

Southern Connecticut State University

Werth Center for Coastal and Marine Studies



WCCMS Annual Report 2016-2017

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Prepared for:

The Werth Family Foundation, Woodbridge, CT

March 2017

CCMS Annual Benchmark/Evaluation Report 2016-2017

Each year the participating faculty of the WCCMS will prepare and submit to the Werth Family Foundation an annual report describing the Center activities. This report will be generated each year and will be made available in electronic and hard copy form. It will provide 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 will be completed and submitted to the Werth Family Foundation during February/March of each year. Contents of the WCCMS 2016-2017 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
 Dr. Elizabeth Roberts
 Biology

Student Participants

Summer 2016; Fall 2016; Spring 2017

Hollie Brandstatter, Graduate Student, Environment, Geography and Marine Sciences
Nick Devito, Undergraduate Student, Biology

Summer 2016; Fall 2016

Dylan Steinberg, Undergraduate Student, Environment, Geography and Marine Sciences
Lara Bracci, Undergraduate Student, Environment, Geography and Marine Sciences

Spring 2017

Nicole Woosley, Undergraduate Student, Biology

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

WCCMS students have now completed four years of water quality monitoring at the Long Wharf Pier, New Haven, CT. A new development this year is our participation in the Long Island Sound Unified Water Study: Long Island Sound Embayment Monitoring coordinated by Save the Sound (<http://www.ctenvironment.org/uws>). The overall goal of the study is to standardize data collection methods and to better coordinate the embayment monitoring efforts among citizen and university researchers examining LIS water quality. This year focused on developing standard practices for monitoring water quality and developing a network for communicating the results of various water quality monitoring programs. Graduate student Hollie Brandstatter and Dr. Breslin attended the Unified Water Study: Long Island Sound Embayment Research, January 11, 2017 at the Bridgeport Public Library, Bridgeport, CT.

Results of our monitoring show that water temperature (-0.8 to 26.8°C) at the pier at Long Wharf, New Haven displays a seasonal trend. Dissolved oxygen concentrations (1.65 to 19.18 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 other Long Island Sound coastal embayments. Undergraduate Biology student Nick Devito was recently added (Summer 2017) to the team and is working with Biology Professor Elizabeth Roberts on determining fecal coliform bacteria concentrations at the Long Wharf pier. Coliform bacteria are used as an indicators of possible sewage contamination because they are commonly found in human and animal feces.

Seasonal Growth of the Temperate Coral *Astrangia poculata* from 1972 to 1981 Using Historical Photographs

Faculty Dr. Sean Grace
 Biology

Student Participant(s)

Summer 2015; Fall 2015; Continued with research through Spring 2016

Gabriella DiPreta, Biology, Undergraduate Student

The purpose of this study was to examine historical photos taken with a Nikonos III underwater camera between the years 1972-1979 by Wes Pratt who worked as at the National Marine Fisheries Laboratory in Narragansett, Rhode Island. The photos were of the temperate coral *Astrangia poculata* and are unique in that growth measurements on corals world-wide were rare at that time. Pratt visited the same colonies over the course of 7 years and took photographs of them. The photos were given to Dr. Grace recently by Wes Pratt. Photos were digitized (moved from slide film to jpeg) and examined to count polyp number, a measure of coral growth over time. Each coral was identified by a clear marker and 47 corals were followed throughout the timeframe of the original photographic data-set. The number of polyps were counted and any other organisms that were over-growing the corals were also noted.

Results to Date/Significance

Results demonstrate that during the summer months, *Astrangia poculata* displayed a positive growth rate with an increase in polyp count. A negative growth rate or no change in polyp count was found when *Astrangia poculata* went dormant during the winter months. Competitive interactions between *Astrangia poculata* and the red boring sponge *Cliona celata*, as well as burial by sedimentation, displayed a negative growth or no change in polyp count. This study demonstrates an understanding of seasonal trends which initiate a positive or negative growth of polyps in the temperate coral, and the ecological and environmental factors which influence coral growth.

Sediment Transport on West Haven Beaches

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

Student Participant

Summer 2016

Jessica Brewer, Undergraduate Student, College of Environmental Science and Forestry, State University of New York. (Tait: FDCA Grant stipend)

Project Description

Extending the results from Ryan Orłowski's study (2014-2016) of the fate of a beach replenishment project, beach profile data was rendered into a time series of 3-D images of the beach as a whole. In addition, a beach sediment transport study of West Haven's northeastern beaches was conducted by Miller and Tait. Miller took a series of aerial photos from 1934 to 2014, geo-referenced to the same boundaries and animated them. Sediment transport patterns were clearly visible.

Results to date/Significance

The results of Brewer's study were consistent with the interpretations of beach sediment dispersal by Orłowski. Sediment is being lost from southwestern beaches and collecting in a shoal to the west of Bradley Point. In the study by Tait and Miller, transport history was also clear. 1) The sand spit known as Morse Point (sometimes confused by an older spit called Sandy Point) originated in the 1950s and has grown rapidly over time. 2) This growth has resulted in the creation of a new marsh but also resulted in sediment starvation of the Sandy Point spit. 3) The Morse Point spit has become a hazard to navigation a threat to the operation of the West Haven water treatment plant. Several beach replenishment episodes on the beaches updrift of the spit provided added sediment that was transported to the northeast by the same SW wavefield that transported sediments from the 2014 beach replenishment project to the shoal at Bradley Point. Construction of a wooden "weir" near the base of the spit acted like a groin diverting sand offshore and away from the original Sandy Point spit.

There is a larger significance that relates to coastal resilience. In a time of rising sea levels and intensified storms, the need for beach nourishment will increase. This is not only becoming more expensive, sources of suitable sand are becoming scarce worldwide. One of the decisions made by the Town of West Haven, in part due to our results and recommendations, is the decision of the town in its Harbor Management Plan, its Coastal Resilience Plan and its Conservation and Development Plan is a commitment to sand management. This entails engaging in sand reclamation, an activity in which eroded sand is reclaimed and replaced in an ecologically sensitive manner. This differs from beach replenishment because replenishment depends on the import of sand from another source. Currently, the state D.E.E.P. discourages extracting sand from the nearshore for sand replacement projects (although it is allowed at state beaches). So this research may result in changes in state environmental policy.

Werth Center for Coastal and Marine Studies Aquarium

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

Student Participants

Summer 2016; Fall 2016; Spring 2017

Hollie Brandstatter, Graduate Student, Environment, Geography and Marine Sciences

Nick Devito, Undergraduate Student, Biology

Summer 2016; Fall 2016

Dylan Steinberg, Undergraduate Student, Environment, Geography and Marine Sciences
Lara Bracci, Undergraduate Student, Environment, Geography and Marine Sciences

Spring 2017

Nicole Woosley, Undergraduate Student, Biology

Werth Center facilities in the new science building 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 (coastal aquarium) and January 2016 (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 one year of water quality measurements on the aquarium system and the fish have been in the aquarium for one year. To celebrate this occasion, WCCMS hosted an Aquarium Open House on March 21st, 2017. The Open House allowed students throughout the campus an opportunity to tour the facilities and learn about LIS fish and invertebrates. Student posters displayed the water quality monitoring results for the past year and information concerning the fish and invertebrate species in the aquarium. We also recently added a second touch tank to the lab in SCI 111, separate from the original aquarium system. This touch tank serves as a true touch tank for invertebrate specimens for students to handle during visits. The lab also hosted a 6th grade student group from Fair Haven School, New Haven, on Friday March 3rd. WCCMS students led a tour of the lab and educational programming using the invertebrate specimens from the touch tank. Three additional school groups are scheduled to visit the laboratory during the Spring 2017 semester.

Results to Date/Significance

This study is in an intermediate stage. Profiles have been measured at the five study sites in Fall of 2015, Winter of 2015, Spring of 2016, Summer of 2016 and Fall of 2016. Based on initial observations, profiles are mainly immobile with transport of sand offshore or alongshore during high-energy events. The main regime is erosive with only minor gains, those gains being likely the result of alongshore transport from other parts of the beach rather than recovery of sand lost to erosion by the action of fair weather waves.

Cliona celata, Bio-eroding and Changing Temperate Reefs from Mixed Highly Biodiverse Communities to Single Low Diverse Habitats

Faculty Dr. Sean Grace
 Biology

Student Participant(s)

Fall 2015; Spring 2016

Jennifer Lazor, Undergraduate Student, Biology
Todd Massari*, Graduate Student, Biology

Project Description

Competition between the temperate scleractinian coral *Astrangia poculata* and the Red Boring sponge *Cliona celata* was examined *in situ* at Fort Wetherill, Jamestown, Rhode Island. Coral-sponge assemblages were examined using 3, 30m transects at 14m depth. Out of 2,758 corals examined, 21% were in association with the sponge. *Cliona celata* bores under the coral decreasing its attachment strength and ultimately leading to coral dislodgement. The attachment strength of corals alone and those in competitions with the boring sponge was examined.

Results to Date/Significance

Sponges significantly decrease the attachment strength of corals ($T=697$, $P<0.001$). Corals were three times likely to be dislodged when in an assemblage with sponges than alone. Though corals are not overgrown by sponges (not observed in this study), corals that were movable by simply pushing on them increased when in competition with the sponge. Like tropical reefs that may be moving to sponge dominance, temperate corals were negatively affected by boring sponges which decrease their attachment strength thus increasing the likelihood of dislodgement.

This summer (2016) was instrumental in determining the methods for removal to examine changes in attachment strength. Results are interesting for many reasons in this case as it is the first study to demonstrate that temperate reefs are similarly affected by sponges as tropical reefs.

Cove River Marsh Recovery

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

Student Participants

Summer 2016; Fall 2016; Spring 2017

Shannon Bronson, Undergraduate Student, Environment, Geography and Marine Sciences

Mathew Connors, Undergraduate Student, Environment, Geography and Marine Sciences

Student Participants (Volunteer, no stipend)

Scott Thibault, Graduate Student, Environment, Geography and Marine Sciences

Peter Broadbridge, Graduate Student, Environment, Geography and Marine Sciences

Darryl Nicholson, Graduate Student, Environment, Geography and Marine Sciences

Project Description

The town of West Haven recently undertook a salt marsh restoration project that involved replacement of a tide gate and removal via cutting and herbicide of invasive common reed (*Phragmites australis*). Unfortunately, recolonization by native marsh grasses has been very problematic. Studies of marsh elevations, characterization of the marsh surface, water level changes, sediment samples, and observations via drone have been conducted in order to understand current marsh dynamics and to develop hypotheses concerning the failure of the marsh to thrive.

Results to Date/Significance

Marsh elevation data, sediment samples, and extensive drone observations have been collected. The study is still in its initial stages. The study is significant in that coastal environments such as salt marshes, which are highly important coastal ecosystems, will come under increasing stress as a result of climate change. Specifically, with sea level rise, marsh surfaces will be subjected to increased periods of inundation by salt water. This will result, eventually, in losses of high marsh grasses such as *Spartina patens* and *Dystichlis spicata*, and eventually loss of low marsh grasses (*Spartina alterniflora*). The grasses are keystone species in the marsh ecosystem. The study is also significant in that it investigates a marsh that is completely surrounded by an urbanized environment. During sea level rise, marshes typically responded by migrating landward. In this case, there is no place for the marsh to go. The surrounding development presents a barrier to marsh migration.

Assessment of Plastic Microbead Contamination in Long Island Sound

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

Student Participant(s)

Summer 2016; Fall 2016; Spring 2017

Cody Edson, Graduate Student, Chemistry
Lela Jackson, Undergraduate Student, Chemistry

Plastic microbeads (< 5mm) in consumer cosmetic and skin care products bypassing municipal wastewater treatment systems may cause harm to marine ecosystems yet no systematic study has been conducted to confirm their presence in Long Island Sound. New Haven harbor, with two municipal wastewater treatment facilities discharging treated wastewater into the harbor, was selected for this study. Several commonly available consumer cosmetic products were first examined using optical microscopy to determine microbead particle morphologies (size, shape, and color).

The proposed study is designed to examine the temporal and spatial distribution of plastic microbeads in Connecticut coastal harbors. Harbor water was sampled by towing an 80 μ m mesh plankton net at the water surface along four predetermined transects in New Haven (June) and Mystic (October) harbors in 2016. The collected water was filtered and the filter paper examined for the presence of plastic microbeads. Results will allow for a comparison of microbead concentrations in an eastern (Mystic) and central (New Haven) LIS harbor. The goals of this proposed study are to (1) repeat the plankton tow transects conducted in June 2015 in New Haven harbor to determine if microbead concentrations have changed over time; (2) examine the spatial distribution of microbeads in two coastal LIS harbors along the Connecticut coastline; and (3) correlate the measured microbead concentrations within each harbor with wastewater treatment and tributary river discharges in each harbor.

Results to Date/Significance

Five surface water plankton tows (64 and 80 micron mesh nets) were conducted along predetermined transects in New Haven harbor in June 2016 proximate to two municipal wastewater discharges to quantify plastic microbead concentrations in the harbor. Using a dissecting microscope (10-45x magnification) microbeads were photographed using a Ken-A-Vision PupilCAM camera and measured using Toupview digital imaging software. A total of 185 plastic microbeads were found in the harbor plankton tows. Plastic microbead diameters captured in New Haven harbor plankton tows were primarily in the 60-300 micron size range.

Microbeads were also sampled in Mystic harbor in October 2016. Two of the plankton tows were conducted in Mystic harbor and one tow was conducted in Long Island Sound. Final microbead counts and microbead imaging are still in progress.

Acquisition of DIVING-PAM Underwater Fluorometer

Faculty Dr. Sean Grace
 Biology

The DIVING-PAM Underwater Fluorometer is a unique instrument for studying *in situ* photosynthesis of underwater plants, including sea grasses, macroalgae, and zooxanthellae in corals. Based on the large experience with chlorophyll fluorescence analyses of terrestrial plants, investigations using the DIVING-PAM have shaped a clearer understanding of underwater photosynthesis under natural conditions. The Diving-PAM underwater fluorometer was recently purchased (Spring 2017) by Werth Center co-coordinator Dr. Sean Grace (Biology) and will be used to study *in situ* photosynthesis by chlorophyll fluorescence analysis. This unique instrument is one of only a few available regionally and represents a significant advance in our ability to conduct underwater photosynthesis studies. It can be used in underwater studies of sea grass, underwater plants, macroalgae and coral. The Diving-PAM is rated to a depth of 50m, has an external fiber optic sensor and multiple sample holders. All necessary underwater commands are via a touch sensitive keypad. The instrument automatically displays and records fluorescence yield (F), maximal yield (F_m) and photosynthesis yield ($Y=\Delta F/F_m$). The fluorometer stores up to 4000 datasets in internal memory for later transfer to a PC. Further, the Diving-PAM fluorometer determines the basic health measurements for any photosynthetic animal (corals, anemones), all macroalgae, and sea-grasses. Essentially, this instrument can be used to compare the 'health' of photosynthetic organisms in one area of Long Island Sound to other areas and since it is a hand-held device, it is easily transportable and students can use it easily when properly trained.

Results to Date/Significance

Dr. Grace and others will utilize this instrument to determine the photosynthesis/respiration rates for temperate corals with (zooxanthellate) and without (azooxanthellate) the endosymbiont *Symbiodinium psysgmophilum*. Additionally, this equipment will be utilized to examine kelp and other macroalgal photosynthetic rates in Long Island Sound.

An Analysis of Mercury Sorption in Macroalgae across the Long Island Sound East-West Gradient

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

Student Participants

Fall 2016; Spring 2017

Lela Jackson, Undergraduate Student (Chemistry)

Seaweeds have been used worldwide as bio-indicators and to evaluate the quality of the surrounding environment. A macroalgae bio-indicator, especially for mercury, would be of great utility in LIS. Differences in sediment and dissolved mercury concentrations in LIS coastal harbors provides an opportunity to assess the resultant spatial trends in macroalgae tissue mercury concentrations along this gradient. This study will examine the mercury sorption capacity of two common macroalgae across an east-west gradient in Long Island Sound, the brown alga *Fucus spiralis* (Flatwrack) and the red alga *Chondrus crispus* (Irish Moss). To our knowledge, this is the first systematic analysis of algae mercury concentrations in Long Island Sound. We propose to collect macroalgae (N=10 of each species) from the five Connecticut harbors spanning an East to West gradient in LIS. Freeze-dried algae tissue samples (0.100-0.250 g) will be analyzed directly for mercury by thermal decomposition amalgamation and atomic absorption spectrophotometry using a Milestone DMA-80 direct mercury analyzer.

Results of this study will be critical in the systematic analysis of mercury concentrations in these two macroalgae species in Long Island Sound. Results of this study will also be useful in assessing the utility of these two common macroalgae species as bio-indicators of mercury pollution in estuarine waters.

Results to Date/Significance

Chondrus specimens were collected from six Connecticut embayments in November 2016 by Dr. Grace for analysis in this study. These specimens were prepared and analyzed for mercury in Spring 2017. Results show that mercury concentrations in *Chondrus* varied and ranged from 10.6 ng/g in New Haven harbor to 21.3 ng/g in Groton. We are currently analyzing *Chondrus* tissues from herbarium mounted, archived specimens collected in past years (2000-2014) for comparison to recently collected *Chondrus* specimens. These analyses may provide an indication of temporal changes in *Chondrus* tissue mercury concentrations in Long Island Sound.

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 2016 to discuss topics concerning the health and quality of Long Island Sound and its environs as part of the Thirteenth Annual Seminar Series on Environmental Issues of Long Island Sound 2016.

The seminar series consisted of three separate one-hour seminars by invited experts on Long Island Sound environmental issues during the Spring 2016 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 2016 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.

Date	Seminar	Attendance
3/30/2016	Mercury Cycling in the Coastal Zone William Fitzgerald, Professor Emeritus Department of Marine Sciences, UCONN, Avery Point	Cancelled due to power failure
4/6/2016	Molecules to Embryos: The Aryl Hydrocarbon Receptor Signaling Pathway and Development in Chondrichthyes Rebeka Rand Merson Associate Professor, Biology, Rhode Island College, Providence, RI	

The aryl hydrocarbon receptor (ARH) is a ligand-activated factor that mediates a response to many environmental chemicals, including many planar halogenated aromatic hydrocarbons (HAH) and polycyclic aromatic hydrocarbons. Exposure to coplanar polychlorinated biphenyls (PCBs) and other dioxin-like chemicals on developing vertebrates involve many organ systems, including skeletal and cardiovascular systems. Apex predators, including those from the class Chondrichthyes (sharks, skates and rays) accumulate high body burdens of PCBs through biomagnification of chemicals moving through the food web. A study was undertaken to assess the developmental effects 3, 3', 4, 4', 5 pentachlorobiphenyl (PCB 126) exposure in little skate, *Leucoraja erinacea*, a model for oviparous elasmobranchs. PCB 126 exposure induced yolk sac edema, deformities of the jaw, cranium and fins, and cardiovascular system failure in skate embryos at all concentrations. This study demonstrated that little skate embryogenesis is sensitive to the toxic effects of PCB 126. Understanding the interactions of environmental pollutants with biological molecules will allow for predictions about the susceptibility of vertebrates to the toxic effects of AHR ligands.

4/20/2016	Zombie Crabs vs Invaders: Does a Marine Parasite Make its Host Vulnerable to another Invasive Crab? Aaren Freeman Associate Professor, Biology, Adelphi University, Garden City, NY	
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Our research team has found several native mud crab populations along the north shore of Long Island harboring *L. panopaei* infections. We've seen that prevalence of parasitic infection in Cold Spring Harbor can reach as high as 64%. Such a high level of infection could be detrimental to established crab populations because rhizocephalan infection can reduce overall reproductive rates within a population, possibly lowering mud crab densities over time. On top of this parasitic invasion, mud crabs are also competing for survival with an invasive Asian shorecrab (*Hemigrapsus sanguienus*) that has been in this area since the early 1990s. Preliminary evidence suggests that where Asian shorecrabs are abundant, native mud crabs are not and this might be the result of competitive interactions between the native and non-native species. Our research team is trying to understand more about how the double threat of parasitic

attack and competition from these invasive species is affecting our local mud crab populations. These experiments will help us understand the synergistic effect of two invaders, a rhizocephalan parasite and the Asian shore crab, on native communities of Long Island. Our study suggests a strong impact of the two invaders on native mud crab abundance and survival, which could have cascading effects throughout the ecosystem.

4/27/2016 Mapping and Visualizing Coastal Dynamics Using Drones

Joel Stocker

Assistant Extension Educator, UCONN Extension Center, Middlesex County, CT

Small Unmanned Aircraft Systems (sUAS) provide an entirely unique platform for visualizing and capturing the dynamics of the shoreline. From the ground the view is too low, from an aircraft too high - the sweet spot perfect from the drone. Combined with new mapping technology coastal change can be captured as often as the user can fly, limited only by extreme weather or the whims of regulation. This presentation highlights a completed sUAS mapping project over Great Gull Island in New York and several personal experiments, each demonstrates the value of drones for capturing the nature of the coast. Gull Island is a bird sanctuary located 7 miles off shore from Connecticut and owned by the American Museum of Natural History in New York. Mapping Gull Island aimed to create a high resolution map of this 17-acre island as part of a habitat restoration project funded by Long Island Sound Study's Futures Fund and the National Fish and Wildlife Foundation. As part of a habitat restoration project, the University of Connecticut Cooperative Extension System used Pix4Dmapper and custom-built UAV images to map a 17-acre island that serves as a bird sanctuary. The result will be used for vegetation management planning, which strives to improve Roseate and Common Tern nesting habitats. A high-resolution (1.2 cm/pixel) orthomosaic of the island was generated, using images of compressed JPEG format. The usage of UAVs and Pix4Dmapper made our mapping task a lot easier. It is time and cost efficient, with satisfying results obtained. Currently no other technology could achieve the same output with such advantages.

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:

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. In particular, they are monitoring the fate of a beach replenishment project that stretches from Tyler Street to Bradley Point. They have also conducted studies on beach stability for the entire West Haven coast that can be used to refine beach sand management for the city. 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.

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 UCONN Avery Point. 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.

SoundWaters was founded in 1989 with the mission to protect Long Island Sound through education and action. Soundwaters staff have engaged hundreds of thousands of students and adults to build a deeper interest and literacy in science for improved school achievement and to raise awareness about the small differences we all can make to protect the health of the Sound. Dr. Breslin will be working with Dianne Selditch to assist the Soundwaters staff develop educational programming concerning microbeads in Long Island Sound. This collaboration will include assisting staff develop sampling strategies for microbead collection aboard the schooner *SoundWaters*.

The Maritime Aquarium at Norwalk and SCSU are developing 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. WCCMS and SCSU are currently developing a memorandum of understanding to formalize this relationship. Three WCCMS students were employed as interns at the Maritime Aquarium during the past year: Hollie Brandstatter, Laura Bracci and Nicole Woosley. 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.

Sustainability Transitions in the Coastal Zone Conference will be held at Southern Connecticut State University, March 30th-April 1st, 2017 in collaboration with the International Geographical Union's Commission on the Dynamics of Economic Spaces and the International Geographical Union's Commission on Coastal Systems. This conference will explore themes

including coastal spatial planning and sustainability, integrated coastal zone management and sustainability, sustainable waterfronts/sustainable coastal cities, energy transitions in the coastal zone, sustainable transport (ports/harbors), coastal aquaculture/3-D ocean farming, climate change and coastal sustainability, radical transition pathways. WCCMS faculty and students will present results of their research during the conference. Papers presented at Coastal Transitions will be invited for peer review and subsequent publication in an edited volume and/or edited issues in a journal focused on Sustainability Transitions in the Coastal Zone.

PerkinElmer, a company headquartered in Massachusetts with a facility in Shelton, CT provides instruments and services designed to help improve human and environmental health.

PerkinElmer donated several pieces of instrumentation to the university in support of research and education programs. PerkinElmer donated an Inductively Coupled Plasma Optical Emission Spectrophotometer (ICP-OES) to Dr. Breslin's laboratory 211 in the new science building. ICP is an argon plasma maintained by the interaction of a RF field and ionized argon gas. ICP-OES is the measurement of the light emitted by elements in a sample introduced to an ICP source.

This instrument will allow for multi-element determinations of metals in sediment digest samples. An air compressor was purchased this year in support of the installation and operation of the ICP-OES. Progress on the installation of the ICP-OES is awaiting the installation of an oxygen monitoring system in Breslin's lab 211. The presence of liquid argon in the lab requires the oxygen sensor. The installation is scheduled for March 22nd, 2017. PerkinElmer technical staff will then complete the installation of the ICP-OES.

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 will be to prepare and distribute educational materials, including new curricula that focuses on the importance of Long Island Sound and environs. Communication of research results will be 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 2015-2016 research presentations is listed below:

Presentations

Grace, S.P. (Oral Presentation). March 2016. 45th Annual Benthic Ecology Meetings. "*Winter quiescence and the release from competition in the temperate scleractinian coral *Astrangia poculata* (Ellis & Solander 1786)*". Portland, Maine

Massari, T. and S.P. Grace (Poster Presentation). April 2017. 46th Annual Benthic Ecology Meetings. "Effects of the Red Boring Sponge *Cliona celata* on the attachment strength of the temperate scleractinian coral *Astrangia poculata*". Myrtle Beach, South Carolina.

DiPreta, G.M. and S.P. Grace (Poster Presentation). April 2017. 46th Annual Benthic Ecology Meetings. "Seasonal growth of the temperate coral *Astrangia poculata* from 1972 to 1981 using historical photographs". Myrtle Beach, South Carolina.

Breslin, V.T., P. Litwin and J. Tait. 2016. Evidence of plastic microbead contamination in New Haven Harbor. 2016 Long Island Sound Research Conference, Holiday Inn, Bridgeport, CT. May 13, 2016.

Younas, S. and V.T. Breslin. 2016. Comparison of Sediment Cadmium Concentrations in Black Rock and Stonington Harbors, CT. 2016 Long Island Sound Research Conference, Holiday Inn, Bridgeport, CT. May 13, 2016.

Jackson L., C. Edson and V.T. Breslin. 2016. Plastic Microbead Contamination in New Haven Harbor, CT. WPI Water Innovation Workshop, Worcester Polytechnic Institute, Worcester, MA. October 24, 2016.

Younas, S. 2016. Comparison of Sediment Cadmium Concentrations in Black Rock and Stonington Harbors, CT. New Haven Section of the American Chemical Society, First Annual Undergraduate Research Symposium. Southern Connecticut State University, April 30th, 2016.

Tait, J., Orłowski, R., Brewer, J. and M. Miller, 2017. Coastal Sediment Management as a Response to Intensifying Storms and Sea Level Rise: A Case Study. Sustainability Transitions in the Coastal Zone Conference, International Geographic Union, New Haven, March 30-April 2, 2017.

Tait, J., Connors, M., Bronson, S., Bracci, L. and R. Becker, 2017. Wave Energy Asymmetry, Seawalls and Beach Erosion on a Fetch-Limited Shoreline. CSCU Faculty Research Conference, Central Connecticut State University, New Britain, CT, March 25, 2017.

Tait, J., 2016. Wave Energy Asymmetry, Seawalls and Beach Erosion on a Fetch-Limited Shoreline. American Association of Geographers National Meeting, San Francisco, March 29-April 3, 2016.

Publications

Tait, J., Orłowski, R., Brewer, J. and M. Miller, 2017. Coastal Sediment Management as a Response to Intensifying Storms and Sea Level Rise: A Case Study. Sustainability Transitions in the Coastal Zone (*Paper submitted for peer review*).

Grace, S.P. (in review). Winter quiescence and the release from competition in the temperate scleractinian coral *Astrangia poculata* (Ellis & Solander 1786). Special Winter Ecology Issue, Northeastern Naturalist.

Participation

Breslin, V.T. and Hollie Brandstatter. 2017. Unified Water Study: Long Island Sound Embayment Research, January 11, 2017. Bridgeport Public Library, Bridgeport, CT.

Grace, S.P. 2016. Dr. Grace was co-host and co-organizer for the 1st Annual Temperate Reef Ecology Meeting held at Roger Williams University in Summer 2016 (August 1-3). This

meeting introduced over 20 coral scientists 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 second meeting is planned for Summer 2017 as well.

Student Theses and Reports/Advisors

Student	Thesis Title	Completion Date
Lela Jackson	Mercury Sorption in Long Island Sound Macroalgae	Spring 2017
Todd Massari	<i>Cliona celata</i> , bio-eroding and changing temperate reefs from mixed highly biodiverse communities to single low diverse habitats	2016

*Todd Massari passed away on 10-23-16 from Acute Myeloid Leukemia just after submitting his thesis proposal. The methods proposed in his work have been used to examine coral attachment strength in competition with the boring sponge *Cliona celata* and results will be presented at the 46th Annual BEM meeting in South Carolina this year.

Grants

Assessment of Plastic Microbead Contamination in Long Island Sound. Connecticut State University 2016 Research Grant. Project Duration: June 1, 2016– May 30, 2017. PI – V.T. Breslin. Total Funds \$5,000.

Fourteenth Annual Seminar Series on Environmental Issues in Long Island Sound. Southern Connecticut State University Faculty Development Grant. Spring 2017. PIs – V.T. Breslin, S. Grace and J. Tait. Total Funds \$4,000.00.

An Analysis of Mercury Sorption in Macroalgae across the Long Island Sound East-West Gradient. 2016-2017 Faculty Creative Activity Research Grant. Project Duration: May 1, 2016- April 30, 2017. PI- S.P. Grace and V.T. Breslin. Total Funds \$2,500.

Mercury Sorption in Long Island Sound Macroalgae. 2017 Spring Undergraduate Research Grant. Southern Connecticut State University Research and Scholarship Advisory Committee. Lela Jackson, Chemistry Department. Total Funds \$3,000.

Undergraduate Participation in Regional Conferences

Todd Massari (Werth Center Fellow 2016) and Sarah Koerner (Werth Center Fellow 2014, 2015) presented at the 1st Annual Temperate Reef Ecology Meeting (August 2016). Roger Williams University, Bristol, Rhode Island.

Werth Center Fellows Alumni Update

Sarah Koerner (Werth Center Fellow 2014, 2015) has started (Fall 2016) a Ph.D. Program at NOVA-Southeastern University in Florida working with Joana Figueiredo, Ph.D. (Coral Larval Biologist).

Michelle Ritchie (Werth Center 2014-2015) has been offered full funding for a PhD program in Geography with a focus on climate change for Fall 2017 at Penn State.

Sadia Younas (Werth Center 2015-2016) has been selected as a Henry Barnard Distinguished Student Award recipient. Sadia, a Chemistry Major and graduating senior, completed her honors thesis research with Dr. Breslin concerning cadmium contamination in Connecticut coastal harbors. A total of 12 students are chosen for the award each year from the four Connecticut State University campuses, including four from Southern. It is considered among the university's most prestigious awards. Criteria include a 3.7 GPA or better and having demonstrated significant participation in university and/or community life.

Outreach

Tait, J., 2017. Rising Sea Level, Intensified Storms and Connecticut's Beaches. Invited talk in the Menunkatuck Audubon Society's Public Programs. Public talk be given April 12 at the Blackstone Memorial Library in Branford, CT, April 12, 2017.

Kate Yuan, Amity High School. Analysis of Mercury Content in Sediment in New Haven Harbor, CT. Poster presented at the CT STEM Fair on February 4th 2017 at Darien High School and the CT Science and Engineering Fair, Quinnipiac University on March 14, 2017.

Lela Jackson, Presentation, Microbeads in Long Island Sound Coastal Embayments, SCSU Legislative Breakfast, Tuesday January 30th, 2017.

The Long Island Sound microbeads/microplastics study coordinated by Vincent Breslin, Department of the Environment, Geography and Marine Sciences, generated the following media attention.

WNPR Radio: Searching for the Elusive Plastic Pollution off Connecticut's Coast

<http://wnpr.org/post/searching-elusive-plastic-pollution-connecticuts-coast>

Werth Center Aquarium Events

Werth Center Aquarium Open House, March 21st, 2017. An open house allowed students, staff and faculty at SCSU to view the "behind the scenes" operations of the aquarium and celebrate one year anniversary of fish in the aquarium. Activities included laboratory tours, raffles for students to feed the fish, water quality demonstrations and basement filtration tours.

The Werth Center aquarium facilities will be used for education outreach to local visiting school groups. The first school group visit was Friday March 3rd. Twenty students from the 6th grade class from Fair Haven School, New Haven visited the aquarium and wet lab (SCI 211) to view the organisms and learn about Long Island Sound. Additional school groups are scheduled to visit on March 10th, March 31st and April 6th.

Undergraduate Research and Creativity Conference

Southern Connecticut State University

Werth Center for Coastal and Marine Studies Participants

April 30th, 2016

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

Students	Presentation Title
Sadia Younas	Comparison of Cadmium Concentrations in Long Island Sound Harbor Sediment
Cody Edson	Method for the Determination of Arsenic Using Silver Nitrate and the Gutzeit Method
Ryan Orlowski and Dylan Steinberg	Observed Distribution of Beach Fill Material of a Recent U.S.A.C.O.E. Replenishment Project along West Haven Beaches from May 2015- to Present
Laura Bracci and Dylan Steinberg	Testing for the Presence of Seasonal Beach Profiles on the Connecticut Coast

VI. Accounting, Budget Expenditures and Grant Writing

Academic Year 2016-2017 Itemized Budget Justification

Funds totaling \$75,000 were requested for Year 11 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 (\$ 8,260 expended)

Werth Foundation funds were used in support of salaries for faculty mentoring students during the Summer 2016. Professors Breslin (\$3,000), Tait (\$2,000) and Grace \$2,000) were compensated for mentoring student research projects (\$1,080 fringe benefits). The SCSU Dean of Arts & Sciences provided faculty reassigned time (3 credits time each for Breslin and Tait) during the academic year in support of managing the CCMS activities and programs. Reassigned time (6 credits) for faculty in support of CCMS management totaled \$12,144.

Neil Geist, Sound School, New Haven CT was paid an honorarium (\$450) for serving as captain of a skiff in support of Dr. Breslin's microbead sampling in New Haven harbor.

Student Research Fellowships (\$27,900 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 2016 (7 students; \$12,500), Fall 2016 (9 students; \$7,200) and Spring 2017 (7 students; \$8,200). 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 seven different academic fields (Biology, Chemistry, Environmental Studies, Marine Studies, Earth Sciences, Geography and Honors) in support of faculty-directed research projects during this past year totaling \$26,400.

Permanent Equipment and Service Contracts (\$27,244 expended)

Werth Center funds were used to purchase a DIVING-PAM Underwater Fluorometer for Dr. Sean Grace. Werth funds (\$13,448) provided approximately 50% of the total purchase price of the instrument (\$25,915). Matching funds were provided by the Biology Department. The DIVING-PAM Underwater Fluorometer is a unique instrument for studying *in situ* photosynthesis of underwater plants, including sea grasses, macroalgae, and zooxanthellae in corals. Dr. Grace and others will utilize this instrument to determine the photosynthesis/respiration rates for temperate corals with (zooxanthellate) and without (azooxanthellate) the endosymbiont *Symbiodinium psymophilum*. Additionally, this equipment will be utilized to examine kelp and other macroalgal photosynthetic rates in Long Island Sound.

Additional equipment funds were used to purchase a PerkinElmer basic air compressor (\$1,580) for use in support of the recently donated ICP-OES in Dr. Breslin's lab analytical in SCI 211.

Funds in the service contract budget category (\$12,216) were used to purchase a service contract for fiscal year 2016-2017 for the PerkinElmer AAnalyst 800 Atomic Absorption Spectrophotometer (\$7,716). Werth funds were also used to purchase a one year service contract (2016-2017) for the Milestone DMA 80 Direct Mercury Analyzer (\$4,500).

Ship Time (\$2,708 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 (\$1000) were used to charter the R/V *Island Rover*, Sound School, New Haven, CT to collect sediment in New Haven harbor on July 13, 2016. This cruise was conducted in support of Dr. Breslin's research examining the effects of sediment dredging in New Haven harbor on sediment quality. The R/V *Island Rover* was also chartered (\$600) on November 4th 2016 in support of an education cruise for students in MAR 210 Coastal Marine Studies. The UCONN R/V *Lowell Weicker* was chartered (\$508.80) on October 3rd 2016 in support of a cruise in Mystic harbor for the collection plankton tows for the examination of microbeads. The R/V *Island Rover*, Sound School, New Haven, CT was also chartered on June 3rd 2016 in support of microbead collection in New Haven harbor.

Travel and Conference Funds (\$661 expended)

Travel funds totaling \$1,500 were budgeted to reimburse costs associated with travel in support of field sampling activities and attendance at local, regional and national scientific meetings. Travel funds were used to support Dr. Breslin and two students participating in the Long Island Sound Research Conference on May 13, 2016 at Danfords Inn, Port Jefferson, NY. Dr. Breslin presented the results of his research concerning microbeads in LIS and the students presented a poster concerning cadmium contamination in Bridgeport and Stonington harbors. Funds (\$500) were also expended to support WCCMS faculty and student participation in the Coastal Resilience Conference on March 30-April 1st at SCSU.

Publication Costs (\$42 expended)

A total of \$600 was budgeted for publication costs for FY 2016-2017. Funds will be used primarily in support of printing large format posters (3' x 4') for student research posters. WCCMS students have submitted abstracts for poster presentations at the Undergraduate Research and Creativity Conference at SCSU in April and for presentation at the Werth Aquarium Open House.

Expendable Supplies (\$6,696 expended)

Funds for laboratory and office supplies (\$5,000) were budgeted to allow the purchase of materials in support of the CCMS research and educational initiatives. Supply funds were used to purchase laboratory chemicals, tank gas for instrumentation, SCUBA diving expenses, 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 chlorophyll *a* and coliform determinations 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 the move to the new science building.

Balance of Funds

To date, CCMS has expended \$73,961 of the \$75,000 funds budgeted for FY 2016-2017. The majority of the remaining funds will be used to purchase materials and supplies in support of WCCMS laboratories and field studies. Near-term expenses include the completion of the installation of the ICP-OES (SCI211), a sediment sampling cruise in Norwalk harbor (April 2017), and repairs to a malfunctioning freeze dryer.

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 2016-2017

Assessment of Plastic Microbead Contamination in Long Island Sound. Connecticut State University 2016 Research Grant. Project Duration: June 1, 2016– May 30, 2017. PI – V.T. Breslin. Total Funds \$5,000.

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