in Long Island Sound	May 2021
Shayla Peterson	Coastal Vulnerability to Storm Wave Impacts and Recommendations for Enhancing Resilience	May, 2021
Renee Chabot	An Examination of the Sediment and Water Quality for the Walk Bridge Construction in Norwalk Harbor	May 2021
Cassandra Bhageloo	Examination of Mercury in Aquaculture and Native Macroalgae form Long Island Sound	May 2021

Werth Center Fellows Alumni Update

Sarah Koerner (Werth Center Fellow 2014, 2015) finished her MS degree at NOVA-Southeastern in Florida with Joana Figueiredo, Ph.D. (Coral Larval Biologist) in May 2019 and beginning a PhD program at the University of Rhode Island with Dr. Hollie Putnam's lab examining tropical coral reef ecology and biology.

Julia Honan (Werth Center Fellow 2017-2018) graduated with her BS Honors in Biology from SCSU and is currently a first year Veterinary student at the Royal School of Veterniary Sciences at the University of Edinburgh in Scotland.

Gabriella DiPreta (Werth Center Fellow 2015-2019) finished her MS degree here at SCSU and started a job in January 2020 with the Washington DC office of the Environmental Protection Agency and is examining the effects of sedimentation on coral reefs.

Michelle Ritchie is currently a Ph.D. Student in Geography at Penn State University. Dissertation Topic: Social impacts of climate change on native populations in the Arctic.

Fatima Cecunjanin received her Master's Degree from Columbia University in Climate Studies and is currently an Adjunct faculty in EGMS at Southern Connecticut State University.

Ryan Orlowski is employed as an Environmental Specialist with Triumverate Environmental, Hartford, Connecticut.

Research and Creativity Conference Presentations

Southern Connecticut State University

Werth Center for Coastal and Marine Studies Participants

Undergraduate April 13th, 2019; Graduate May 13th, 2019

Werth Center for Coastal and Marine Studies students were well represented at the fifth annual undergraduate research and creativity conference held at SCSU. The following students presented oral or poster presentations at the conference.

Students	**Presentation Title**
Cassandra Bhageloo	Macroalgae as Bioindicators for Mercury Contamination in Long Island Sound
Lauren Brideau	Coastal Management on an Eroding Shoreline: An Alternative Restoration Technique
Brooke Mercaldi	Testing for Seasonal Beach Profiles Along the Connecticut Coast
Sierra Mayerson	Are the Marine Animals of the Maritime Aquarium Being Exposed to Microplastics Through Their Diet
Gabrielle Restrepo	Gross and Microscopic Anatomy of the Olfactory Turbinates and Vomeronasal Organ of a Grey Seal, *Halichorus grypus*
Julia Honan	The Effects of Temperature on the Rate of Photosynthesis of Intertidal *Astrangia poculata* (Ellis and Solander 1786)
Renee Chabot Mallery Breban Cassandra Bhageloo	Long-term Water Quality Monitoring at Long Wharf, New Haven (2012-2019)
Gabriella DiPreta	Successional State of Benthic Communities in Temperate Coral Dominated Habitats in Rhode Island

V. Accounting, Budget Expenditures and Grant Writing

Academic Year 2019-2020 Itemized Budget Justification

Funds totaling $75,000 were requested for Year 14 (2019-2020) to support the research and educational mission of the Center (see attached budget spreadsheet). Three columns are shown in the budget sheet showing the Werth Foundation request, the Werth Foundation Fund Disbursement (how dollars were actually spent) and the SCSU Matching Funds (dollars committed by the University or obtained from other sources).

Professional Salaries and Honoraria ($9,260 expended)

Werth Foundation funds were used in support of salaries for faculty mentoring students during the summer 2019. Professors Breslin ($3,000), Tait ($2,000) and Grace ($2,000) were compensated for mentoring student research projects ($1,260 fringe benefits). The SCSU Dean of Arts & Sciences provided faculty reassigned time (3 credits time each for Breslin, Grace and Tait) during the academic year in support of managing the CCMS activities and programs. Reassigned time (9 credits) for faculty in support of CCMS management totaled $20,100.

Student Research Fellowships ($31,700 expended)

A major portion of the Center budget consists of funds in support of undergraduate and graduate student research stipends. A major goal of the Center is to increase undergraduate student participation in the processes of "doing science" through participation in faculty guided research projects. The CCMS awarded fellowships during summer 2019 (10 students; $14,000), Fall 2019 (8 students; $8,200) and spring 2020 (9 students; $9,500). Fellowship amounts per student ranged from $500-$2,000 per semester (50-200 hours @ $10/hour). The CCMS has a system-wide mission to support student research. This past year, the CCMS supported thirteen different students in six different academic fields (Biology, Chemistry, Environmental Systems and Sustainability Studies, Marine Studies, Geography, and Honors) in support of faculty-directed research projects during this past year totaling $31,700.

Analytical Equipment Service Contracts ($21,766 expended)

Funds in the service contract budget category ($21,766) were used to purchase a service contract for fiscal year 2019-2020 for the PerkinElmer AAnalyst 800 Atomic Absorption Spectrophotometer ($9,622). Werth funds were also used to purchase a one-year service contract (2019-2020) for the Milestone DMA 80 Direct Mercury Analyzer ($4,500). This year the WCCMS assumed the service contract fees ($7,644) for the ICP-OES instrument in Analytical laboratory SCI 211. The ICP-OES was donated to the university by the PerkinElmer corporation and has now become an important analytical instrument for the determination of metals in environmental samples.

Ship Time ($2,550 expended)

Funds for chartering ship time were budgeted ($4,500) to provide access to field sample sites for research and education along the Connecticut shoreline and in Long Island Sound. Funds totaling ($750) were used to charter the R/V *Spirit of the Sound*, Maritime Aquarium, Norwalk, CT to collect sediment in Norwalk harbor on July 5, 2019. This cruise was conducted in support of a graduate Environmental Education course EVE 537 Analytic Techniques and Instrumentation. Sediment samples collected during this cruise were used in support of Dr. Breslin's research examining the trends in sediment quality in Norwalk harbor. The R/V *Island Rover* was also chartered ($1,800) for three three-hour cruises in New Haven harbor in support of educational programming. Cruises for MAR 210 were scheduled in the fall semester 2019 for 10/23, 10/24 and 10/25. Sediment samples obtained during these cruises were examined for metals in support of the WCCMS harbor studies.

Long Island Sound Seminar Series

Funds were allocated to support the annual spring Long Island Sound Seminar Series. This year marks the 16th consecutive year that the Werth Center for Coastal and Marine Studies has hosted the seminar series. The annual spring seminar series was solely supported through a grant to Grace, Tait and Breslin by the Office of Faculty Development at SCSU ($3,000).

Travel and Conference Funds ($656 expended to date)

Travel funds totaling $1,500 were budgeted to reimburse costs associated with travel in support of attendance at local, regional and national scientific meetings. WCCMS students presented posters at the Undergraduate Research and Creativity Conference at SCSU, the Milford Aquaculture Seminar, Shelton, CT on January 13-15, 2020, the CT DEEP sponsored Many Waters, One State Water Quality Conference at Three Rivers Community College, April 5, 2019 and the NESTVAL 2019 meeting at Framingham State, Framingham, MA on October 18-19, 2019. Most of the funds expended covered mileage and registration fees.

Travel funds were also used in support of travel to the Marine Biological Laboratory at Woods Hole to pick up and transport fish specimens to the display aquaria at SCSU.

Publication Costs ($350 expended)

A total of $600 was budgeted for publication costs for FY 2019-2020. Funds were used primarily in support of printing large format posters (3' x 4') for student research posters for scientific meetings.

New Equipment/Software Purchases ($3,061)

A large fiberglass tank (270 gallon) equipped with a filtration system was purchased ($1,263) in June 2019 to house the mummichog fish captured for use in the MAR 210 Coastal Marine Studies courses. The large tank provides a permanent home for the standing stock of mummichogs (100 fish). The aquarium was required as our new CT DEEP Specimen Collection permit (2019 renewal) does not allow us to return captured fish to the marsh of origin.

WCCMS faculty purchased two site licenses for Sigma Plot 14 ($899 per license). Sigma Plot software is used in support of statistical analysis of data and as a scientific graphing software package. The licenses will be used to install the software on faculty computers and student computers in the Werth Center (SCI 208A).

Expendable Supplies ($5,921 expended)

Funds for laboratory and office supplies ($5,000) were budgeted to allow the purchase of materials in support of the WCCMS research and educational initiatives. Supply funds were used to purchase laboratory chemicals, tank gas for instrumentation, cartridges for water purification systems, standard reference materials for laboratory instrument calibration, supplies for the sediment metals research and laboratory and field supplies for the sediment grain size and beach surveying research. Additional funds were used for the purchase of chemicals, supplies and reagents for water quality and aquarium supplies and general office supplies. Supplies were also purchased to support educational and aquaculture activities in the Werth Center aquarium laboratory. Supplies include filter cartridges for 30-gallon aquaria, water quality test kits, and water quality meters.

Supply purchases exceeded the budgeted amount as supply needs were increased due to new research initiatives.

Balance of Funds

To date, CCMS has expended $74,079 of the $75,000 funds budgeted for FY 2019-2020. The remaining balance of funds will be carried over to FY 2019-2020.

Matching Funds

Each of the following grant awards listed have been used in support of CCMS research and education activities.

Connecticut State University Research Grant Award 2019-2020

A Documented Phase-Shift on Temperate Reefs in Long Island Sound: from Kelp to Turf Dominance. CSU-AAUP, Faculty Research Grant. PI- S. Grace. Total Funds $4,000.

Examination of Atlantic Herring (*Clupea harengus*) for the Presence of Microplastics. 2019 CSU-AAUP Research Grant. Project Duration: June 1, 2019– May 30, 2020. PI – V.T. Breslin. Total Funds $5,000.

Characterization of Microplastics in Wastewater Treatment Facility Effluent. 2019-2020 Faculty Creative Activity Research Grant. Project Duration: June 1, 2019– May 30, 2020. PI – V.T. Breslin. Total Funds $2,500.